

A large background image showing a serene landscape with a calm blue lake in the foreground, a rocky shoreline, and a range of brown mountains in the distance under a clear sky. The image is framed by a blue border.

MEDRC - PWA Research and Academic Cooperation 2010-2020

2020



MEDRC - PWA

Research and Academic Cooperation

2010-2020

Organized by

Chemistry Department at An-Najah National University,

in partnership with Palestinian Water Authority (PWA)

and with support of Middle East Desalination Research Center (MEDRC).

2020

Designed by: Eng. Nisreen Hamadneh

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MEDRC Program

MEDRC program was under the title “Scholarship Program- Palestinian Water Authority, (2012 in progress), the program funded by Middle East Desalination Research Center (MEDRC). The main juristic justification for MEDRC is to focus on priority research, training and communication needs. As a result,

each year, the Center will reevaluate its overall program, to continually enrich its activities and maintain close proximity to the changing needs of the desalination technologies. Each year a revised Program Framework and Profile (PFP) will be presented to the Research Advisory Council (RAC) for their review and their input for the technical agenda of the upcoming year. The MEDRC-PWA CoE Scholarship Program offers students in Gaza and the West Bank the opportunity to study at local universities in the fields of water management, desalination and reuse. The aim of the program is to allow

students to gain skills and expertise to make a long term contribution to the further development in water management, desalination and water reuse activities in Gaza and the West Bank.

MEDRC has developed a MEDRC-Palestinian Water Authority (PWA) scholarship program for Palestinian students to obtain M.Sc degrees at universities in the Palestinian territories: Gaza and the West Bank. The study focus should be engineering related to the fields of desalination, environment and water reuse.

MEDRC has so far supported about 225 MSc Fellowships, 30 Innovation Initiative research projects and 10 PhD's in Palestine through Palestinian Water Authority in cooperation with local universities in the period 2012-2020.

MEDRC is directed to focus on priority research, training and communication needs, in order to achieve the objectives defined by its Establishment Agreement. As a result, each year, the Center will reevaluate its overall program, to continually enrich its activities and maintain close proximity to the changing needs of the desalination technologies. Each year a revised Program Framework and Profile (PFP) will be presented to the Research Advisory Council (RAC) for their review and their input for the technical agenda of the upcoming year.

Objectives of MEDRC:

1. Decrease the cost of desalination.
2. Develop productive partnerships and cooperation.
3. Develop sustainable desalination technologies.
4. Improve communications in the desalination community.
5. Develop human resources for application of desalination and foster international cooperation in research activities, particularly among regional experts.
6. Utilize limited regional and international research resources
7. Maximize technology transfer.



In Palestine, youth represent 30% of the total population, which is equivalent to a one third of our population. For the Palestinian government, this percentage is considered a valuable development opportunity and the fundamental stone of our state building, especially in light of the Israeli domination of our natural resources, including more than 85% of our water resources and the daily Israeli restrictions on all aspects of life and development.

These facts made the human capital the most important components that we must invest in for a better tomorrow. For this, the Palestinian Water Authority set a strategy to engage youth in the water sector. Engorging water researches and supporting academic programs for students are main pillar of this strategy considering the importance of scientific research on addressing the sector's challenges and its role on developing all its components.

The ten years of cooperation with the Middle East Desalination Center (MEDRC) significantly contributed to achieve our shared objectives of promoting water research and facilitating applied research by providing all needed technical, financial, mentoring support for more than 225 master students and 10 Ph.D students from many Palestinian universities in West Bank and Gaza Strip, in addition to 30 Innovation Initiative research projects. On this occasion, I would like to express our high appreciation to MEDRC's efforts and to assure them that we are keen to strength this effective partnership towards more future successful initiatives.

Today, PWA has a strategic partnership with a majority of the Palestinian academic institutions, regional and international universities, and International research centers, aligned with a network of specialized experts diversified on almost all water related fields. The scientific research department at PWA makes a great efforts to employ these partnerships in building an effective programs with a strategic objectives of achieving sustainable development goals, contributing to enhancing water and wastewater services, applying SMART technologies, monitoring water quality, evaluating the possibilities of applying new harvesting techniques, focusing on treatment and desalination, among many other fields of sector's developments.

To complete this approach, there should be a planned efforts to localize researches and innovations resulted from these programs by supporting entrepreneurship, providing internship and the opportunity to apply researches on a real environments, and here come the importance of PWA efforts of building a strategic partnership with related public and private sector institutions, Palestinian incubators and many other civil society organizations.

The racing rivalry of advancements and technology encouraging to intensified efforts of supporting researches and innovation. I am looking forward to continuing the work and to capitalize on our shared experiences to achieve future outstanding impacts on the ground.

Finally, our people, who face enormous challenges, place their greatest hope in youth. We must complete our endeavors to develop the water sector and pave the way for youth towards constructive work and innovations aiming at laying the foundations for building our Palestinian State with its capital Al Quds Al Shareef.

Minister Eng. Mazen Ghonaim
Head of Palestinian Water Authority

Messages



On behalf of An-Najah National University, I would like to welcome you all to the 3rd Middle East Desalination Research Center (MEDRC), and the Palestinian Water Research Alumni Forum. I would like to acknowledge the efforts of the distinguished delegates

Minister of Palestinian Water Authority, Eng. Mazen Ghonaim;

the MEDRC Center Director, Dr. Ciaran Cuinn;

the MEDRC Development Cooperation Program Manager in Oman,

Mr. Brendin Smith;

the distinguished delegates of the Palestine Water Authority (PWA) Eng. Hazem Kittani and Dr. Subhi Samhan.

I extend my deeply felt wishes to the postgraduate students from An-Najah National University and other universities who have received MEDRC scholarships.

The cooperation between An-Najah National University and PWA started more than 12 years ago through the Scientific Centers at An-Najah National University. We have supported the PWA with their water pollution analysis as well as with multiple projects and conferences related to improving water access.

Over the past 12 years, MEDRC, in collaboration with PWA, have consistently promoted scientific research in Palestine. One of the many MEDRC programs to enhance the quality of scientific research has included the creation of a scholarship program for graduate students.

This program has provided more than 250 Palestinian scholars with the opportunity to do graduate research in Universities across Palestine; An-Najah National University graduate scholars significantly benefitted from this research fund through using around 65% of the available fund.

This scholarship program has greatly supported An-Najah's ability to support the work for outstanding students from the chemistry and engineering programs. Prior to the creation of this scholarship program, only ten students were enrolled in the related graduate programs. Currently, we host over 55 graduate students (22 of whom are PhD candidates). MEDRC has also provided training to our graduate students, including travel to Oman for expert trainings. Additionally, the number of published articles and the quality of research has significantly increased since the start of the scholarship fund, which has positively reflected on the ranking of our university in prestigious international ranking systems such as the QS World University Rankings.

Only last year, 3 Ph.D. researchers from An-Najah received scholarships through MEDRC funds, which has greatly helped the scholars' efforts to create high quality research for local and global impact.

I would like also to note the other support from MEDRC related to Innovation support (I2) which supports researchers who have an innovative idea and who want to use it in the world of practical work. The department of chemistry obtained more than 5 such awards and they are now in the final stages of idea application.

Distinguished guests,

At the end of this welcoming speech, I would like to say that we look forward to continuing what has proven to be a very successful collaboration between MEDRC and the Palestinian Partners. Let's continue the work on producing quality applied research both within our institution and at national level. I strongly believe that our continued collaboration will support our shared efforts to improve sustainable development work in Palestine in many practical ways, for example the development of smart irrigation, water purification, and other environmental and sustainability initiatives.

One viable venue to develop this collaboration with PWA and MEDRC can be achieved through establishing an incubator and research center, which will serve as a local and regional research and incubation hub for innovation in the field.

Before I leave, I must extend my sincere gratitude to the Forum's Organizing Committee and everyone who contributed to organizing this important event.

Wishes for the best in today's events and let's aim for sustained effort and practical steps towards implementing the international goals and objectives in the field of water treatment and water resources.

Thank you all,

Prof. Maher Natsheh
President of An-Najah National University

Messages



Minister, Colleagues,

It is an honour for me to address you today on the occasion of the third MEDRC PWA Research Forum. I was honoured to sit with you in Nablus last year for the Forum. This year, because of the Covid-19 pandemic I regret I cannot be there in person. But in December 2021 Covid-19 will have passed and we will sit together again and celebrate the achievements of your magnificent researchers.

For many years now, through good and bad days, MEDRC and the Palestinian Water Authority, under the leadership of His Excellency, Minister Mazen Ghunaim,

have worked hard together to support water research in Palestine.

Against many challenges the universities of Palestine have consistently managed to achieve research excellence with researchers as talented as any on earth. Great credit is due to the faculty and management of the universities represented here today for their tremendous work. The highest credit is due to the individual researcher who, year after year, astound us with their achievements.

Over the past few years MEDRC and the PWA have supported almost 265 water research projects in 7 universities across Palestine. There have been 225 MSc water research projects, 10 PhDs and 30 Innovation Initiative research projects

We have worked closely with the PWA and university faculty to ensure those research projects are addressing issues directly relevant to the water needs of Palestine today.

Topics include:

- The Use of Economic Matrices Parameters for Water Evaluation & Planning in Regional Planning
- Fecal Sludge Management-Septage Characterization and Pre-treatment in Nablus
- Scale Reduction by Magnetic Water Treatment
- The Financial Sustainability of the Palestinian Water Service Providers
- Modeling Recharge Rates of Stormwater/Reclaimed Wastewater Ponds in the Vadose Zone: Gaza Strip Case Study
- Removal of Difenoconazole from Wastewater Using New Synthesized Nanomembranes

There are countless others and in the years ahead there will be countless more.

Can I conclude by thanking the organisers, the student committees, the faculty and staff of the Universities. I want finally to recognise our Partners in the PWA Research and Development Department lead by Dr Hazem Kittani and Dr Subhi Samhan who have made all of this happen.

Ciarán Ó Cuinn
Center Director
MEDRC Water Research



An-Najah National University is a fully independent, non-governmental university, run by the Board of Trustees and the University President. The structure of the administration is composed of the University President, Assistant and Vice Presidents, University and Deans Council, Administrative Departments and the University Comptroller. The academic structure divides faculties into academic departments.

An-Najah seeks to provide as many facilities as possible to its students through providing each faculty and department with a computer lab for student use. This has created a ratio of three students to each computer. Physically and visually impaired students are welcomed at An-Najah as well. A special computer lab designed for the visually impaired converts all Microsoft Office files to Braille to allow students to share lectures and submit assignments either by email or through the Braille printers available. The university also allocates special cars to transport physically and visually impaired students between campuses.

An-Najah hosts more than 20 scientific centres that offer a wide range of services to the local society. Among those are two centres that are directly connected with the local society and seek to provide high services to the people in different parts of the country. The first one is the Community Service Centre which is involved in numerous projects to help Nablus and the Northern West Bank people. The Community Service Centre also collects blood samples from the community donators for transfusions and provides hot meals to the elderly and needy families in Nablus.

In addition to the Community Service Centre, there is the Energy Research Centre (ERC) which undertakes research projects in the field of energy. The centre has completed a number of projects in several Palestinian cities and villages such as Attouf Village in which the centre provided electricity through harnessing solar power for the first time. In its endeavor to lay down foundations for knowledge-based society, the university established the Centre of Excellence in Materials Science and Nano-Technology (CEMSANT). The centre homes researchers and students to perform their works on preparation, modification and application of advanced materials. CEMSANT encourages research activities directed towards the benefit of the Palestinian society with regard to water, environment, health, renewable energy and agriculture. To be in direct touch with the local community, An-Najah has its own radio and satellite television stations. Both offer programmes that provide practical training for An-Najah's students as well as an avenue to connect with the local and international community through the satellite station. To reach out to more students, videoconferences and e-learning lectures are both offered at An-Najah. The e-learning lectures are available for free on the university's website. Videoconferences have been organized with other academic, non-profit, and private institutions to discuss the academic and political situation with outside parties.



Organizers



Palestinian Water Authority (PWA) was established under Presidential Decree No 90 of 1995, which stated in article 1, the Palestinian water authority, as broad Water Act (2) for the year 1996 in article (2) on the establishment of the Palestinian water authority, which has independent legal personality and its own budget, so follow the President of the Palestinian national authority and have a head appointed by the President of the PNA.

The water authority aims to achieve integrated and sustainable asset management of ed water resources; protection and preservation within organizational tools help them to gain access to a healthy environment by ensuring a balance between quantity and quality of water available and the needs of the Palestinian people to achieve sustainable development through water resources.

And then the water law (3) for the year 2002 which define the framework and levels of water sector in Palestine, in order to regulate the sector and access to the service to the appropriate level on the one hand, and the protection of water sources, on the other hand, with the allocation of functions and powers of the management of the sector into three levels, namely the organizational level and the operational level and the political level.

Water Act No. 3 of 2002 authorized the Palestinian Water Authority the water sector management task, entrusted to regulate the sector and identified the relationship with the official, private enterprises and local government authorities, each according to his specialty and Legal reference.

Through the law No 14 of 2014 on water, the water authority's powers have been clarified and reduce intersection powers. And which also aims to manage and develop water resources in Palestine and to increase capacity and improve the quality and conservation and protection from pollution

drain and improve and upgrade water services by applying principles of integrated and sustainable management of water resources.

Palestinian water authority mission redrafted and defined its vision and strategic goals and objectives in line with its new duties and powers were as follows:

Mission of the water authority:

A public institution working to manage, develop and protect water sources with integrated and sustainable water supply to citizens valid for different uses and ensure the protection of the environment and the achievement of the development goals of Palestinian society.

Vision of the water authority:

Sustainable water sources able to achieve development and basic needs of the Palestinian people.





Middle East Desalination Research Center is an International Organization mandated to find solutions to fresh water scarcity. Established in 1996 as part of the Middle East Peace Process it conducts research, training, development cooperation and transboundary water projects.

The MEDRC Headquarters is in Muscat in the Sultanate of Oman, where it operates a state of the art research facility including desalination plants, laboratories, lecture halls and administrative offices.

In delivering its mission, MEDRC aims to become a viable and transferable mechanism for governments seeking to address significant regional or trans-boundary environmental challenges.



Committees

Organizing Committee

- Dr. Maen Ishtaiwi (Chairman)
- Mr. Brendan Smith (MEDRC)
- Dr. Subhi Samhan (PWA)
- Prof. Shehdeh Jodeh (NNU)
- Dr. Derar Al-Smadi (NNU)
- Eng. Hazem Kittaneh (PWA)
- Dr. Nidal Zatar (NNU)
- Dr. Ibrahim Abu Shqair (NNU)
- Ms. Suhad Al Malki (PWA)
- Mrs. Ghadir Hanbali (NNU)
- Mr. Nafith Dweikat (NNU)
- Mr. Omair Nabulsi (NNU)
- Ms. Renad Hamed (PWA)
- Eng. Nisreen Hamadneh (NNU)

Steering Committee

- Ms. Rinad Hammad (Chairman)
- Mrs. Ghadir Hanbali
- Mr. Abdullah Murrar
- Ms. Laila Khalil

Editorial Committee

- Dr. Maen Ishtaiwi (NNU)
- Dr. Nidal Zatar (NNU)
- Prof. Shehdeh Jodeh (NNU)
- Dr. Subhi Samhan (PWA)

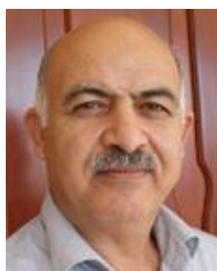
Forum Chairman

- Ms. Rinad Hamed
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Dr. Maen Ishtaiwi, Dean of the Faculty of science in An-Najah National University, was born in Nablus (Palestine) on September 20, 1984. He obtained his B.Sc degree in Physics minor Electronics, from College of Science at An-Najah National University, in May 2007. During July 2007 – August 2008, he was a Teaching Assistant in Physics Department - An Najah National University, Palestine. He obtained TOPMED program scholarship to continue his higher studies in Italy. He obtained his M.Sc. degree in Electronics Engineering from Politecnico di Torino, Italy in November 2010. He obtained his PhD degree in Electronics from Politecnico di Torino, Italy in March 2014. Currently, he is working as an Assistant professor – Physics Department - An Najah National University.

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Dr. Nidal A. Zatar, head of Department of Chemistry at An-Najah National University, was born in Nablus (Palestine) on December 1st, 1956. He awarded his B.Sc degree in chemistry from Birzeit University. He awarded his Ph.D degree in Analytical Chemistry from University of Kent at Canterbury, England, on February 1984. In the period 1984-1985 he was Assistant Professor at the College of Science and Technology, Abu-Deis, Jerusalem. In the period 1985-1993 he was Assistant Professor at the Department of Chemistry, An-Najah N. University. In the period 1993-Present he is Associate Professor at the Department of Chemistry Department, An-Najah N. University. In the period 1999- 2008 he was Director of Chemical, Biological and Drug Analysis Center. An-Najah N. University. In the period 2016 present he is Head of Department of Chemistry, An-Najah N. University. His research interests is: Spectrophotometric and Spectrofluorimetric determination of metal ions, separation and determination of active components from medicinal plants, separation and determination of food additives using chromatographic techniques, analysis of pharmaceutical products, quantitative and qualitative determination of food products, toxicological analysis, Food analysis and determination of nutritional values and quantitative determination of pesticides in food products using GC/MS technique.

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Prof. Shehdeh Jodeh, A distinguished Professor at the Chemistry Department of An-Najah National University. He did his postdoctorate at Alamos National Labs, New Mexico USA (1991). He obtained his Ph.D in Physical Chemistry from Wayne State University, USA in 1990. His B.S Chemical Engineering from University of Mississippi (USA), 1987. His Master degree in physical Chemistry from Sam Houston State University, USA (1985). B.Sc in chemistry from Yarmouk University, Jordan 1983. He worked as Research Scientist at General Motors R&D Michigan, USA from 1992-2004.

He published more than 150 scientific papers and supervised more than 60 graduate students at the chemistry department.

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Chairpersons

Subhi Samhan; PhD in Natural Science from Martine Luther University, Halle Wittenberg Institute for Geosciences, Germany. 2013. Working as Director of Research and Development at Palestinian Water Authority since 1997 and represent PWA.

Samhan is national focal point for:

- National focal point for Sustainable Management of Available Water Resource with Innovative Technologies (SMART).
- Building Capacity and Institutional Reform for and Integrated Management of Water and Sanitation services in Rural Communities, 2009-2013, funded by Austrian
- Palestinian-Dutch Academic Cooperation Program in Water (PADUCO) 2013-2020 Represent Palestinian Water Authority in Technical Advisory Committee
- Sustainable domestic Water Use in Mediterranean Regions project SWMED projects.
- Academic focal point for Austrian and Middle East Desalination Research Center (MEDRC) projects.
- Represent the Palestinian Water Authority in Innovative processes and practices for wastewater treatment and re-use in the Mediterranean region "INNOVA-MED, during 2007-2010. Funded by EU, www.cid.csic.es/innova-med/home.htm.

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Hazem Kittani holds a Masters degree in Civil Engineering majoring in Hydraulics and Fluid Mechanics from the Missouri State University at Columbia in the United States of America. His current position is Director General of Technical Affairs at Palestinian Water Authority. He gained more than 25 years of experiences in civil engineering (construction-sites), and hands-on practical experience in designing, supervising, monitoring, and control manager in infrastructure related to water and wastewater systems in Saudi Arabia, Jordan and Palestine.

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Researcher Rinad Hamed a PhD candidate at the Department of Chemistry at An-Najah University in Nablus. Rinad is one of The MEDRC fellow at Ms. Degree and the winners of MEDRC initiative I1 and I2 projects which was run in March 2018 and March 2020. Rinad has been developing an innovative solution that would enhance the efficiency of water management and make use of the readily available brackish water. The solution uses brackish water as a main source of irrigation and as a replacement to fresh water. Seeds are treated using plant growth-promoting rhizobacteria (PGPR) to produce enhance its growth under harsh environment conditions and can induce changes in the physical properties of soil, which was implemented as lab trail through her master thesis , then it was carried out as field trial by initiative I1. Throughout this initiative I2 the research will be carried out testing new crops and combined with Cold Plasma technique to test its efficiency on plant growth, beside a feasibility study will also be carried out.

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Oral Presentations PhD Students

Abdullah Murrar has bachelor degree in Finance, first master in Business Administration, other master in Strategic Planning and Fundraising. Currently, he is PhD Candidate in financial sustainability of water service providers at joint PhD program between Indiana University of Pennsylvania USA and Arab American University in Palestine. He has experience about 18 years in financial management areas and multidisciplinary research fields. Mr. Murrar published 10 research papers in international journals, subjects in financial sustainability, costing water services, efficiency, and development of water sector.

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Financial Sustainability of the Palestinian Water Sector

Abdullah Murrar¹

¹PhD Candidate, Indiana University of Pennsylvania, & Arab American University.

Abstract:

Water service sector is at the core of any economy as water is essential for human life and sustainable development. Three main actors are involved in this important sector (a) Water customers who purchase water for consumption, for example, households, commercial customers, and agricultural customers. (b) Water service providers whose role is to provide a safe and adequate water supply to their customers while keeping into consideration sustainable economic, social, and environmental dimensions. (c) Government entities whose roles are strategic planning, sector development, water resources management, monitoring the performance of the water service providers, and receiving complaints from the customers. Continuity of the water sector in any economy depends on the mutually supportive roles played by all three actors. The financial sustainability in water sector could be defined as continual availability of adequate revenue from the services provided to meet the water sector obligations. In fact, a few researches tackled the continuity of water services from managerial point of view. Moreover, the literature lacked of a comprehensive model of financial sustainability. It would be prudent, therefore, to further probe this area. This dissertation will have four main topics that include a model of financial sustainability: The service quality and customer satisfaction as drivers of financial sustainability, water debt collection from customers, water pricing of water service, as well as adoption advanced technology in water sector.

Keywords: *Customer satisfaction, Financial Sustainability, Performance Indicators, Service Quality, Technology Adoption, Water Service, Water Pricing*



Bayan Khalaf, PhD researcher in Physical and Analytical Chemistry at An-Najah National University in Palestine, was born in Saudi Arabia on October 7, 1992. She graduated from Arab American University with a bachelor's degree in Chemistry in 2014. In 2016, she graduated with a master's degree in the field of Analytical and Physical Chemistry from An-Najah National University. She started working as a lecturer of Chemistry and Physical Chemistry in Arab American University in 2016 and then as a lecturer in Al Quds Open University in 2018. In 2019, she worked for several months on her researches at Research Center Jülich in Germany. Since 2020, she started working as a Coordinator for External Opportunities Program at Tamkeen Foundation. In addition, Bayan has a great experience in Voluntary Work, such that organization of scientific conferences, free lessons of teaching high school and university students, as well as volunteering in several organizations and initiatives that aim to make our community a better place.

Bayan participated in many scientific papers and International fellowships; her researches are mostly concentrated on adsorption related water purification, she was able to have funding of all of her researches during MSc and PhD. Her main goal in this life is to be always an effective person in the world and hence be able to improve the situation in Palestine scientifically and economically to a high level. She has frequently attended and presented at international scientific conferences in Turkey, Palestine, Germany and Jordan, She has also been invited to several meetings and conferences.

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Purification of Water in Palestine from Persistent Pesticides Using New Synthesized Cellulose Derivatives

Bayan Khalaf

PhD researcher in Analytical and Physical Chemistry.

Supervisors: Prof. Shehdeh Jodeh and Dr. Othman Hamed

Department of Chemistry, Faculty of Graduate Studies, An-Najah National University-Palestine.

Abstract

As the need for water increases annually in Palestine, and the available water resources are barely sufficient to meet the demands of the current quality life and the economy. There is a huge necessity of purifying water from different pollutants including pesticides. The purpose of this research is to develop several new synthesized adsorbents of cellulose based derivatives modified with suitable chemical reagents including Furan-2-carbonyl chloride or Pyridine-2,6-dicarbonyl dichloride, in order to remove different persistent pesticides including Difenoconazole and Tetraconazole from water to drinkable degree. As the process of interaction between synthesized adsorbents and pesticides depends on the circumstances surrounding conditions which are treated in this research.

In this project, a comparison of the efficiency of different synthesized adsorbents in removing pesticides from water will be determined, through the knowledge of the amount of each pesticide before and after the treatment.

Oral Presentations - PhD Students

Persistent pesticide uptake through adsorption can be affected by the extent of cross-linking of macromolecular supports, hydrophilic-hydrophobic balance and the nature of chemical reagents on the synthesized adsorbents. Ligand function also dictates complexation ability, reactivity and efficiency of adsorbents in the present case expected to be good solution for such problem.

This research involves the synthesis of Nanocellulose, Cellulose modified with Furan-2-carbonyl chloride and Cellulose modified with pyridine-2,6-dicarbonyl dichloride. The resulting adsorbents have been characterized by Scanning Electron Microscopy, Infrared Spectroscopy, Ultraviolet-Visible Spectroscopy, Proton Nuclear Magnetic Resonance and Thermogravimetric Analysis. These porous materials showed a very good thermal and chemical stability and hence they can be used as perfect adsorbents for Difenconazole and Tetraconazole pesticides from water in Palestine. The results showed that all of the three resulting products have high adsorption efficiency. Also, it showed strong complexation properties with persistent pesticides.

In order to investigate the adsorption efficiency for the adsorption of Difenconazole or Tetraconazole on Nanocellulose, Cellulose modified with Furan-2-carbonyl chloride or Cellulose modified with pyridine-2,6-dicarbonyl dichloride, the effect of solution conditions on each adsorption process was studied. These conditions involve the effect of contact time, pH, temperature, adsorbent dose and the initial concentration of each pesticide.

The maximum extent of Difenconazole Adsorption was by using Cellulose modified with furan-2-carbonyl chloride. This adsorption process needed 20 minutes of shaking to have 96.63% as percentage removal at solution conditions of 30°C temperature, pH 8, 20 mg adsorbent dose, 10 ppm of pesticide solution as initial concentration and 10 mL solution volume. For Tetraconazole, the maximum percent of removal was 98.51% at solution conditions of 15 minute of shaking time, pH 4, 8 ppm initial pesticide solution, 20 °C temperature and 20 mg dose of Cellulose modified with furan-2-carbonyl chloride dose.

In case of using Cellulose modified with pyridine-2,6-dicarbonyl dichloride as an adsorbent, the maximum percentage of removal was approximately 95% for both Difenconazole and Tetraconazole. While when Nanocellulose Bio adsorbent is used, the percent' of removal were 95.08% and 91.73% for Difenconazole and Tetraconazole respectively.

The best equilibrium isotherm model for each adsorption process was investigated according to the value of the correlation coefficient (R^2) of Langmuir and Freundlich isotherm adsorption models. The kinetics of adsorption were also investigated using pseudo first-order, pseudo second-order and intra-particle diffusion kinetic adsorption models. In addition, Van't Hoff plot for each adsorption was investigated in order to determine the values of Enthalpy Change, Gibbs Free Energy Change and Entropy Change, and hence determining if the adsorption process is spontaneous or not, and if it is exothermic or endothermic one. The results showed that all of these adsorptions followed Langmuir adsorption isotherm and the mechanism of all of these reactions followed pseudo second-order kinetic adsorption model. The thermodynamic parameters of all the adsorptions proved that these processes are favorable in which they are both spontaneous ($\Delta G < 0$) and exothermic ($\Delta H < 0$).

Each of the synthesized cellulose derivative adsorbents was also regenerated, and the percentage removal before and after adsorbent recovery is determined. The results showed a promising percent of removal for Difenconazole and Tetraconazole.

Keywords: Pesticides, Cellulose Derivatives, Water, Nanocellulose, Difenconazole, Tetraconazole.



Fuad Al-Rammal started his work in the Palestinian Water Authority's laboratory since 2000 and he joined a great team that worked on institutionalizing quality water management and developing advanced laboratory analyzes, which laid the foundation for the Palestinian Information Bank on the quality of water sources. He moved to work in the field of administration in the Internal Control Unit as Director of Administrative Control, and he established the methodology for monitoring work in the PWA in cooperation with the internal control team and a group of local and international experts. He held the position of Acting Administrative Director of the Water Authority, where he led the Water Authority's institutional reform project in terms of the administrative aspect and developed the necessary procedures, structures and job descriptions manuals. He participated in developing the policies and strategies of the Palestinian Water Authority during his work, so that they helped establish the scientific bases in the institutional work platform for the Water Authority. He is now working as a Director of Administrative Control at the Water Authority. It is mentioned that he has wide and varied experiences in training in more than one field.

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Water sustainability and the challenges of its application in the West Bank and Gaza Strip in Palestine

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¹ College of Arts and Humanities-Dhar Al-Mahraz-Sidi Mohamed Bin Abdullah University-Fez -Morocco

Abstract

This research paper aimed to touch base with the water issue and the requirements of its sustainability in the West Bank and Gaza Strip, as it is one of the major problems that mortgages development in its comprehensiveness and the security of the whole region, by analyzing the Palestinian water strategy extending from 2014 to 2032, and by comparing it with the requirements and elements of water sustainability mentioned in the related literature. The paper stood to achieve the requirements of water sustainability, with all its components. The paper face basic challenges, the most important political of which is the domination of the Israeli occupation and its endless violations of Palestinian soil resources, on top of which is water. Other challenges of the institutionalized, material and environmental nature, this study confirmed the necessity of adopting a participatory approach between the different actors, sharing the risks between them, in addition to networking with international strategic partners to move forward in providing safe water supply and sanitation services and their sustainability in the field of study.

Keywords: *Water sustainability, Palestinian water policy, Economic efficiency, Ecological sustainability, Social justice.*

Dr. Ghadir Hanbali, Part time lecturer in Chemistry department at An-Najah National University, was born in Nablus (Palestine) on March 23, 1993. She obtained her B.Sc. degree in applied chemistry from An-Najah National University in 2014. During 2014 - 2016, She worked as a teaching assistant in the department of chemistry. In 2016, She obtained a master's degree in the field of chemistry with GPA of 4.00 out of 4.00. She obtained her PhD degree in the field of Organic and analytical Chemistry, from An-Najah National University in November 2020. Her PhD research was in part done in Jülich Forschungszentrum in Germany. Her researches in both master and PhD are funded by MEDRC and also obtained innovation initiative research grant (I2) during her PhD study. Ghadir participated in many scientific papers; she published more than ten paper. Her researches are mostly concentrated on purification of water such as removal of heavy toxic metals using synthetic material that have very good adsorption efficiencies towards these toxic materials. Her main goal in this life is to work to serve its community and to become a researcher working to solve the problems facing the environment, especially the problems of the water sector. She attended and presented in many international scientific conferences inside and outside Palestine and participated in many projects.

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Assessment and Removal of Heavy Trace Metals by Magnetic Multiwall Carbon Nanotube Decorated by Novel Functionality from Ground Water in Jericho, Palestine

Ghadeer "Mohammed Moen" Nemer Hanbali¹

Supervised: Prof. Shehdeh Jodeh¹

Co-Supervised :Prof. Othman Hamed¹ and Prof. Roland Bol²

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Abstract

This study examines the use of multiwall carbon nanotubes (MWCNTs) after derivatization and magnetization as new and renewable adsorbents. The adsorbents were synthesized by an initially oxidation of multiwall carbon nanotube followed by derivatizing the oxidized product with either (i) hydroxylamine (HA), (ii) hydrazine (HYD) or (iii) cysteine (CYS). The obtained adsorbents were analyzed by various spectroscopic techniques, including Scanning Electron Microscopy (SEM), Transition Electron Microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, Brunauer–Emmett–Teller surface area analysis (BET), thermogravimetric analysis (TGA), and Vibrating Sample Magnetometer (VSM). As a practical test application of the prepared adsorbents, samples were collected from fourteen wells in Jericho during the Spring and Fall season. The groundwater samples showed high concentrations of Pb²⁺, Fe³⁺ and Na⁺. All wells treated samples are earth alkaline waters according to Piper and Durov plotting, of which 92% fall in the

domain of Ca – Mg – HCO₃. The concentration of heavy metals in the water samples were measured by inductively couple plasma mass spectroscopy (ICP-MS).

Adsorption efficiency of the multiwall carbon nanotube adsorbents for metals, and Ibuprofen was assessed. The impact of adsorbent's dose, temperature, pH, and time on the adsorption efficacy were also evaluated. The three adsorbents showed excellent efficiency toward Pb⁺², Fe⁺³, Na⁺¹ and Ibuprofen with a quantitative removal. For metals, the maximum efficiency was found to be for: (i) room temperature, (ii) pH 8.0, (iii) 10.0 ppm initial concentration and (iv) contact time ranged between 15 min (minimum time) and 60 min (maximum time) depending on both the adsorbent and the adsorbate. The maximum removal rates were 99.8% for Pb⁺² by m-MWCNT-CYS, 97.8% for Fe⁺³ and 98.9% for Na⁺¹ by m-MWCNT-HA.

For Ibuprofen, the optimal pH for its nearly complete removal (98.4%) was 4.0 at room temperature by m-MWCNT-CYS. After passing through MWCNTs the quality of obtained water made it acceptable water for different agricultural purposes, such as irrigation.

The thermodynamic analysis showed a negative free energy, indicating a spontaneous adsorption process at room temperature. The Langmuir isotherm was better able to fit the linearized data points than Freundlich isotherm.

The adsorbents could regenerated removing the captured metal ions by treatment with 0.1N HCl, and 0.1 N NaOH for Ibuprofen, therefore can be used repeatedly.

Heba Nassar, PhD candidate in Inorganic and Analytical Chemistry at An-Najah National University in Palestine. Her master and B.sc degrees in chemistry were taken from An-Najah National University in 2012 and 2005 respectively. Heba works as a teacher in the Palestinian Ministry of Education from 2005 until present. She have participated in different workshops for the development of Palestinian science and chemistry curriculum. Heba have various research interests such as: purification of water from different types of contaminants by physical methods, photodegradation and electroreduction techniques, modifications of solar cells and electrochemistry applications. She has attended and presented in many international scientific conferences inside and outside. Her PhD research is funded by MEDRC.

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Water purification from nitrate ions by electrochemical reduction on modified nanocomposite electrode catalysts

Heba Nassar

Supervisors: prof. Hikmat S. Hilal and Dr. Ahed Zyoud

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Abstract

Water contamination with nitrate is a serious health issue all over the world. The aim of this work was to develop a practical and effective nitrate electroreduction system that has high selectivity, high rate of reduction and low energy consumption. Different nanocomposite electrodes were prepared and examined for the electrochemical reduction of nitrate in aqueous solutions. These electrodes includes: FTO, FTO/Cu-x, FTO/Gr, FTO/Gr-Cu and FTO/ MWCNT-Cu. (Where: FTO is fluorine doped tin oxide transparent conducting film on glass; MWCNT is multiwalled carbon nano tubes).

The prepared electrodes were characterized by scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), energy-dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). Also the electroreduction behavior of those electrodes were studied by cyclic voltammetry using an electrochemical work station.

The electroreduction has been performed at relatively low working potential (~ -1.8 V vs SCE) which is advantageous to earlier literature reports. The electrochemical reduction study of nitrate is underway in an undivided electrochemical cell. The modified nanocomposite electrode FTO/ MWCNT-Cu was found to be the most effective electrode in electroreduction of nitrate ions from aqueous solutions. In order to design an effective electroreduction system, different variables have ben studied; (contaminant concentration, electroreduction time, applied voltage, electrolyte type, electrolyte concentration, temperature, stirring and distance between electrodes). The new modified electrode FTO/MWCNT-Cu, remove $\sim 75\%$ of nitrate during the first 120 min with a good selectivity for N_2 , which is another virtue for this work.

Key words: Nitrate ion removal; Electrochemical reduction; Electrochemical catalysis; Graphite; Carbon nano-tubes; Water purification.

Posters

Effect of Irrigation with Treated Wastewater Using Surface and Subsurface Drip Irrigation Systems and Different Irrigation Quantities on Pearl millet Productivity and Water Use Efficiency



Adnan Mohammad Ibrahim Nassar
Dr. Nidal Mahmoud



Abstract

A great challenge for the agricultural sector in Marj Ibn Amer as well as in Palestine is less water availability for agricultural purposes. This causes decrease in irrigated agricultural land and consequently make the agricultural sector more vulnerable and infeasible that lead to food insecurity. So, adoption of optimum water management practices considers prime importance for attaining national food and water security which can be achieved by producing more food from less water use.

The main objective of this research is to study the influence of different irrigation systems and irrigation water quantities on water use efficiency for Pearl millet crop cultivation using treated wastewater (TWW) in irrigation.

This research was carried out during summer season of 2017 where pearl millet seeds cultivated in clay soil in late of May in the field of Marj Ibn Amer as semi-arid area in Jenin governorate where secondary treated wastewater is used in irrigation. Crop water requirement (WR) for Pearl millet estimated based on CROPWAT model.

Field experiment was conducted based on a split plot design (SPD) with three replicates. The main plots consisted two irrigation systems including subsurface drip irrigation system (SSDI) and surface drip irrigation system (SDI). The sub-plot comprised three irrigation water quantities (100% water requirement (WR), 75% WR and 50% WR).

The results showed that the fresh weight and water use efficiency for fresh weight (WUE) significantly higher in SSDI compared with SDI for each cut. Furthermore, dry weight and plant height were higher in SSDI compared with SDI.

Fresh and dry weight productivity were significantly higher under 100% WR followed by 75% WR and 50% WR, respectively. While, WUE by applying 50% WR was the highest than 100% WR and 75% WR, respectively. Also, WUE with SSDI was significantly higher than SDI.

It's recommended to disseminate the technology of SSDI among the farmers in order to increase the WUE in arid and semi-arid regions as well as applying 50% WR using TWW for irrigating Pearl millet.

Table 1: Means of fresh weight, dry weight (kg/dunum), WUE (kg/m³) and plant height (cm) of pearl millet under the effect of irrigation system as average of four cuts during experiment

Cut number	Treatment	Fresh weight	Dry weight	WUE	Plant height
1	subsurface	3247.22 ^{a*}	599.77 ^{a*}	26.13 ^{a*}	161.07 ^{a*}
	surface	2491.66 ^b	444.54 ^b	20.37 ^b	153.81 ^b
2	subsurface	932.96 ^c	136.73 ^c	9.91 ^c	99 ^c
	surface	778.17 ^b	108.42 ^b	8.28 ^b	92.41 ^b
3	subsurface	1013.2 ^a	165.36 ^a	12.31 ^a	112.78 ^a
	surface	986.24 ^a	160.68 ^a	12 ^a	112.41 ^a
4	subsurface	704.11 ^a	135.16 ^a	10.42 ^a	112.52 ^a
	surface	619.58 ^a	116.75 ^b	9.27 ^a	100.7 ^b
All	subsurface	5891 ^a	917 ^a	16.16 ^a	112.52 ^a
	surface	4876 ^b	820 ^a	13.50 ^b	100.7 ^b

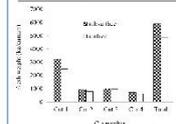


Figure 1: Comparison between surface and subsurface drip irrigation systems and fresh weight productivity (kg/dunum) at each cut and whole cuts

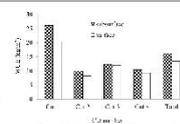


Figure 2: Comparison between surface and subsurface drip irrigation systems and water use efficiency (kg/m³) at each cut and whole cuts

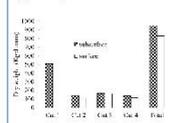


Figure 3: Comparison between surface and subsurface drip irrigation systems and dry weight productivity (kg/dunum) at each cut and whole cuts

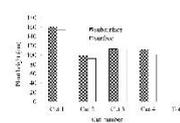


Figure 4: Comparison between surface and subsurface drip irrigation systems and plant height (cm) at each cut

Table 2: Means of fresh weight, dry weight (kg/dunum), WUE (kg/m³) and plant height (cm) of pearl millet under the effect of irrigation water application as average of four cuts during experiment

Cut number	Treatment	Fresh weight	Dry weight	WUE	Plant height
1	50%	2275.97 ^a	400.52 ^a	23.05	145.49 ^a
	75%	2713.95 ^b	458.16 ^b	22.24	150.76 ^b
	100%	3553.23 ^c	553.8 ^c	22.46	156.62 ^c
2	50%	483.27 ^a	80.28 ^a	9.08 ^a	92.73 ^a
	75%	586.42 ^b	112.21 ^b	8.62 ^a	94.11 ^b
	100%	1707.25 ^c	164.44 ^c	10.63 ^b	110.78 ^b
3	50%	697.46 ^a	115.56 ^a	12.50 ^a	96.57 ^a
	75%	922.67 ^b	146.19 ^b	14.88 ^a	101.97 ^a
	100%	1312.76 ^c	256.77 ^c	15.16 ^a	106.95 ^a
4	50%	415.8 ^a	73.55 ^a	9.48 ^a	98.72 ^a
	75%	522.29 ^b	121.8 ^b	9.28 ^a	102.29 ^a
	100%	1043.66 ^c	167.12 ^b	10.01 ^a	109.76 ^a
All	50%	2134.1 ^a	352.1 ^a	14.11 ^a	101.1 ^a
	75%	2746.7 ^b	419.1 ^b	14.93 ^a	104.97 ^a

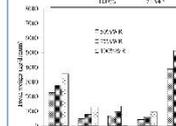


Figure 5: Comparison between irrigation amount at 50%, 75% and 100%, respectively and fresh weight productivity (kg/dunum) at each cut and whole cuts

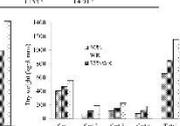


Figure 6: Comparison between irrigation amount at 50%, 75% and 100%, respectively, and water use efficiency (kg/m³) at each cut and whole cuts

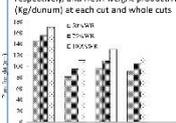


Figure 7: Comparison between irrigation amount at 50%, 75% and 100%, respectively, and plant height (cm) at each cut and whole cuts

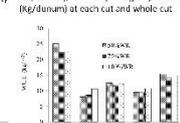


Figure 8: Comparison between irrigation amount at 50%, 75% and 100%, respectively, and water use efficiency (kg/m³) at each cut and whole cuts

Results & Discussion

Effect of Irrigation System on Crop Parameters and WUE

The effects of investigated surface and subsurface drip irrigation systems on fresh weight, dry weight, plant height and WUE of pearl millet are presented in Table 1.

The results showed that the fresh weight, plant height and WUE were the highest by SSDI compared to SDI for each cuts as shown in Figure 1, Figure 2, Figure 3 and Figure 4. (2018) and these results are attributed to many reasons causing SSDI superior than SDI including eliminating soil evaporation (Sinobas and Rodriguez, 2012; Mali et al., 2016), surface runoff, deep percolation (Sinobas and Rodriguez, 2012) and salt accumulation at upper soil surface (Lamm, 2016). In addition to remain the soil moisture more stable relatively (Mali et al., 2016) as showed in maize production on sandy loam soil (Dough and Boujelben, 2011; Dough et al., 2013) and increase nutrient availability (Mali et al., 2016) and consequently increased WUE (Dough and Boujelben, 2011; Dough et al., 2013; Mali et al., 2016).

Effect of Water application on productivity and WUE:

The effects of investigated irrigation water applications on fresh weight, dry weight, plant height and WUE of pearl millet are presented in Table 2.

The results showed that the fresh weight, dry weight and plant height for each cuts were increased by increasing irrigation amount at 50%, 75% and 100%, respectively as shown in Figures 5, 6 and 7, and these results are similar to the findings indicated by Ismail et al. (2018).

Also, as shown in Figure 5 the highest fresh weight was obtained from plants irrigated with 100 % WR (3558.73 kg/du) at the first cut while the minimum fresh weight was in the fourth cut at 50% WR (418.18kg/du), the highest fresh weight production in the first cut at 100%WR attributed to the reasons of no deficit irrigation and to the typically growth conditions for pearl millet. Where, The first cut done on the mid of July. These results are similar to the results obtained by Ismail et al. (2018). The lowest fresh weight production in the fourth cut attributed to the reasons of deficit irrigation (50% WR) and to the stress growth conditions, where the fourth cut done on mid of October when the crop enter to the senescence stage. Whereas, the pearl millet crop in this stage tends to flower and produce seeds in order to keep the offspring and these results similar to the results gained by Ismail et al. (2018). The highly decrease of fresh weight in the second cut comparing with the first and the third cuts was caused by unusually sudden increase of temperature which negatively impact on the growth after first cutting which leads to increase evaporation, decrease transpiration and consequently decrease photosynthesis. So, growth rate was decreased. By the way, the fresh weight improved in the third cut comparing with the second due to the temperature becomes closed to the typical of Pearl Millet growth.

The highest WUE was obtained from plants irrigated with 50 % WR (15.43 kg/m³) followed by 100% (14.91 kg/m³) and 75% WR (14.14 kg/m³) for both systems as shown in Figure 8. These results attributed to less water losses and water use for producing unit of product.





The Amalgamation of Palestinians Water Service Providers into Regional Water Utilities: Strategic Planning and Roadmap Setting

Prepared : *Ameen Dawabsheh*
 Supervised : *Dr. Suhail Sultan , Dr. Anton Sabella*



Abstract

- According to studies, the Palestinian water providers have no financial sustainability; wherein, financial losses reaches 30%, high outstanding debt, bills collection less than 60% in some areas, average non-revenue-water near to 35 %. In some cases, water service providers non-revenue water reaches 50%.
- According to the data bank of Palestinian Water Authority, there are more than 280 water and wastewater service providers in Palestine, in the form of undertakings, water departments within municipalities, villages, joint service council's, cooperative associations, and private sector
- So far, the Palestinian water law calls for merging current water providers into regional utilities; changing the structure and ownership to be fully legally and financially independent utilities. The purpose of this merging is based on expectation and previous studies that amalgamation will achieve more efficiency, high quality of water services, expanding the services into new areas, infrastructure development, and increase collection efficiency reduce of debt, long term sustainability.

PROBLEM

- The Palestinian Water Law, 2014 calls for merging water providers into regional utilities. However, the law did not specify the period of time that it will take to complete this merging, or the methodology of this amalgamation i.e. per governorate, per structure, per size and so forth.
- On the other hand, it also didn't propose the amalgamation rules such as merging the fixed assets, staff and hierarchy, long term liabilities and account payables, account receivables, and so forth.

OBJECTIVE

- In summary, the main purpose of this research is to deliver rational strategic and roadmap for implementation of the merging Palestinian water providers into regional utilities. Those results and findings may be considered as tools for safety amalgamation of water providers in the long run.

SIGNIFICANT

- The research significant in the Palestinian context is simply it can facilitate the merging process of water providers through optimal reforming. The merging expected to support the Palestinian water providers as per the following points:
- The merging will lead to decrease the cost per unit due to economies of scale.
- Expand the services into new areas as per the regional utilities.
- The amalgamation will achieve more efficiency in non-revenue water i.e. the network leakage.
- The expectation is to receive more quality of service compare with current providers that are under municipalities.
- The merging will expect to increase the collection efficiency of the water providers.





SYNTHESIZE AND CHARACTERIZATION OF CELLULOSE AMINE-ACTIVATED ASH COMPOSITAND APPLICATION IN WASTE WATER PURIFICATION

BAHIA FARED ABU LEIL
SUPERVISORS
Dr. Ahmad Abu Obaid
Prof. Othman Hamed



Abstract

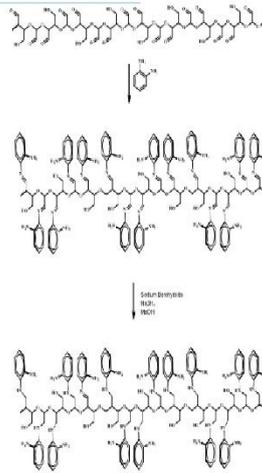
A cellulose Langmuir isotherm model. derivative with several coordination sites for metal ions composed of cellulose powder extracted from olive industry waste and 1,2-phenylenediamine was synthesized and evaluated as an adsorbent for metal ions from sewage. The adsorption efficiency of the cellulose amine polymer toward Fe(III) and Cd (II) was investigated as a function of adsorbent dose, concentration temperature, pH, and time. The adsorption parameters that gives the highest adsorption efficiency were determined. In addition, the cellulose amine polymer showed an excellent efficiency toward approximately twenty metal ions present in thesewagesample. The highest adsorption efficiency was at pH of about 8.3, room temperature and with 2mg/ml of polymer dose. The cellulose amine polymer has various coordination sites amine, hydroxyl, and aromatic groups. The diversity and frequency of the coordination was the reason for the high efficiency of the cellulose amine polymer toward the metal ions. The thermodynamic analysis results (The Gibbs energy (ΔG_0), enthalpy (ΔH_0), and entropy (ΔS_0) were calculated) supported the spontaneous adsorption efficiency of the polymer at room temperature. The kinetic study revealed that the metal ion adsorption by cellulose amine polymer was pseudo-second-order and followed the



Apparatus for oxidation of cellulose



Images of waste water sample before and after treatment with cellulose polymer



A representative scheme shows the molecular structures of and products and reaction condition.

Results & Discussion

1. Characterization of the cellulose aldehyde and cellulose amine polymer:

Cellulose powder derivatized with aromatic amine was prepared and used as an adsorbent for metal ions. The cellulose powder used in this work was extracted from olive industry solid waste, oxidized to cellulose aldehyde, and then reacted with o-phenylenediamine followed by a reduction with sodium borohydride. The produced cellulose amine polymer was subjected to an analysis via various spectroscopic methods

2. Metal ions extraction:

The efficiency of the prepared cellulose amine polymer toward adsorbing Fe(III) and Cd(II) was studied as a function of adsorbent dose, temperature, pH, metal ion initial concentration, and time. The polymer showed an excellent efficiency toward both metals, the highest absorbency was observed at pH of approximately 8.0 at room temperature.

3. Wastewater purification from metals:

The polymer was then evaluated on a real sample of sewage that contained approximately 20 metal ions. The cellulose amine polymer showed excellent efficiency toward most of the metal present in the sewage.

4. Adsorption analysis:

The kinetic study revealed that the metal ion adsorption by cellulose amine polymer model. The thermodynamic analysis showed a negative free energy, indicating spontaneous adsorption process at different temperatures.





Synthesis of Three Dimensional Cellulose Diamine Polymer for Wastewater Purification

Basima Qasem Ahmad "Radwan Khleif"
Prof. Shehdeh Jodeh



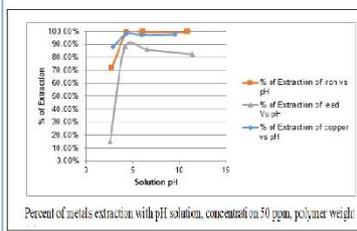
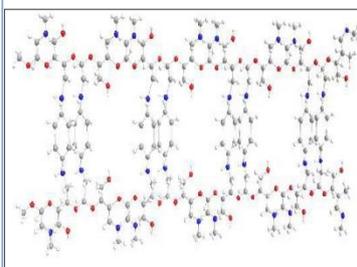
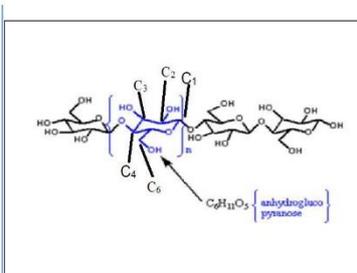
Abstract

Synthesis of Three Dimensional Cellulose Diamine Polymer for Wastewater Purification

Cellulose is the most abundant natural product; it has unlimited number of industrial applications. It reacts like alcohol and can be converted into various polymers with various functionalities. In this work cellulose extracted from Olive Industry Solid Waste (OISW) was converted to cellulose dialdehyde by oxidation with periodate, then reacted with the bifunctional amine 1,4-diaminobenzene to form cellulose diamine which then reduced to cellulose diamine by reacting it with sodium borohydride. The structure of the prepared polymers were analyzed by FT-IR, NMR (¹H and ¹³C), and other spectroscopic and thermal methods. Produce cellulose diamine has a unique molecular structure, diamine compound holds the cellulose chain together and both form a kind of crown amine. The crown amine cages have several binding sites of nitrogen and oxygen that are distributed through the ring. These sites have high affinity for metals. The prepared cellulose diamine was used to extract toxic metals from wastewater. copper. The extraction efficiency of the cellulose The metal that were extracted are lead, iron, and diamine for these metals was evaluated as a function of pH, adsorbent dosage, temperature and time. The optimum about 120 min, pH was about 4.0 and the dosage is 0.5 g. Under these conditions a quantitative remove of metals from solutions concentrations 10, 20, 50 ppm was attained. conditions were the temperature was 30 °C, the time was

The extraction efficiency for heavy metals were studied by using two type of polymer: powder and fiber polymer, we found powder polymer more efficient in extraction

The kinetic calculations showed that, adsorption rate followed the Pseudo-second-order. The R² for Pseudo-second-order equation was 0.9999.



Results & Discussion

Oxidation of Cellulose to 2,3-Dialdehyde Cellulose :

Periodate oxidation of cellulose was carried out according to a method reported by Jackson and Hudson [34,35]. In this method cellulose is treated with an aqueous solution of periodate in a system completely isolated from light. Periodate complexes to the vicinal hydroxyl group at C2 and C3 which leads to cleavage of C2-C3 bond and oxidation of the vicinal hydroxyl groups to form 2,3-dialdehyde units along the cellulose chains

Reaction of Dialdehyde Cellulose with Diamine :

The aldehyde groups are known to be versatile, it is very reactive and could be converted to various function group. For example, it can be further oxidized to carboxylic groups [37] or reduced to primary alcohols [38], or reacted with amine to form imine [39]. The imine then could be reduced to an amine. Amine is known to have tendency to complex with metal due to its lone pair of electrons. In this study it was chosen to be converted to an imine then reduced to an amine. The carbon of the carbonyl group of the aldehyde is an electrophilic carbon it undergoes condensation reaction with amine as shown in Scheme III.6 to form an amine after the loss of a water molecule. Figure shows the reaction between cellulose dialdehyde and 1,4-diaminobenzene. The nucleophilic addition of the amine to the carbonyl compound of the molecule gives rise to a hemiaminal intermediate, followed by transfer of a proton from nitrogen to oxygen, then a loss of water is lost in an elimination reaction to give an imine with excellent yield (>95%). This diamine was chosen because it bridges to cellulose aldehyde chains and form a kind of crown amine. A circle with multi coordination site for metals.

Reduction of cellulose imine to amine :

The reduction of cellulose imine was carried out with sodium borohydride, the reaction is a straight forward reaction and usually carried out in methanol. The reduction of the arylimine into an amine, 1,4-diaminobenzene was chosen, because it crosslinks the cellulose chains to form a crown amine with high affinity for metal.

Extraction of metals from Wastewater Using Cellulose Based Diamine:

In this part of this study, heavy metal ions with different concentration was shaken with different amount of polymer. The effect of other variables such as extraction time, temperature and pH were evaluated to determine optimum conditions for the highest adsorption efficiency.

The extraction was carried out using a batch adsorption process which included suspension then filtration. The analysis was performed on the supernatant to determine the concentration of free unextracted ions Lead, Copper and Iron ions were evaluated.

1. Effect of polymer (3) dosage on percent of adsorption of lead
2. Effect of time on percent of extraction of lead by polymer (3)
3. Effect of temperature on percent of extraction of lead by polymer (3)
4. Effect of pH on percent of extraction of lead by polymer (3)



CELLULOSE GRAFTED WITH β -CYCLODEXTRIN FOR WASTE WATER PURIFICATION FROM TOXIC METAL IONS



Fellow's Name: Hadeel Abu Dehmaz
 Advisor's Name: Dr. Othman Hamed, Dr. Shehdeh Jodeh



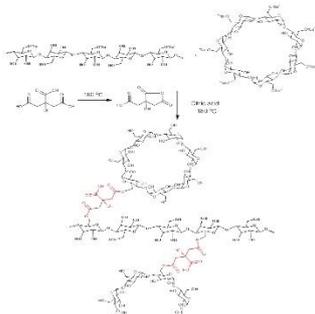
Abstract

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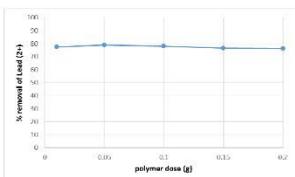
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FILL ANY EMPTY SPACE WITH VISUALS—GRAPHS, CHARTS, PHOTOS, ETC.

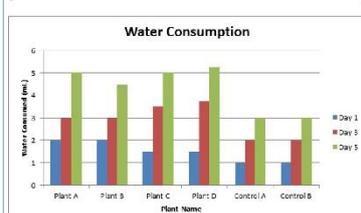
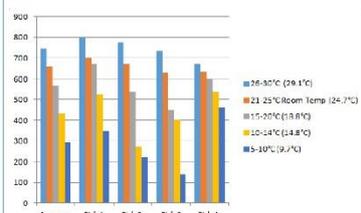
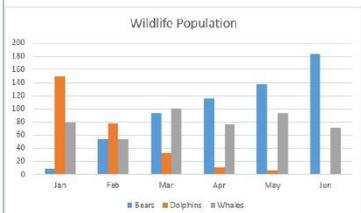
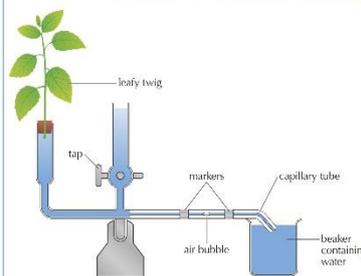
Three polymers of crosslinked cellulose and β -cyclodextrin (A, B, and C) were designed and synthesized. The cross-linking agent used for this purpose was citric acid. Various proportion of the three materials were used for preparing the polymers. The polymer structures were determined by FT-IR and the polymer morphologies were studied by SEM. The adsorption efficiency of the three cellulose- β -cyclodextrin polymers toward Pb(II) from an aqueous solution was investigated as a function of adsorbent dose, temperature, pH and time, the adsorption parameters that lead to an excellent adsorption efficiency were determined. The high adsorption efficiency of the cellulose polymers could be attributed to the presence of various coordination sites which includes carboxyl, hydroxyl and β -cyclodextrin. Thermodynamic analysis results support the high adsorption efficiency of the polymer. The adsorption process fits well with the second pseudo order model and the adsorption isotherm follows a Freundlich isotherm model. Polymer 2 that contains the largest quantity of citric acid showed the highest efficiency toward lead (II). This could be due to the availability of carboxyl groups.



The reaction between cellulose, β -cyclodextrin and citric acid.



The effect of polymer A dose on the removal efficiency.



Results & Discussion

Headline Number One: Synthesis of Cross-linked cellulose polymers

- In this work, a tri component polymer was designed, synthesized and used in waste water purification from toxic metal ions. The three components chosen for this purpose were citric acid, β -cyclodextrin and cellulose.
- Citric acid was used in synthesis of the three polymers as crosslinking agent, in order to form two ester linkages between cellulose and β -cyclodextrin.
- The ester bonds are formed between the carboxyl groups of citric acid and the hydroxyl groups of β -cyclodextrin and cellulose. The reaction was carried in a solid phase at high temperature. Since at high temperature over 170 °C, citric acid undergoes dehydration and forms anhydride a functionality that undergoes addition reaction with hydroxyl groups to form ester bond.

Headline Number Two: Adsorption conditions and procedure

- A batch adsorption procedure was followed in this work, all experiments were performed in plastic containers (50 ml), that were placed in a water bath with shaker. The effect of the following variable on polymer adsorbent efficiency were evaluated: metal ion concentration (5 to 50.0 ppm), pH values from 2 to 10, adsorbent dosage (0.01 to 0.2 g), adsorption time (1 to 30 min) and temperature from 25 to 40 °C. The adsorption study was performed on Pb(II) nitrate.
- Determination of optimum adsorption conditions:**

Optimum adsorbent dosage

The dosage that provided the lowest residual concentration of metal ion was chosen as an optimum dosage. This was achieved by performing the experiment on 10 ml of each Pb^{2+} with a concentration of 50.0 ppm, pH value of 6.3 for 30 min and at room temperature.

Headline Number Three: The final Results

- In this work, three polymers (A, B and C) were prepared by mixing various amounts of cellulose, β -cyclodextrin and citric acid.
- The polymers were used in water purification from lead (II), the three polymers showed high adsorption efficiency toward lead (II). The optimized adsorption conditions for polymers were determined.

The optimum adsorption conditions for polymer A were polymer dosage 0.05 g, 15 minutes of extraction time at room temperature (25°C) and a pH value of 8.0. For polymer B, the polymer dosage was 0.2 g, 10 minutes of extraction time at room temperature (25°C) and a pH value of 8.0. And for polymer C, the polymer dosage was 0.2 g, 10 minutes of extraction time, room temperature (25 °C) and pH value of 8.0.





Continuous Flow System ZnO-Based Catalyst for Aqueous Chlorophenols Degradation with Direct Solar Simulated

Hala Zeyad Aref Salah
Prof. Hikmat S. Hilal
Dr. Ahd Zyoud

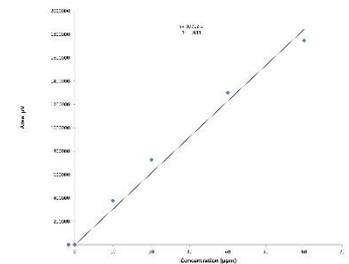
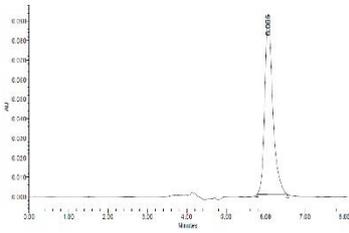
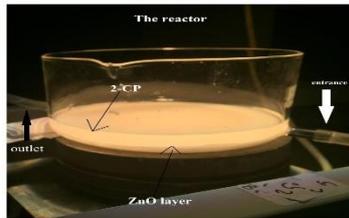
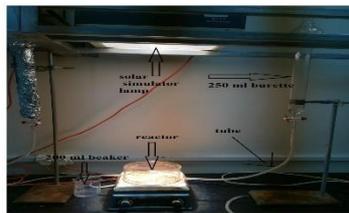
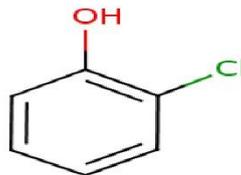
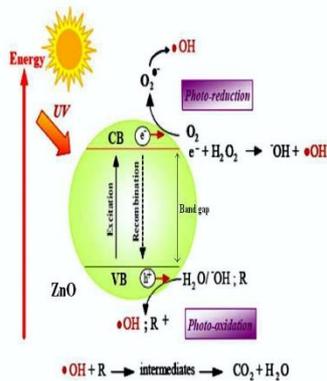


Abstract

Water pollution has become a major concern that motivates scientists to solve. This is due to the tremendous pollutant sources and types that affect the water quality. This work shows a safe method to remove 2-chlorophenol (2-CP) pollutant from water, and to avoid its hazards completely.

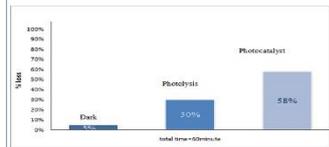
The method used in our study is photo degradation using commercial ZnO nano-particles as the photo catalyst. The continuous-flow reaction system was carried under solar simulated light. The commercial ZnO nano particles were plated on a glass dish, and characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). Under neutral conditions, using 2-CP (40 ppm), pH = 6, light intensity 100000 Lux (equal to daily average solar light intensity), the results show 58 % 2-CP photo degradation after one hour, 98 % photo degradation after 3 hours, and 100 % photodegradation after 6 hours. The results were confirmed by UV-Visible spectrophotometer and total organic carbon TOC in treated water.

The study shows the feasibility of using the photodegradation method to eliminate 2-CP from contaminated water. Effects of different reaction parameters, onto photo degradation reaction of 2-CP, such as pH, light intensity, concentration of 2-CP, and exposure time have all been studied. High Performance liquid chromatography was also used to study the 2-CP photo degradation. Values of : Photo degradation percentage, turn over number (TN), turnover frequency (TF) and quantum yield (QY) were all calculated as measures for relative catalyst efficiency in the photodegradation process.



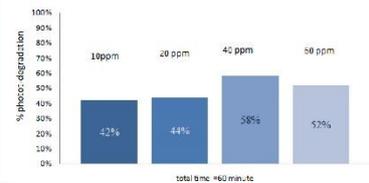
Results & Discussion

Control experiments:

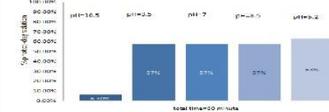


Light the adsorption of 2-CP on ZnO surface does not significantly affect % loss value, but under light and without catalyst existence, 30 % of contaminants will degrade by photolysis. On the other hand, the photocatalyst degraded about 60 % of contaminants in one hour.

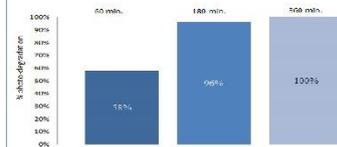
Effect of contaminant concentration:



The % degradation changed with pH as: 5.2 > 3.5, 7.0 and 8.5 > 10.5. At pH 5.2 and higher, acidity has slightly effected the % degradation until it reached 10.5 where the % degradation sharply decreased. This is due to the repulsion between negatively charged phenoxide ion (which results from 2-chlorophenol by the high NaOH concentration), and the negatively charged ZnO surface. The value of pH at zero point charge for ZnO is 9. Therefore, if pH value < 9 the ZnO surface is in the H⁺ form while if pH value > 9 the catalyst surface is negatively charged.



Photodegradation with longer time:





The use of magnetic multiwalled carbon nanotubes functionalized with chitosan for nitrate removal from wastewater

By
Inas Ibrahim Mahmoud Bsharat
Supervised by: Prof. Shehdeh Jodeh



Abstract

This study aims to synthesis magnetic multiwalled carbon nanotubes functionalized with chitosan, and used for removal of nitrate from wastewater. The resulting adsorbent characterized by TEM, ATR, XRD, TGA and Raman analysis. This porous material showed a very good thermal and chemical stability and hence it can be used as perfect adsorbent to uptake nitrate ions from wastewater.

The concentration of the nitrate in the filtrate was determined using UV-visible Spectrophotometer. The results showed that the resulting product has high adsorption efficiency. Also, it showed strong complexation properties with nitrate ions. In order to investigate the adsorption efficiency for the adsorption of nitrate onto magnetic multiwalled carbon nanotubes functionalized with chitosan the effect of solution conditions on each adsorption process were studied. These conditions involve the effect of contact time, pH value, temperature, adsorbent dose and the initial concentration of adsorbate.

The best equilibrium isotherm model for each adsorption process was investigated according to the value of the correlation coefficient of Langmuir and Freundlich isotherm adsorption models. The kinetics of adsorption were also investigated using pseudo first-order, pseudo second- order and intra-particle diffusion kinetic models. In addition, Van't Hoff plot for the adsorption was investigated in order to determine the values of enthalpy change and entropy change, and hence determining if the adsorption process is spontaneous or not, and if it is exothermic or endothermic one. The results showed that the adsorption followed Freundlich isotherm and the mechanism of the reaction followed pseudo first-order kinetic adsorption model. The thermodynamic parameters of the adsorption proved that this process is endothermic ($\Delta H > 0$) and spontaneous ($\Delta S > 0$). The synthesized adsorbent was also regenerated, and the percentage removal before and after adsorbent recovery is determined.

Results & Discussion

Effect of the pH Value

In this study at low pH there was rise of the adsorption capability for NO_3^- . The adsorbent of magnetic multiwalled carbon nanotubes (MWCNTs) functionalized with chitosan has the maximum amount of NO_3^- removal that is 96.54% at the maximum pH = 2. This behavior is due to the excess of protons in solution at this value of pH. This increases the number of positively freighted sites on adsorbent surface, which favor the adsorption of the nitrate anions onto the adsorbent surface due to electrostatic attraction to each other. The acid-base interaction between base nitrate and acid on the surface of the adsorbent also favors adsorption

Effect of temperature on nitrate adsorption

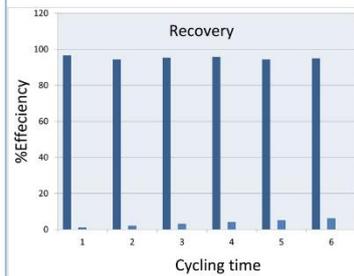
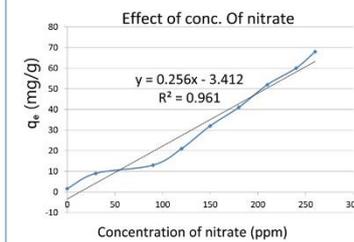
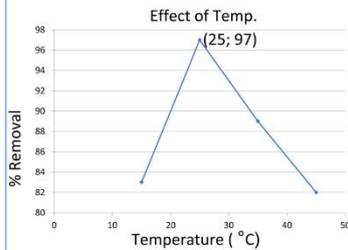
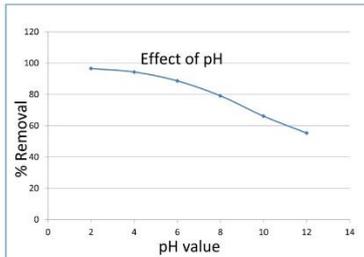
Temperature acts a critical parameter in every type of adsorption operations. Adsorbent and nitrate interplay temperature was appeared in Figure 3.9. This figure shows that rising in temperature above to the room temperature (25°C) has impact on reducing the adsorption capability of adsorbent surface. Reduce in eluting percentage maybe due to reduction of the physical forces of attraction between the nitrate ion and adsorbent.

Effect of the concentration of nitrate .

The impact of the concentration of nitrate on adsorption capability was studied over wide range of nitrate concentration with conserving other factors like quantity of adsorbent, volume of solution, adsorbent size, and solution pH as constant. Figure shows that as the NO_3^- concentration increases from 30-260 mg/L, the adsorption capability is rising from 9-68 mg/g. This may be due to gradual rise in the electrostatic attraction between nitrate ions and the adsorbent desired active sites.

Recovery of nitrate and reusability of the adsorbent

Recovery of nitrate from the adsorbent was achieved at room temperature. The first step was filtration to collect the adsorbent. The second step was washing the adsorbent with 6M of HCl then washing with deionized water, and finally left the adsorbent to desiccate at room temperature for three days. 100 mg of the regenerated adsorbent was added to a 10 mL of 50 ppm of nitrate solution at pH 2 in order to compare the adsorption capability of the regenerated adsorbent with fresh adsorbent. Figure shows small variations between the amount of nitrate ion eluting after the first to the six regeneration of adsorbent as shown in this plot. This is strong evidence that the magnetic multiwalled carbon nanotubes (MWCNTs) functionalized with chitosan adsorbent can be used for several times.



EXPERIMENTAL



Extraction and Modification of Lignin From Olive Industry Liquid Waste and Application in Waste Water Purification

By: Maryam M. Khraiwish
Supervisor: Prof. Othman Hamed



Abstract

In this study, two new copolymers from lignin, acrylic acid and a cross-linking agent, N,N-methylenebisacrylamide, were synthesized and evaluated as adsorbents for toxic metal ions from contaminated water. The lignin used in this work was extracted from liquid waste of olive industry (Zebar). The adsorption efficiencies of the prepared two polymers toward Pb(II) was investigated as a function of adsorbent dose, metal ion concentration, adsorption time, temperature, and pH value. The adsorption parameters that lead to an excellent adsorption efficiency were determined. In addition, the two polymers showed medium to excellent extraction efficiencies toward sixteen different metal ions present in a sewer sample collected from Hebron Palestine. The high efficiency of the prepared polymers toward various metal ions could be attributed to the several coordination sites present in the polymers including aromatic, hydroxyl, carboxyl and amine. The adsorption efficiency reached about 90% for polymer PAA-Lignin-A and 85.5% for PAA-Lignin-B. The greater efficiency of PAA-Lignin-A could be attributed to the higher porosity. The isotherm models that best fits the results were investigated according to the value of the correlation coefficient of Langmuir and Freundlich isotherm adsorption models. The kinetics of adsorption were also investigated using pseudo first-order and pseudo second-order models. The results showed that, the adsorption follows the Langmuir isotherm and the mechanism of the reaction is consistent with pseudo second-order kinetic adsorption model.

Introduction

Contamination of water by toxic metal ions is of a great worry due to their high harmfulness and carcinogenicity. Scientists have been devoting a great time and effort searching for new cost-effective natural based adsorbents for these toxic metals. Lignin [C₉H₁₀O₂(OCH₃)_n] is an amorphous and a 3D biopolymer. It is one of the major by-product of olive industry. It is the second in abundance after cellulose, and also the most abundant natural phenolic polymers in the world. Lignin was chosen in this study for many reasons: it's a safe byproduct, cheap and present in waste material (zebar). Moreover, unprocessed lignin is insoluble in many solvents including water. Also it's unique huge cross-linked polymer, with several functional groups being very useful for heavy metal adsorption. Modifications of the Lignin structure provides better stability and add various properties that allow better performance of Lignin polymer composites structures. Several chemically modified Lignin polymers were prepared and used in water purification in many previous studies.

Specific Objectives

- 1) Extraction of Lignin from Zebar (olive industry liquid waste).
- 2) Synthesis and characterization of two new hybrid co-polymers
- 3) Comparison of the efficiency of the two co-polymers for the adsorption of lead from contaminated.
- 4) Evaluate the possibility of using the prepared polymer for sewage treatment from toxic metal ions.

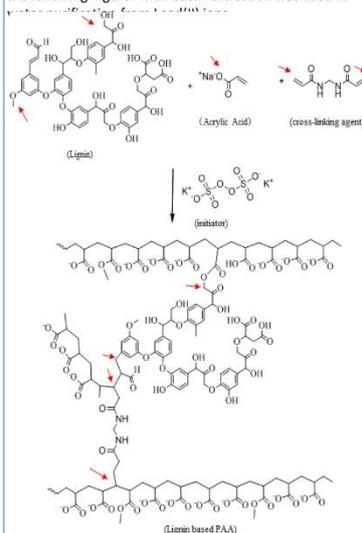


Zebar no longer threatens Palestinian waters

Experimental

The Acrylic Acid was polymerized and cross-linked within

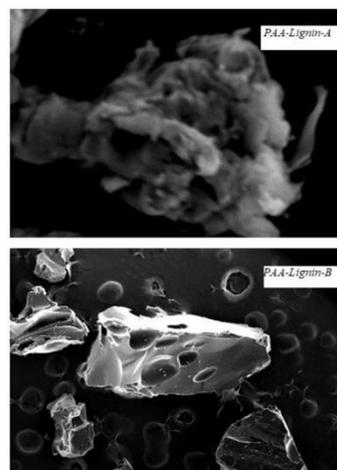
Lignin that extracted from Zebar. Two were prepared copolymers PAA-Lignin-A and PAA-Lignin-B as shown in the following figure. Then batch extraction was used in



Results & Discussion

I. Morphological Analysis of polymers A and B

The SEM morphology showed that Polymer PAA-Lignin-A that contains large quantity of Lignin shows surface covered with high number of micro cavities which could be attributed to porous polymeric network. While polymer PAA-Lignin-A has more of a solid smooth surface as shown below.



II. Determine the parameters that affect the removal efficiency of the two polymers

The second objective of this study is to examine the efficiency of Lignin based polymers as adsorbents for toxic metal ions from wastewater. The effect of various factors such as amount of adsorbent, the metal concentration, contact time, temperature and pH value on the adsorption of metals ions were studied and summarized in the conclusion.

Conclusion

The observed results of this research include the following:

- 1) Over 90% removal efficiency of Pb (II) was achieved using 0.05 g PAA-Lignin-A, after a contact time of 10 min, at pH 8.5 and temp of 30 °C, using Pb (II) solution with initial concentration of 50 ppm. 90% for polymer PAA-Lignin-A.
- 2) Above 85.5% removal efficiency of Pb (II) was achieved using 0.1 g PAA-Lignin-B, after a contact time of 25 min, at pH 8.5 and temp of 40 °C, using Pb (II) solution with initial concentration of 50 ppm.
- 3) The greater efficiency of PAA-Lignin-A could be attributed to the higher porosity.
- 4) All two polymers obey pseudo-second order model for adsorption kinetics, and obey Langmuir isotherm model.
- 5) They have been successful in being as perfect adsorbents to uptake various type of metal ions from real sewer samples with removal efficiency ranges from medium to excellent.



The Discrepancy in Water Sales Prices in Palestine: Social Equity for the Household Customers and Financial Performance of the Water Service Provider



Abdullah Murrar
Dr AbdelRahman Tamimi



Abstract

According to the Palestinian Central Bureau of Statistics there are some considerable discrepancies in important economic indicators among the various Palestinian areas. The prices of some goods and services are high in a given area, while in other areas the same goods and services may be lower significantly. That is, the water price is NIS 1.54 per cubic meter in Qalqiliya city, which is lower by more than three times than the water price in the Ramallah city which is at NIS 6.78 per cubic meter. discrepancy in water prices leads feelings lack of inequality in social justice among people in given city and another. In total this feeling may increase and affect the stability of communities and society. Therefore, the local and community development process would be negatively affected. Hence, it is necessary for government and policy makers to monitor these differences, their size, their drivers, their focus, to provide community sustainability and prosperity. This thesis aims to study the discrepancies in water price of the water service providers in the West Bank and the Gaza Strip, and to correlate these discrepancies with the financial and technical performance indicators such as the per capita, non-revenue water, staff productivity, operating cost. It is important also to know the direction of the relationship between the average water price and the performance indicators while positive or negative relationship. To achieve the expected results, this thesis will test by conducting Multivariate Analysis of Variance (MANOVA) the relationship and significant impact of average water price as predictor over many dependent parameters. The sample size in this thesis has included all water service providers that deliver water services to more than 80% of the Palestinian population. The study shows that there are more than 250 water tariffs in the West Bank and the Gaza Strip for about 273 Water Service Provider in Palestine. There is also a significant difference in the performance indicators for water providers based on the average water price. The low price category of water service providers is the worst category in performance. The low price category includes the highest percentage of water losses, the lowest collection rate of the accumulated debts, the highest percentage of water consumption, the lowest productivity of staff, and the highest percentage of financial losses. These indicators are particularly give the decision makers the worries about the sustainability of water sector especially that there is, 44% of water service providers falls under this category.

Results & Discussion

Palestinian water sector is a fragile sector

According to previous studies in this research and the study of the water sector in Palestine, it was found that the Palestinian water sector is a fragile sector. The water sector is organized i.e. regulated and at the same time unorganized. There is a water law for 2014, a water tariff bylaw, a financial sustainability bylaw, a public-private partnership bylaw, a non-revenue water bylaw and other regulations and gridlines. At the same time, all these laws and regulations are not actually fully implemented on the ground.

Differences in Palestinian Areas

The results indicate that there are almost every water service provider sells water prices different that other prices of other water provider. The data shows discrepancies in almost everything in Palestinian water sector. It is noted at some water providers such as in Hebron areas that the water service takes 90 days to reach the areas such as Daherya, Yata, while it takes about 40 days in Sawahara Sharqiya in East Jerusalem; in Qalqilya and Jericho the water is in continuous supply. The Water Law also calls for a unified tariff system for all water service providers in Palestine. This study shows that there is no implementation for this article of the law and the current tariff system is not also implemented as well. The study also reveals that the government subsidizes the purchase price of water regardless of the financial situation of the service provider and regardless of other factors such as water availability, family income, marginalized areas and other economic and social indicators. It was also noticed that there are high percentage and quantity of prepaid meters that are implemented in the Jenin and Tubas areas, which those governorates are suffer from low level of family income compared with other families' income in other governorates. The differences between the Palestinian areas in the water price, water availability, and water consumption can be one of the factors that cause instability in the Palestinian society and therefore the lack of social justice.

Headline Number Three:

The study showed that the price of water has an impact on the financial performance of water service providers. Water service providers who sell water at high prices have been found to be better performing financially than those who sell water at low prices. There are many areas of performance that are noted such as an improvement in the performance of debt collection, high profits, employee productivity, water loss and other performance indicators. It has been noticed that there is a high non-revenue percentage in water providers who sell at low and high prices. The medium prices are the lowest percentage of non-revenue water. This indicates at low prices that the water providers may find difficulties to make maintenance for the water network due to financial losses and lack of cash availability. Water providers, who sell at high prices, also have high non-revenue water percentage, this high non-revenue water percentage may be explained as illegal connections in addition to other factors. Water prices are high in areas where there is no Palestinian security control such as Abu Dis, as well as areas of southern Hebron such as Dahariya, Dora, Ithna, Targomya and others.

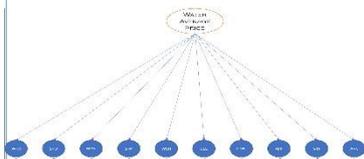
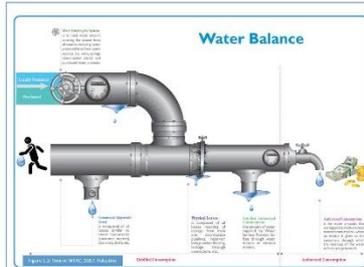


Figure 1-4 Distribution of Water Providers According to the Location

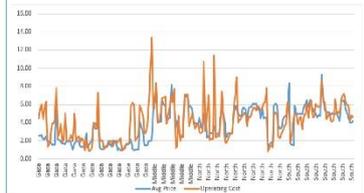


Figure 2-5 Relationship between the Average Sales Price and Operating Cost of Water in Palestine

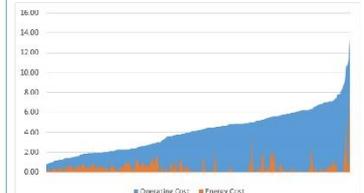


Figure 3-2 Relationship between the O&M cost and Energy Cost





Septage Characterization and Fecal Sludge Treatment in Rural Nablus

Mohammed A. Hussein
Dr. Abdel Fattah R. Hasan



Abstract

As urbanization continues to take place, the management of sanitation is becoming a major concern. Palestine is one of the countries that have major issues with sanitation, providing that most of the population relies on cesspits for disposal of wastewater. This work has characterized the septage, and quality of wastewater collected in cesspits in three villages near Nablus city (Qusin, Iraq Burin, and Tell), also proposed a pretreatment model. Samples were collected from the vacuum tankers used for emptying the cesspits in the three villages. They were then analyzed for pH, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Turbidity, Phosphorous, Ammonia, Nitrogen, Nitrate, Alkalinity, Conductivity, Solids parameters, Total and Fecal coliform, and Heavy metals. The concentrations of the analyzed samples were compared with the EPA guidelines and municipal wastewater and septage in other countries as compared through literature, for example; in west Nablus wastewater treatment plant the average BOD concentration of row WW was 573 mg/l, Whereas the septage had an average BOD₅ of 371 mg/l. While the average COD of municipal row wastewater and septage were 1,174 and 1,087 mg/l, respectively.

Modeling and optimization of wastewater treatment processes were applied to improve the efficiency of a wastewater treatment model. The model was applied on the Septage characterized by this study (which has a high organic loading and suspended solids concentrations) to optimize a treatment process of a two-units of Sequencing Batch Reactors SBR model using GPS-X 7.0 simulator.

Even though there were no fecal sludge disposal sites for the studied villages, the Septage was dumped untreated to open environment. This model was designed to meet the Palestinian regulations of type C of treated wastewater for agricultural reuse. The designed values for this model were (456, 1221, 386) mg/l for BOD₅, COD, and Total Suspended Solids (TSS) respectively. The results revealed that, two-units of SBR model were operated with removal efficiencies higher than 98% for BOD, 94% for COD, and 98% for TSS.

This modeling analysis was applied to define a performance measuring plan based on the most important parameters that can be reliable and applicable for any wastewater treatment plant. The produced models were feasible for construction and operation. Also, it is recommended to implement the modeled TP to examine the operation and efficiency of such TPs on the ground and to make calibration for the model if needed.

Keywords: Characteristics, Septage, Pre-Treatment, Modeling, SBR, Activated sludge.

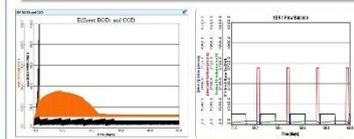
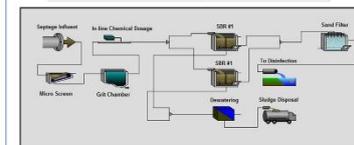
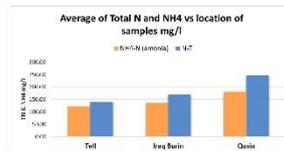
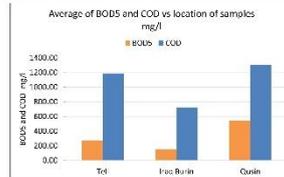


Discharge of the septage in the natural wadis.



Parameters	Range of values		AVG.	STD
	Min.	Max.		
pH	7.15	8.14	7.74	0.38
Turbidity (NTU)	150.00	820.00	438.00	242.26
Temperature	20.60	24.50	22.09	1.43
TS	1030.00	2245.00	1620.54	368.46
TSS	142.50	572.50	328.25	162.25
TDS	786.00	1498.00	1001.08	234.10
VS	732.00	1244.00	965.50	171.86
VSS	132.00	400.00	203.50	90.09
VDS	447.50	914.00	651.68	141.35

Parameters	Range of values		AVG.	STD
	Min.	Max.		
TCC (C/1ml)	1.96E+06	4.83E+07	1.95E+07	1.80E+07
FCC (C/1ml)	3.60E+03	3.80E+04	1.12E+04	8.59E+03



Results & Discussion

Results:

- Physical, chemical, and Bacterial Septage characteristics from three villages were obtained and consolidated.
- The measurement of Turbidity was done and the average value of turbidity of septage from cesspits in rural Nablus was (483.0±242.26 NTU). The big variation between these locations is related to the water consumption, frequency of emptying the cesspit, and to soil content. The lower readings were in Iraq Burin and this is due to the nature of this village as it is located on a rocky mountain.
- The average value of PO₄-P and PO₄-T of septage from cesspits in rural Nablus were (11.22±2.89) and (12.10±2.86) respectively in mg/l.

Conclusions:

- Almost all values of septage parameters in rural Nablus were within the values of EPA and USA septage parameters except BOD and COD as they are less than the ranges.
- The rural Nablus septage characteristics were higher than the municipal wastewater received to NWWTP. Also the septage parameters were higher than the design value in NWWTP. So as expected that septage need an independent treatment facility.
- The parameters of Turbidity, TN, PO₄-T, TS, VS, TSS, VSS, Alkalinity, and FC had the highest values for septage in Qusin village and lowest in Tell village. Mainly due to behavior of people in households, the soil context, cesspit criteria, and frequency of emptying.
- The removal efficiencies of COD, BOD₅, TSS and TKN in the proposed TP model were acceptable according to the process guide lines that reached to 94%, 98%, 98%, and 78% respectively. And the effluent from run are within with the Palestinian limitation's of 2017 regulations for type C. Which made the treated water suitable for irrigation of Almond, Olive, Citrus and Forest trees. Also, for Industrial crops, grains, Dry feed. Moreover, and the most important it can feed the aquifer by filtration.

Recommendations:

- Increasing the proportion of sludge transported to the treatment facilities should be the immediate priority.
- In order to gain a better overall understanding of the composition of FS, there is the need to conduct further studies in different locations at different seasons.
- It is recommended to implement the modeled TP to examine the operation and efficiency of such TP on the ground and to make calibration for the model if needed.
- Further researches should be carried out to improve this technology and enhance the effectivity of such TP.
- In order to benefit from operating of the treatment plant, a feasible strategy for effluent water reuse should be elaborated.

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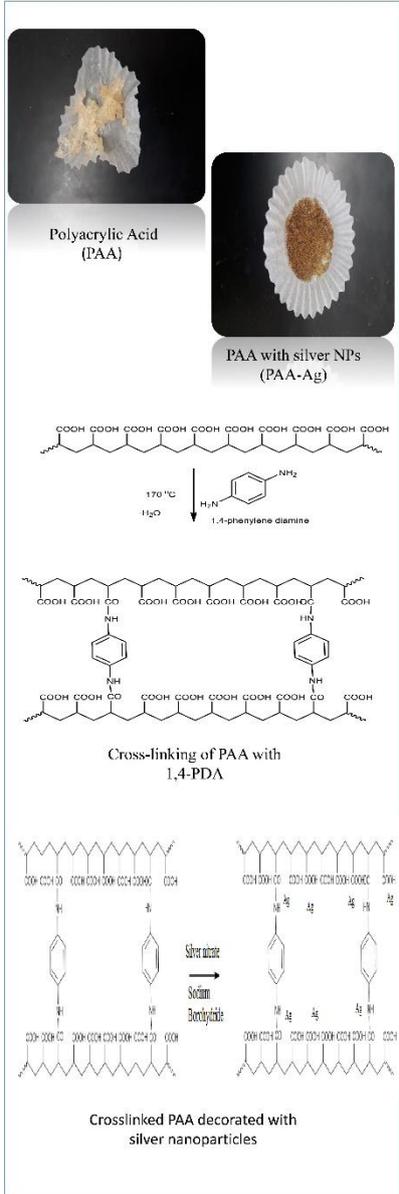
Polyacrylic acid with amide crosslinks decorated with silver nanoparticles: synthesis and application in wastewater Treatment

Naba Abu Hafeth
Prof. Shehdeh Jodeh & Dr. Othman Hamed



Abstract

In this study, Polyacrylic Acid with amide crosslinked (PAA) was decorated with Silver Nanoparticles (NPs). The resulting polymers PAA and PAA with silver NPs (PAA-Ag) were characterized by IR spectrophotometer. Both were used as adsorbents for Lead(II) and 5-Fluorouracil from aqueous solutions. The adsorption efficiency of each adsorption process was investigated as a function of adsorbent dose, adsorbate concentration, contact time, temperature and pH value. Tendency of prepared PAA-Ag for extracting Pb(II) from water was evaluated and compared to PAA. It was observed that adsorption of lead on PAA-Ag and PAA was affected by the amount of PAA-Ag until the equilibrium level. The optimum pH value for lead adsorption was 7.33 and 4.7 for PAA-Ag and PAA respectively and the equilibrium was established within the first 10 min adsorption was done at room temperature. It was found that Lead adsorption kinetics has followed pseudo-second-order. Experimental data were analyzed using two model equations: Langmuir and Freundlich and it was found that the data fitted well with Freundlich isotherm model. Meanwhile, PAA-Ag was used as adsorbents for the removal of 5-FU from aqueous solution. The concentration of 5-FU in the supernatant was measured by UV-vis spectrophotometer. It was observed that adsorption of 5-FU was affected by the amount of PAA-Ag until the equilibrium level. The optimum pH value for 5-FU adsorption was 8.18 and the equilibrium was established in 5 min. It was also evident that the adsorbed 5-FU was decreasing as the concentration of 5-FU was increased in solution. It was found that 5-FU adsorption kinetics has followed pseudo-second-order. And it was found that the data fitted well with Langmuir isotherm model.



Results & Discussion

The synthesis and characterization of the new Polyacrylic acid modified surfaces including PAA and PAA-Ag showed that these polymers have very good thermal and chemical stabilities, and hence they can be used as perfect adsorbents to uptake Pb(II) and 5-FU from aqueous solutions.

The observed results of this research include the following:

1. The maximum extent of adsorption was for PAA-Ag polymer in the presence of lead ions. This adsorption needed only 10 minute of shaking at 25°C, 0.15g of polymer to have 98.19% as percent of Pb(II) removal. The maximum percent of lead removal onto PAA was 89.06% at the same condition.
2. Adsorption thermodynamics of lead ions onto the two materials PAA and PAA-Ag was studied, both followed Freundlich isotherm model and pseudo-second order kinetic model.
3. 5-FU was adsorbed onto PAA-Ag polymer, the maximum percent of 5-FU removal was 94.8% after 5 min of shaking, 0.05 g of PAA-Ag and 5 ppm of 5-FU solution at room temperature.
4. The results showed that the adsorption of 5-FU followed Langmuir isotherm and the mechanism of this reaction followed pseudo-second order kinetic adsorption model.





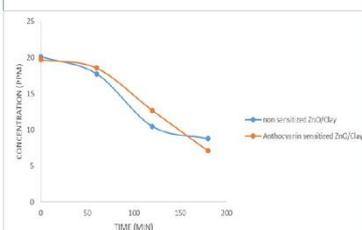
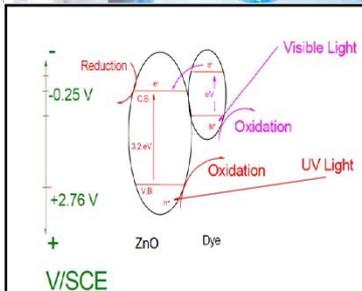
Clay-supported sensitized nano-ZnO in photocatalytic degradation of aqueous halophenols using direct solar light

Sarah Asaad
Hikmat Hilal



Abstract

This work describes the adsorption and photo catalytic degradation of aqueous 2-chlorophenol (2CP) contaminant using nano sized ZnO semiconductor photo catalyst. The ZnO particles are trapped into solid natural clay particles, producing a new highly active and easy to recover ZnO catalyst system. The degradation was performed under direct sun light. This research investigates the effect of sensitization on the photocatalytic efficiency. The prepared ZnO and prepared ZnO/natural clay systems were characterized by several methods, such as FT-IR, UV-Visible, Photoluminescence, SEM and XRD which confirmed the ZnO formation in the composite catalyst. High Performance liquid chromatography was used to study the 2-chlorophenol adsorption and degradation. The results showed that the 2CP photo-degradation on the sensitized ZnO/clay occurred with highest activity (~64% + 0.01) loss of 2CP compared with ZnO/Clay composite catalyst (~56% + 0.01) loss of 2CP under direct sun light under natural conditions. Effects of different reaction parameters onto photo degradation reaction of 2CP by natural clay/ZnO catalyst have also been studied. The ability of catalyst recovery and reuse in photo-catalytic reactions was also studied, the recovered catalyst showed loss efficiency (~41%) of 2CP. Attempts were made to regenerate efficiency of recovered catalyst by adding new dye molecules. When calculating relative catalytic efficiency, in terms of turnover number, all recovered and regenerated catalysts maintained original efficiency of fresh samples.



Catalyst sample	% removal of 2-Chlorophenol	T.N (10 ³)	T.F (10 ³)
Fresh catalyst	64	2	0.01
Recovered catalyst	41	1.5	0.0125
Re-dying recover catalyst	50	1.87	0.015

Results & Discussion

-Comparison between Sensitized ZnO/Clay catalyst and non-sensitized ZnO/Clay photo catalysts

ZnO semiconductor has wide band gap (3.2 eV). Therefore, it can oxidize organic pollutants to simple non-toxic molecules. However, ZnO demands UV regions of solar light, which limits its degradation activity to only 4% of fallen sunlight. Using alternative smaller band gap semiconductor is unfavorable due to its instability. In this work, Anthocyanin dye was used to improve ZnO catalyst properties. Anthocyanin has a medium band gap of 2.3eV and absorbs visible regions of fallen sun light. This leads to electron-hole generation in the dye molecule. The electrons move from dye LUMO to ZnO conduction band, lead to generation of oxygen radical which reacts with hydrogen to produce hydroxyl radicals that oxidize the pollutant. Thus dye-sensitized composite ZnO/Clay catalyst uses both UV (by ZnO) and visible (by dye) regions together. This increases its photo catalytic degradation activity.

This explain the increase in photo-degradation of 2CP pollutant when Anthocyanin/ZnO/Clay catalyst was used, indicates that anthocyanin-sensitization improved activity of the supported catalyst by ~ 10%.

-Recovery of the ZnO/Clay catalyst and sensitized ZnO/Clay catalyst

- The ability of catalyst recovery and reuse in photo-catalytic reactions is an important characteristic. This can contribute significantly to lowering the cost of water treatment processes, and prevents further water contamination.
- After the end of the photo-degradation reaction, the treated mixture was filtered, and catalysts were collected and reused for fresh reactions, following the same procedures. In another experiment the filtered sensitized composite catalyst was re-dyed in attempt to restore its efficiency as photo-catalyst under direct sun light.
- The recovered composite catalyst used showed good but decreased efficiency (~41%) loss of 2CP. Re-dying the used catalyst was found to restore its efficiency to (~50%) loss of 2CP in each run. The lowering in contaminant removal by recovered catalyst is due to loss of catalyst while recovery.
- Asper catalyst efficiency, in terms of T.N and T.F, the catalyst did not lose its efficiency on recovery and reuse,



MSc/ Photo-mineralization of aqueous gram positive and gram negative bacteria together with their organic components using sensitized ZnO nano-particles.



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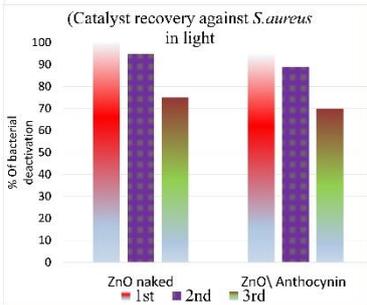
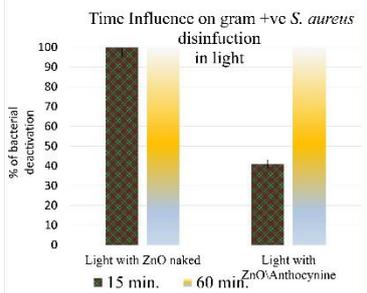
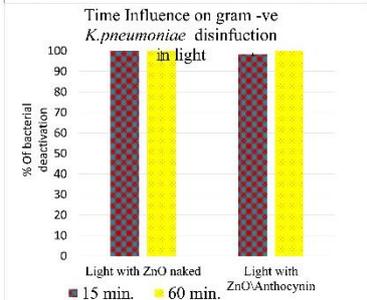
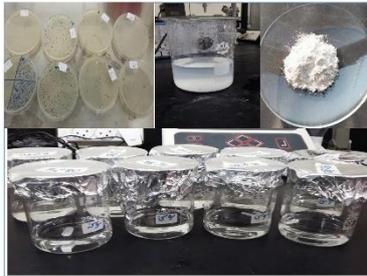
Abstract

Water purification and disinfection is becoming a necessity of life. Different strategies are followed for water purification, the best one is the one with higher efficiency, safety and low cost.

Photo-degradation is one of the most attractive methods. It involves excitation of the suitable semiconductor by light, followed by degradation of biological and chemical contaminants in water. ZnO nano-particles are being used for photo-degradation of widely spread water organic contaminants. Due to its wide broad band gap (~3.2 eV), ZnO photocatalytic activity is limited to shorter wavelengths which located in UV region. As only ~4% of the solar spectrum falls in the UV region, smaller band gap natural dyes, such as natural dyes (Anthocyanin) are examined to sensitize ZnO particles for visible solar light.

In this work disinfection of water by complete killing and degradation of gram positive and gram negative bacteria, together with their organic components, using ZnO nano particles (ZnO NPs) was investigated. ZnO NPs are known as antibacterial agents, noxious to microorganisms, and hold good biocompatibility to human cells. Both naked ZnO and ZnO\Anthocyanin are tested here against gram negative *Klebsiella pneumoniae* and gram positive *Staphylococcus aureus* bacteria by using direct solar light simulator.

The efficiency of ZnO-NPs was documented here, using both synthesized and commercial ZnO-NPs, with and without anthocyanin dye sensitizer under sun light simulator were used for killing bacteria, finding that after 30 min. gram+ *S. aureus* and gram - *K. pneumoniae* bacteria were totally killed with 100% killing percentage. While after 3 hrs. 98.7% of gram+ *S. aureus* and 45.2% of gram - *K. pneumoniae* bacteria organic matters were degraded by using ZnO-NPs.



Results & Discussion

Complete mineralization of gram-negative bacteria with large polysaccharide capsule *K. pneumoniae* and gram-positive with non-moving small round shaped *S. aureus* are investigated by photodegradation. Naked and sensitized ZnO NPs are being used under simulated sun light.

Methodology:

ZnO nanoparticles were prepared by precipitation method. Aqueous solution of $Zn(CH_3COO)_2$ was added dropwise over a period of 40 min to the heated 0.9 M NaOH solution with vigorous magnetic stirring. Then white fine ZnO nanoparticles were precipitated.

Results:

- The results show that direct solar light with safe, economic and available ZnO NPs catalyst can completely (100%) deactivate G +ve *S. aureus* and G -ve *K. pneumoniae* bacteria in both dark and light experiments.
- Under light, complete mineralization (TOC) bacteria occurs for *S. aureus* (99%) and *K. pneumoniae* (45%), as observed for the first time.
- ZnO catalysts also can be recovered and reused for second time without loss of relative activity.
- For future work, applying the ZnO catalyst against other types of bacteria and other species such as hazardous viruses and fungi, is strongly recommended. Studying the impact of presence of other ions inside water, such as Zn^{2+} , Ca^{2+} and Mg^{2+} on the water disinfection is also worthwhile. therefore, using the described strategy in Palestine and other countries, in addition to, Pilot plant study on naturally polluted water is highly recommended.

Key Words: ZnO nano-particle photocatalysis; Solar light; Gram-negative and gram-positive bacteria; Inhibition & photo-mineralization.

Acknowledgement: Financial support from An-Najah N. University and from MEDRC is acknowledged. Technical help from PTU (in TOC measurement) and UAE University (for measuring XRD and SEM) is also acknowledged.



Status of Water Governance in View of the Water Service Providers in the West Bank



Suhad Baerat
Dr.Fayez Freijeat

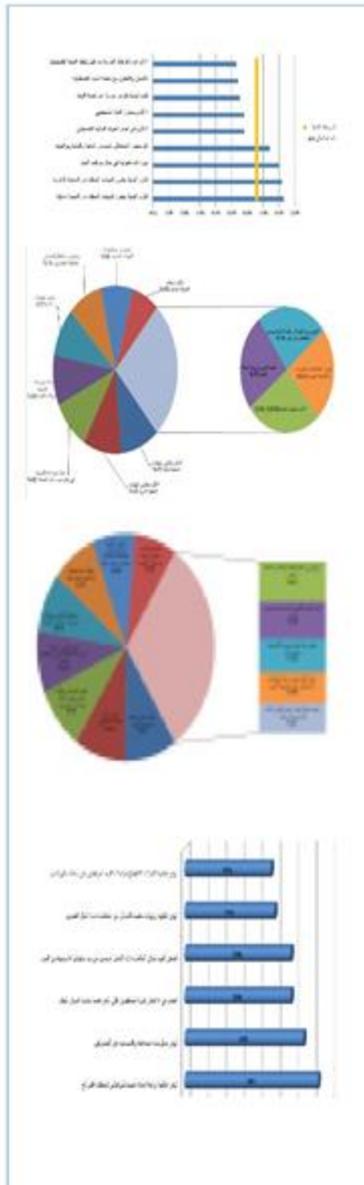


Abstract

Research Background: This study has been conducted in the period between April 2013 and June 2014. The main aim of this study was to status of water governance in view of the water service providers in the west bank, and the providing mechanisms that may contribute to and support adopting the principles of water governance by the Palestinian institutions, and identifying the status of the water governance in the institutions that deal with water in the West Bank, the level of applying these principles of water governance in these institutions, and the identification of the situation of water service management in the institutions that deal with water in the West Bank. The main assumption of this study is that the implantation the water governance principles may have a positive financial, technical and administrative impact on the management of water service.

Methodology: The data used in this study have been collected by reviewing reports and documents pertaining to the water sector in Palestine as well as the scientific literature that has been published in this field. The study was also based on a questionnaire that was aimed at collecting data from its primary source within the frame work of the study area and within the community of that area. Data was analyzed statistically using SPSS in order to evaluate the situation and to achieve the goals of the study.

Area of study: The study mainly focused on the 54 municipalities that supplied with water by the West Bank Water Department. The WBWD is responsible for the operation and maintenance of all Palestinian bulk water supply and distribution systems and hence for the trans-regional distribution of water resources



Results & Discussion

The study concluded among which are that firstly the level of implementation of law enforcement, transparency, effective and efficiency is moderate, secondly and the level of implementation of the principle of justice and equity was poor, thirdly the level of services providing of citizen was poor in term of financial, technical and administrative aspects, and lastly the implantation the of water governance principles may have a positive impact on financial, technical and administrative aspects of the management water service.

Recommendations:

The study recommended to:

1. Establish a committee from the institutions that deals with water sector whose goals are to formulate a strategy for water governance.
2. Propagate the water governance culture in all institutions of the water sector.
3. Review of all legislations that regulate the water sector, and explain that to every one working in water sector.
4. Promote transparency through publications and a unified website for all municipalities that illustrates the water situation of each water cluster.
5. Achieve social justice in terms of water distribution and water quotas.
6. Find a mechanism in cooperation with the Ministry of Local Governance and other related ministries that would oblige the local bodies to pay for the water.
7. Provide necessary institutional, administrative and technical support to municipalities.





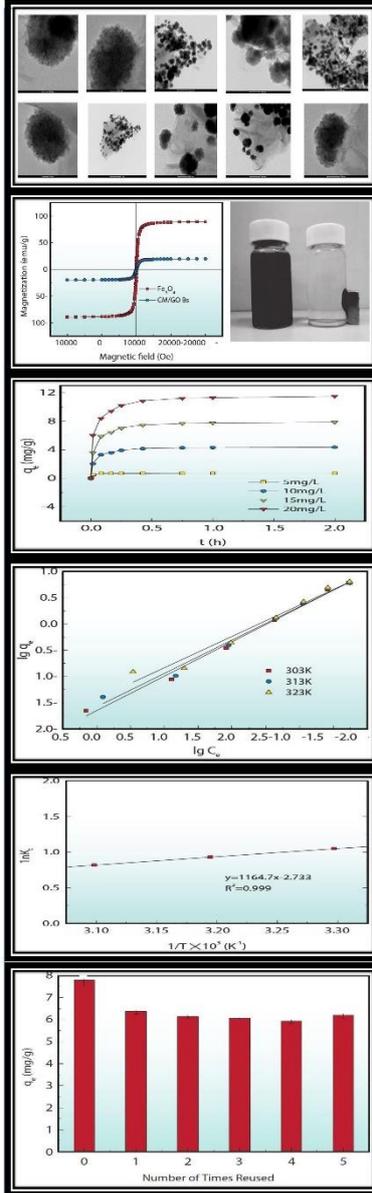
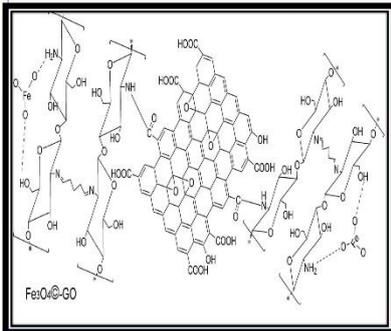
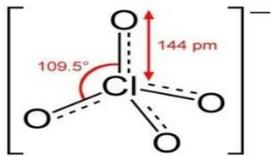
Efficiency of Magnetic Chitosan Supported on Graphene for Removal of Perchlorate Ions from Wastewater

Prepared : *Mahmoud Shawqee Shawahny*
Supervised : *Proff. Shehdeh Jodeh*



Abstract

One of an emerging trace contaminants is perchlorate that has been detected in surface water, ground water, soil and food globally. Cross linked Magnetic Chitosan / Graphene Oxide Beads (CM/GO Bs) were synthesized and tested to remove perchlorate anions from waste water. The complex was characterized by transmission electron microscopy, Fourier Transformation Infrared spectroscopy and vibrating sample magnetometry. The effect of pH, contact time, co-existing anions and temperature on adsorption was investigated. Particles could be recovered easily by external magnetic field because they were super-paramagnetic. The CM/GO Bs complex could adsorb perchlorate in a wide range of pH from 4 to 10 . Co-existing anions may inhibit the adsorption of perchlorate on CM/GO Bs. Kinetic data were well fitted to the pseudo-second-order model. The enthalpy and negative gibbs standard free energy show that the adsorption process was exothermic and spontaneous . the exhausted adsorbent can be regenerated well by 0.1% NaCl solution.



Results & Discussion

The CM/GO Bs complex could adsorb perchlorate efficiently at a wider range of pH than raw chitosan which was from 4 to 10. Co-existing anions, especially SO_4^{2-} , will affect the perchlorate adsorption onto CM/GO Bs. The adsorption data fitted the pseudo-second-order model. In addition, Langmuir and Freundlich isotherms followed the equilibrium data well. The enthalpy and Gibbs standard free energy showed that the adsorption process was exothermic and spontaneous

Perchlorate adsorption on CM/GO Bs was a complex chemical and physical adsorption

The exhausted adsorbent could be regenerated efficiently using NaCl eluent.

T(K)	Q ₀ mg/g	B L/mg	R ²
303	28.153	0.068	0.913
313	28.352	0.062	0.897
323	26.455	0.061	0.910

Langmuir Adsorption Isotherm

C ₀ mg/L	K ₁ h ⁻¹	R ²	K ₂ g/mg.h	R ²
5	0.991	0.635	269.550	0.999
10	0.446	0.607	12.919	0.999
15	0.448	0.641	8.017	0.999
20	0.392	0.693	3.780	0.999

Adsorption Kinetics

T(°C)	K	q ₀ (g/mol)	H ₀ (K/mol)	S ₀ (mol K)
303	2.852	-2.883	-8.773	-22.821
313	2.768	-2.405	-8.773	-22.821
323	2.294	-2.251	-8.775	-22.821

Adsorption Thermodynamics



Characterization and treatment of Al-Menya Landfill leachate

Using Biological and Physical Method

Student Name: Ala' Abuayyash
Supervisors: Dr. Mohammad Qurie



Abstract

Sanitary landfill is the most common way to eliminate solid urban wastes. Al-Menya is Palestinian sanitary landfill located in south West Bank. The most disadvantages of Al-Menya sanitary landfill is leachate production as results of solid waste compacted. Leachate is a complex liquid that contains many contaminants and excessive concentrations of biodegradable and non biodegradable products including organic matter, phenols, ammonia nitrogen, phosphate, heavy metals, and sulfide. If not properly treated and safely disposed, landfill leachate could be an impending source of surface and ground water contamination as it may percolate throughout soils and sub soils, causing adverse impacts to receiving waters.

Al-Menya landfill leachate is classified as young leachate according to BOD, COD and solids analysis. The BOD/COD ratio shows indicated the possibility of biological treatment. The heavy metals concentrations were variation in leachate samples because there different solid waste types as metal electroplating, as stabilizers or pigments in plastics, batteries and alloys as a result of no complete waste separation stage. The concentration of Cr and Ni is the highest concentration with higher than 5 ppm where as the Ag and Pb below the detection limit.

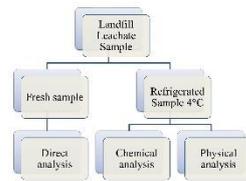
The primary treatment and biological treatment using SBR shows 88%, 95%, 100% and 96% removal for COD, TSS, Ammonia nitrogen and phosphate. The final stage of treatment included the advanced membrane technology (UF and RO). The treatment of SBR effluent using UF unit shows highly efficient of UF unit for TSS, Nitrate, and phosphate. Al, Zn, removal with (100%), (98%), (95%), (100%), (82%), respectively. The heavy metals were partial removal, the Al was complete removal where as Cr concentration shows no different concentration. An efficient removal ranging between 97-100% were observed for COD, Ammonia-Nitrogen, TSS, Al, K and Na using RO unit whereas Cr and Cd still have high concentration.

Key words: Sanitary Landfill, Leachate, Biological Treatment, Physical Treatment, Sequence Batch Reactor, solid waste management.

Results and Discussion

Al-Menya leachate samples were taken during the years 2014 and 2015.

The number of leachate samples were 6 taken directly from the pool influent without consider the seasonal parameter. 3 - samples were taken for triplication.



Leachate Sample, Effluent from SBR, RO Effluent, UF Effluent

Table 5. The average physical and chemical characteristics of influent and effluent leachate samples after completed biological treatment using SBR cycle. The total time (8 hrs) , filling time: 1hr , reaction time: 3hrs, settling time: 2hrs, decantation time: 1hr, and idle time: 1hr. Under HRT: 1.5 day and temperature: 25°C.

Characteristic	Influent	Effluent (Bio)	removal %
COD (ppm)	11000 ± 400	1330 ± 0.0	(88%)
TSS (mg/l)	2500 ± 5	124 ± 0.5	(95%)
Ammonia-Nitrogen (mg/l): NH ₃ ⁺ -N/NH ₄ ⁺ /NH ₃	0.48 / 0.62 / 0.58 ± 0.1	0.0	(100%)
Nitrate: (mg/l) NO ₃ ⁻ / N/NO ₃ ⁻	19.57 / 4.4 ± 0.0	13.00 / 3.0 ± 0.0	(34%) / (32%)
Phosphate (mg/l)	8.00 ± 0.0	0.289 ± 0.0	(96%)
Na (mg/l)	5700 ± 0.1	730 ± 0.0	(87%)
K (mg/l)	1000 ± 0.0	659 ± 0.0	(34%)

Results and Discussion

Table 7. Physical treatment effluent and percentage removal using Ultrafiltration

Characteristic	Influent	Effluent (UF)	Removal %
COD (ppm)	11000	975	91%
TSS (mg/l)	2500	0.0	100%
Ammonia-Nitrogen (mg/l): NH ₃ ⁺ -N/NH ₄ ⁺ /NH ₃	0.48 / 0.62 / 0.58	0.0	100%
Nitrate: (mg/l) NO ₃ ⁻ / N/NO ₃ ⁻	19.57 / 4.4	0.3 / 0.1	98% / 98%
Phosphate (mg/l)	8.00	0.122	95%
Na (mg/l)	5700	338.68	94%
K (mg/l)	1000	377	62%
Al (mg/l)	3.86	0.531	100%
Cd (mg/l)	3.66	3.64	0.55%
Zn (mg/l)	3.37	0.622	82%
Ag	***	***	***
Cr	5.22	5.07	3%
Cu	0.643	0.393	39%
Ni	5.15	5.23	***
Pb	***	***	***

Table 8. Physical treatment effluent and percentage removal using Reverse Osmosis

Characteristic	Influent	Effluent (RO)	removal %
COD (ppm)	11000	345	97%
TSS (mg/l)	2500	0.0	100%
Ammonia-Nitrogen (mg/l): NH ₃ ⁺ -N/NH ₄ ⁺ /NH ₃	0.48 / 0.62 / 0.58	0.0	100%
Nitrate: (mg/l) NO ₃ ⁻ / N/NO ₃ ⁻	19.57 / 4.4	5 / 1.1	74% / 75%
Phosphate (mg/l)	8.00	0.490	95%
Sodium (mg/l)	5700	136	98%
K (mg/l)	1000	9.47	99%
Al (mg/l)	3.86	0.08	100%
Zn (mg/l)	3.37	1.19	68%
Ag	***	***	***
Al	3.86	***	***
Cd	3.66	3.63	0.8%
Cr	5.22	4.88	7%
Cu	0.643	0.089	86%
Ni	5.15	4.93	4%
Pb	***	***	***

Acknowledgment:

A.A and M.Q. thanks Palestinian Water Authority for there support to start this study, represented by The Middle East Desalination Research Center (MEDRC). Also, thanks Al- Menya sanitary landfill Administration for helping in leachate sampling and information.





Reverse osmosis membrane fouling reduction using Kinetic Degradation Fluxion Media

Student name: Rawan Abu Eisheh
Supervisors: Dr. Jawad Shoqier



Abstract

Nowadays reverse osmosis is one of the most used technologies for water treatment and it is a favored method for potable water production from seawater. However, membrane fouling is a critical problem associated with reverse osmosis (RO) plants, since it has many negative impacts on RO efficiency, effectiveness and operation costs. Moreover, membrane cleaning techniques used to overcome fouling reduce the membrane life time, and sometimes it damage the membrane, also these techniques may create environmental issues related to the waste chemical disposal.

Generally, membrane life is a function of feed water source, pretreatment, frequency of cleaning, system design, and operating conditions. Pretreatment is a key step in RO plants, it involves proper techniques that can change the characteristics of RO feed water, so RO systems must be protected from biological contaminants, the potential for scale formation, and excessive fouling. In case pretreatment was inadequate, higher frequency of cleanings will be necessary, and the membrane performance will be dropped which will lead to complete failure of RO system. Chemical pretreatment can be performed by adding anti-scaling, this practice can probably be optimized in terms of anti-scalant type and dosage rate, but it will remain problematic for operators, plant management, cost and environment. Therefore, an intense research work is being done to develop new pretreatment methods, called non-conventional or emerging techniques, more efficient and more environmental safe, most of these techniques are physical involve applying magnetic field, electric field, ultrasonic and adding proper metal ion like copper (Cu(II)) and zinc (Zn(II)). It has been proven in many fields of water treatment that the use of Kinetic Degradation Fluxion (KDF) media can improve feed water characteristics; using KDF in water treatment systems removes chlorine, chloramines, iron, lead, bacteria, hydrogen sulfide, and other contaminants from the water supply. It also reduces scale and hardness. In this study the effectiveness of applying KDF media as pretreatment step in RO system for membrane fouling reduction was investigated, depending on the reduction in the salt rejection and permeate flow.

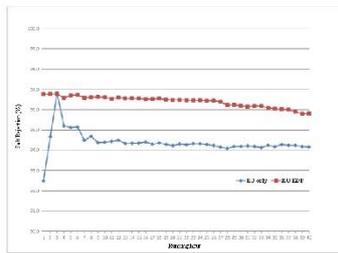
Keywords: reverse osmosis, KDF media, membrane fouling, pretreatment, antiscalant.

Results and Discussion

• RO membrane performance parameters in scaling experiments

1. Salt rejection

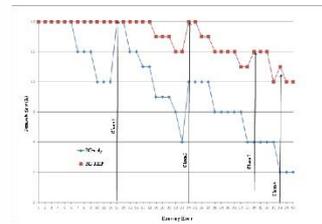
In CaCO₃ experiments 1349L were filtered by KDF media, no change on water composition was occurred, from the permeate flow results it is concluded that the KDF media improved the efficiency of the membrane by prevent the formation and accumulation of mineral hardness scale, primarily calcium carbonate. KDF media alters the morphology of insoluble CaCO₃ crystals to relatively small, evenly shaped, and rounded grains that won't adhere to surfaces and can be removed, therefore the RO-KDF fouling was reversible while the fouling in the RO-only converted to irreversible by the third time of backwashing, on the other hand the permeate flow rate in the RO-KDF was higher than that in RO-only system because the blockage of the membrane surface by lateral growth of the scaling on the membrane was less than the blockage of the RO-only membrane.



Figure(1): Salt rejection obtained by RO-only and RO-KDF systems in scaling experiments.

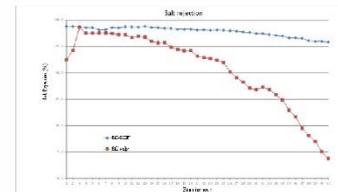
2. Permeate flow

In RO-only system after 40 running hours the permeate reduction was 41%, while it was only 16% for RO-KDF.



Figure(2): Permeate flow obtained by RO-only and RO-KDF systems in scaling experiments.

• RO membrane performance parameters in Chlorine experiments



Figure(3): Salt rejection obtained by RO-only and RO-KDF systems in chlorine experiments.

1. Salt rejection

In RO-only system within the 41th running hour the salt rejection was 75.7% with 26.3% reduction while it was 95.8% in RO-KDF system.

Results and Discussion

1- Scaling experiments

In CaCO₃ experiments 1349L were filtered by KDF media, no change on water composition was occurred, from the permeate flow results it is concluded that the KDF media improved the efficiency of the membrane by prevent the formation and accumulation of mineral hardness scale, primarily calcium carbonate.

KDF media alters the morphology of insoluble CaCO₃ crystals to relatively small, evenly shaped, and rounded grains that won't adhere to surfaces and can be removed, therefore the RO-KDF fouling was reversible while the fouling in the RO-only converted to irreversible by the third time of backwashing, on the other hand the permeate flow rate in the RO-KDF was higher than that in RO-only system because the blockage of the membrane surface by lateral growth of the scaling on the membrane was less than the blockage of the RO-only membrane.

The KDF media was damaged rapidly in CaCO₃ experiments. During the 40 running hours 10 discs of KDF media were fully oxidized, with average 4 hours only for each one which is considered as short lifetime.

2. Chlorine experiments

KDF redox media is unique combination of copper and zinc that creates an electro-chemical reaction. During this reaction, electrons are transferred between molecules, and new elements are created. Some harmful contaminants are changed into harmless components. Free chlorine is changed into benign, water-soluble chloride, then the concentration of Cl₂ in the feed solution contacted with membrane is reduced.

From the 11 discs of the KDF media only one was oxidized by chlorine during the 41 running hours with 1237L of high chlorinated feed solution passed through it.

Acknowledgment

I would like to express my sincere gratitude to my supervisor Dr. Jawad Shoqier for his guidance, and I am thankful for Palestinian Water Authority represented by the Middle East Desalination Research Center (MEDRC) for their continuous support for my study.





Techno-economic Evaluation of BWRO Systems for Brackish Water Desalination in the Jordan Valley

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Abstract

Due to the brackish water nature of ground and limited access to fresh water resources, few Brackish Water Reverse Osmosis (BWRO) desalination plants were constructed in the Jordan Valley. The aim of this study is to evaluate the techno-economic feasibility of these water treatment facilities, with focus on factors affecting the unit cost of desalinated water and coupling solar photovoltaic (PV) to BWRO desalination unit.

The analysis results revealed that the unit product cost (UPC) of Marj Na'aja BWRO unit is \$0.245 /m³ and is capable of producing water in the range of \$0.21-\$6.54 /m³, depending on the plant size, power source and cost. The cost breakdown results of Marj Na'aja unit showed that energy, material, labor, and capital costs account for 64%, 4%, 20% and 12% of the total costs, respectively.

Research Questions and Objectives

- Research Questions**

What are the key considerations in BWRO desalination projects in the Jordan Valley to define the best practices to be applied to reduce the cost of desalination?
 What are the effects of applying various sources of power (electricity and solar energy) in RO desalination plants on the unit cost of desalinated water?
 What are the factors that affect the unit cost of desalinated water in the Jordan Valley?
- Research Objectives**

This research aims to highlight the applicability of RO desalination systems to overcome the water issues in the Jordan Valley. Consequently, this research is intended to evaluate cost and performance of various sources of power (electricity and solar energy) in order to enable an effective comparison of different alternatives. Moreover, this research intends to study the effect of different parameter (e.g. feed salinity, electricity cost, interest rate, etc.) on the unit cost of desalinated water.

Methods

As a first step, the research highlights the current water and energy issues in the Jordan Valley. Field data was collected by a comprehensive survey, as a form of personal interviews with RO plants operator. In the evaluation process, local data and assumptions from pervious literature were used. The cost data include site-specific feed intake, pretreatment, post-treatment, site development and concentrate treatment costs, RO replacement, water transport costs, etc.

In order to perform the cost comparison, the Desalination Economic Evaluation Program (DEEP) was used. DEEP was used to evaluate the performance and the cost of various water and power co-generation configurations. The results were used to hold a comparison of a large number of design options and scenarios on a consistent basis with common assumptions.

In this study, three scenarios were analyzed economically. The first case was analyzed by taking the present situation in Marj Na'aja BWRO unit as the base case. The second scenario was to analyze the option of coupling solar energy to the BWRO unit in Marj Na'aja. And the third scenario was the small scale Al-Zubiedat BWRO unit- powered by PV. Besides, sensitivity analyses were carried out by changing several important parameters that could potentially have a major influence on the UPC. Those parameters are plant water capacity, electricity cost, interest rate, plant availability, feed water salinity, and feed water temperature. These analyses will be carried out to permit deep understanding of possible trends in the cost of desalinated water as the mentioned factors change. The common approach is to choose a base case scenario of input values and to change one factor, while holding all other input variables constant.

Results

Case 1: Marj Na'aja BWRO unit powered by a conventional energy sources- present situation
 The UPC is found to be 0.245\$/m³, this value is lower than the value given by Abu-Alhaja, 2015, which is \$ 0.346 /m³. However, the calculated UPC value is in agreement with the value estimated by Karagannis and Soldatos, 2008, with UPC value ranged between \$0.26-\$1.33/m³ for brackish water desalination. Miller, 2003; and Sethi, 2007 also have found that the UPC ranges between \$0.10/m³ - \$1.00/m³. Whereas, the UPC of Marj Na'aja BWRO is lower than the cost trends for BWRO desalination units provided by Jaber and Ahmed, 2004. They reported that for BWRO units with capacity range between 20-1200 m³/d, the cost may vary from \$0.78- \$1.23/m³. This shows the variation in the reported UPC values in literature. The estimated UPC is less than the water selling price in The Jordan Valley which is around \$0.41 /m³, this indicate that applying RO technology for brackish water desalination is a feasible option.

It is also noticed, that Marj Na'aja BWRO exhibits a low capital costs, (12 % of the total cost). This is contributed to the lower operating pressures required for the low salinity feed, therefore, equipment costs are low. The highest percentage in the cost breakdown is energy cost (64%). If the cost of electricity decreases, from \$ 0.15 /kWh to \$ 0.1/kWh, the UPC will be decreased potentially by 23 %. However, it has been reported, that the power cost of typical brackish water RO represents only 11% of the total cost, and the largest costs are fixed costs at 54% (Miller, 2003).

Case 2: Marj Na'aja BWRO unit powered by the solar PV cells
 The resulted installation cost of the PV system found to be \$230,651.8. Under case 2, the capital cost percentage increased up to 76% of the total cost compared to 12% of case 1. The UPC of the desalinated water by Marj Na'aja unit coupled with PV cells became \$0.423/m³. This UPC found to be relatively high when compared to the first case despite the reduction in energy costs. Yet again this is attributed to the high equipment and installation costs of the PV cells.

Sensitivity Analysis

-Effect of purchased electricity cost on UPC
 The effect of the cost of purchased electricity consumed by pumps and other components in the BWRO on UPC was studied. The results obtained from the analysis were presented in Figure 11. The analysis shows that increasing the electricity price from \$0.08 up to \$0.10 per kWh will increase the UPC by about 13%.

-Effect of water capacity on UPC
 The sensitivity of UPC to the specific capacity of water plant was established and represented in Figure 12. The trend shows the decrease on UPC as the water capacity of the plant increases. It was found that UPC decreased by 6 %, when the plant capacity increased from 1320 m³ to 2000 m³. Moreover, the effect of smaller plant capacities on UPC is major represented by the steep slope of the curve at the start. For example, if the plant capacity is increased from 100 m³/d up to 200 m³/d the decrease on UPC is about 38 %.

Conclusions

- Energy is certainly the most significant item and has a significant effect on UPC for electricity powered BWRO desalination unit, where, energy represents 64% of the total cost in Marj Na'aja unit powered by electricity.
- The cost of the small scale BWRO desalination units is higher than the larger ones. The estimated UPC found to be between \$0.514-\$6.54 /m³ for desalination plant with capacity ranges between 10- 200 m³, while for capacity ranges between 300-5000, the estimated UPC was between \$0.409-\$0.21/m³.
- Sensitivity analysis results indicate that for high capacity BWRO units, the economy of scale is only a few percent of the UPC. This effect is higher for lower size plants. Moreover, increasing interest rate will increase UPC. While increasing plant availability or feed water temperature will reduce UPC.

Future Directions

- Focused research on optimizing the PV cells to use the solar energy should be a significant boost to the BWRO powered by those cells.
- The suggested key considerations should be translated into action plans.
- The option of combining power plant for energy generation to a large-scale desalination plants should be investigated.

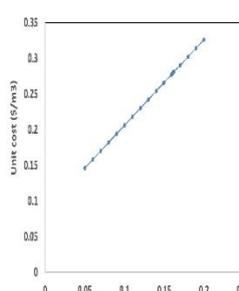


Figure 1: Effect of purchased electricity cost on UPC

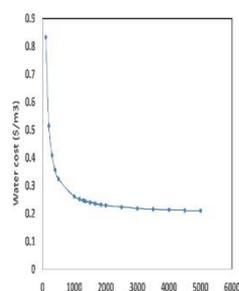


Figure 2: Effect of the water capacity of the units on UPC

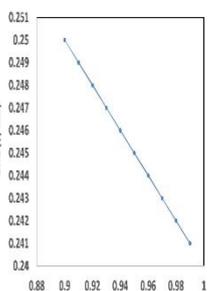


Figure 3: Effect of the plant availability on UPC

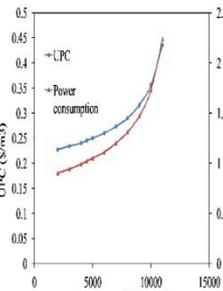


Figure 4: Effect of the water salinity of the units on UPC

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Impact of Irrigation with Desalinated Brackish Water on the Productivity and Fruit Quality of Tomato Crop Planted in Heavy Saline Soil at Marj Na'aja Village

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Research Background: Agricultural wells salinization is a major problem facing the agricultural sector in Palestine Over the past 3 decades, agricultural wells salinity has raised from 570 ppm in 1967 to reach 4500 ppm in 2012. The water salinity in the Jericho district is still under control but due to the excessive agriculture, over pumpage, excessive use of fertilizers and pesticides the problem will become more severe unless some strike management had been done. In 2012, the Ministry of Agriculture has installed a small desalination unit with a total capacity of 60 m³/hr and electrical conductivity of 200 ppm to be used for agricultural purposes. The main objective of the study is to assess the impact of using desalinated, blended, and raw brackish water on the heavy saline soil fertility, the tomato crop productivity, and tomato fruit quality.

Methodology: an experiment was conducted in field of the farmer. Tomato plant, which is commonly used by farmers. The tomato crop was planted in the green house in mid-October 2013; the soil type is clay loam with Ec 7.4 dS/m which is classified as heavy saline soil. Crop was irrigated with four types of Desalinated water: 1) raw saline water with TDS 4500 ppm (T4), 2) desalinated water with TDS 200 ppm (T1), 3) blended water with TDS 750 ppm (T2), 4) blended water with TDS 1600 ppm (T3).The randomized plot design was used, with three replicates water type, each replicate consisting 7 m raw. Planting spacing was 0.8 m within rows and 0.8 m between rows

Area of study (Marj Na'aja):

Marj Na'aja village located to the Northern part of the Jordan Valley (32° 10' 56.74 N, 35° 10' 28.33 E) and about 40 km north to Jericho, and lays 270 m below sea level. The climate of the region is hot and dry in summer and warm to moderately cool in winter. The cropping pattern is mainly vegetables and some date palm and field crops, the total cultivated lands equal 111.3 hectare in which 93% of it is cultivated by vegetables. In the past there were 6 wells were used for irrigation (before 1975). All of these wells are now suffering from salinity problems at different levels, now a days only two out of six wells are used for irrigation.



Map 1: Study Location , Marj Na'aja, West Bank

Table 1: Effect of Irrigation with Different Desalination Levels on Tomato Plant Growth at Different Plant Growth Stages

Treatments	Developmental Stage			Maturity Stage			Harvest Stage		
	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage
Desalinated water with TDS 200 ppm (T1)	1.45 ^a	1.83 ^a	2.27 ^a	4.67 ^a	7.45 ^a	8.62 ^a	1.28 ^a	2.48 ^a	1.00 ^a
Blended water with TDS 750 ppm (T2)	1.75 ^a	2.19 ^a	2.66 ^a	7.03 ^a	8.28 ^a	8.41 ^a	1.17 ^a	1.28 ^a	1.00 ^a
Blended water with TDS 1600 ppm (T3)	1.80 ^a	2.34 ^a	2.57 ^a	7.12 ^a	8.97 ^a	9.35 ^a	1.17 ^a	1.58 ^a	1.00 ^a
Raw saline water with TDS 4500 ppm (T4)	1.28 ^b	1.68 ^b	2.10 ^b	5.07 ^b	7.21 ^b	7.75 ^b	1.00 ^b	1.50 ^b	1.00 ^b

Table 2: Effect of Irrigation with f Different Desalination Levels on Tomato Plant Growth at Different Plant Growth Stages

Treatments	Developmental Stage			Maturity Stage			Harvest Stage		
	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage
Desalinated water with TDS 200 ppm (T1)	1.00 ^a	2.00 ^a	1.30 ^a	0.81 ^a	0.80 ^a	1.00 ^a	2.00 ^a	2.00 ^a	2.00 ^a
Blended water with TDS 750 ppm (T2)	1.00 ^a	2.00 ^a	1.17 ^a	0.94 ^a	0.94 ^a	1.04 ^a	2.00 ^a	2.00 ^a	2.00 ^a
Blended water with TDS 1600 ppm (T3)	1.00 ^a	2.00 ^a	1.08 ^a	1.00 ^a	1.00 ^a	1.04 ^a	2.50 ^a	2.50 ^a	2.00 ^a
Raw saline water with TDS 4500 ppm (T4)	1.11 ^a	2.00 ^a	1.00 ^a	1.11 ^a	1.11 ^a	2.00 ^a	2.47 ^a	2.47 ^a	2.00 ^a

Table 3: Effect of Irrigation Water of Different Desalination Levels on Tomato Plant Growth at Different Plant Growth Stages

Treatments	Number of flowers per plant			Number of fruits per plant			Fruit Weight (kg)			Leaf Area Index			Average Production per plant (kg)
	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage	Developmental Stage	Mid Stage	Late Stage	
Desalinated water with 200 ppm (T1)	11.59 ^a	6.13 ^a	7.92 ^a	7.50 ^a	12.30 ^a	6.11 ^a	98.22 ^a	90.87 ^a	90.17 ^a	1.68 ^a	1.52 ^a	1.55 ^a	12.16 ^a
Blended water with 750 ppm (T2)	13.47 ^a	7.93 ^a	8.50 ^a	10.14 ^a	12.87 ^a	7.06 ^a	137.06 ^a	131.97 ^a	120.14 ^a	2.33 ^a	2.23 ^a	2.34 ^a	20.03 ^a
Blended water with 1600 ppm (T3)	12.08 ^a	8.27 ^a	8.44 ^a	9.44 ^a	13.40 ^a	7.56 ^a	123.56 ^a	120.47 ^a	112.06 ^a	2.62 ^a	2.44 ^a	2.59 ^a	18.76 ^a
Raw saline water with TDS 4500 ppm (T4)	11.72 ^a	9.83 ^a	12.58 ^a	8.11 ^a	14.03 ^a	8.80 ^a	75.39 ^a	80.80 ^a	86.92 ^a	1.37 ^a	1.19 ^a	1.36 ^a	13.16 ^a

Table 4: Effect of Heavy Saline Soil Nutrient Content on Plant Productivity and Fruit Quality irrigated with different desalinated water

Treatment	Soil Parameter ^a						Fruit Parameters			
	N	P	K	Ca	EC	pH	Average Production /plant	pH	TSS	EC
Before irrigation (blank):	24.5	31.25	111	485	7.4	8.3				
At the end of the planting season:										
Desalinated water with TDS 200 ppm (T1)	10	17	65	108	1.87	8.15	12.16 ^a	4.2 ^a	5.2 ^a	5.1 ^d
Blended water with TDS 750 ppm (T2)	13	22	78	264	3.11	8.07	20.03 ^a	4.2 ^a	6.1 ^a	7.1 ^b
Blended water with TDS 1600 ppm (T3)	15	24	89.5	383	4.13	8.05	18.76 ^a	4.1 ^b	5.4 ^b	5.3 ^c
Raw saline water with TDS 4500 ppm (T4)	18	27	95.5	385	4.47	8.01	13.16 ^b	4.0 ^b	6.2 ^a	7.7 ^a

^a Parameters are in ppm, except EC, (EC: TSS (%)) and pH.
^b Letters represent statistical groups (a=the highest value, d=the lowest) (p<0.05).

Results:

In this research the results show that irrigating heavy saline soil with desalinated water has detrimental effects on the soil fertility, tomato plant productivity and fruit quality as it decrease dramatically as water salinity decrease. Therefore, negative aspects had been alleviated by irrigating with blended water that has positive effects on soil fertility and tomato plant productivity and fruit quality

1. The heavy saline soil macronutrient content (N, P, K, and Ca) decrease with decreasing the water salinity, the decrease ranges from 45-77% and the highest decrease was for the Ca.
- 2- Desalinated water, and raw saline water, gave the lowest level of tomato crop production with only 12 kg, and 13 kg respectively; when it is grown in heavy saline soils this effect can be alleviated by irrigation with blended water.
- 3- Irrigating heavy saline soil with raw saline water and blended water with TDS 750 ppm gave the best fruit quality results, while desalinated water gave the lowest fruit quality

Recommendations:

Based on the results of this research several issues still need to be further investigated. Specifically it is recommended to: Plant more than one season to measure the long effect of desalinated water on the fertility of heavy saline soil and plant growth.

Measure the effect of the desalinated water on the soil and water movement in heavy saline soil within soil profile. Study the amount of fertilizers needed under different water salinity levels.



Modeling of Solar Still Enhanced with Evacuated Tube Collectors for Brine Volume Reduction from Reverse Osmosis Plants

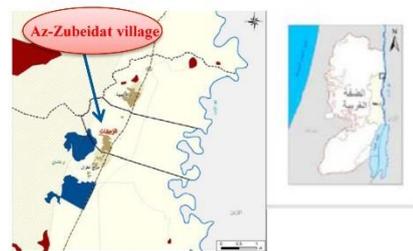
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¹An-Najah National University

Research Background: Brine discharge is generally up to 40% and 90% of the intake flow rate for Desalination membrane and thermal based technologies, contains a high percentage of salts and dissolved minerals (TDS>35000 mg/L). World is trying to minimize the effluent volume from desalination plants by many technologies: Technologies for reducing and eliminating brine disposal: Salt recovery technologies, Brine adaptation for industrial uses and Metal recovery technologies.

Methodology: (i) Identification of solar stills and evacuated tubes collectors as thermal desalination configurations and a brief literature review about these systems. (ii) Derivation of a mathematical and computational model for the hybrid system. (iii) Evaluation of the important design and operating variables and parameters which controlling the efficiency of the system. (iv) Based on the results of the previous steps, the decision will be taken if solar still – evacuated tubes system is effective for brine volume reduction or not.

Area of study (Al-Zubeidat RO Desalination plant in Al-Zubeidat village):

Al-Zubeidat village is one of Jericho governorate villages, located about 35.4 km to the north of Jericho city. it is bordered by the Jordan River to the east, Marj Na'ja village to the north, Tubas city to the west and Marj al-Ghazal village to the south. This village is about 275 meters above sea level. The annual rainfall is about 192 mm and the average temperature is 23 degrees Celsius while the humidity is about 48% their. This village has a RO Desalination Plant with about (10 m³/day) as a production rate.



Map 1: Az-Zubeidat village, Jericho, West Bank

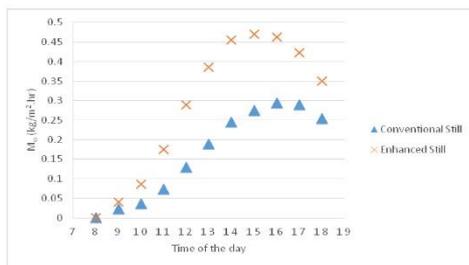


Fig. 1: Productivity of conventional and enhanced (hybrid) stills as a function of time.

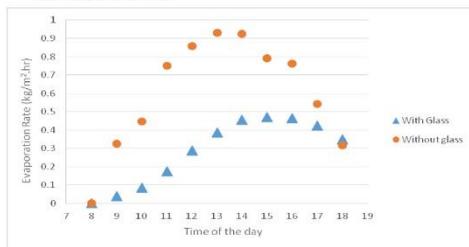


Fig. 2: Rate of evaporation from the enhanced still with and without the glass cover.

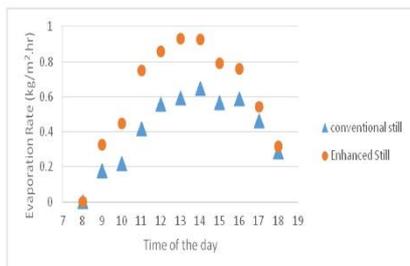


Fig. 3: Rate of evaporation of conventional stills without the glass cover considering variable parameters.

Results:

1. The proposed study indicates a method to increase the productivity of solar still effectively.
2. The water temperature increases when additional heat energy was added from evacuated tube collectors, which in turn increased the productivity of the solar still.
3. The still output is a strong function of temperature difference between the water in the basin and the glass cover, as the difference increases the output increases.
4. At wind speed = 1 m/s the total output water was 3.14 (kg/m²) and at wind speed = 3 m/s it was 4 (kg/m²) and it was 4.39 (kg/m²) at wind speed = 5 m/s which means that the increasing in wind speed will lead to a higher productivity due to the higher temperature difference occurred. A cooling of the outer side of the glass by outer fan in order to increase the air movement on the surface of the glass will increase the productivity.
5. When the depth in the basin was 3 cm the output water was 4.3 (kg/m²), it decreased to 3.13 (kg/m²) as the water depth increases to 5 cm, and when the water depth was set to be 10 cm the output from the still decreased to 1.7 (kg/m²), it is clear that the water depth has an inverse effect on the productivity. Lower water depth still produces more water.
6. Removing the glass cover increases the evaporation rate from the still to 6.7 (kg/m²) with about 100% increasing ratio from the still with the glass cover.
7. Using enhanced still for producing drinking water for individual use in Az-Zubeidat village would be effective.

Summary: Az-Zubeidat desalination RO station has a daily production rate of about (10 m³/day), the input is about (12.1m³/day) producing (2.1 m³/day) as a brine stream. For suggested hybrid system the (2.1 m³/day) retentate could be used as a feed. If 40 houses were included in the project, each house would have 2 m² of this hybrid system with glass cover and 1m² without glass cover, the optimum depth in this case is 2.65 cm for first 2 m². The first 2 m² will produce 8.2 L/day for industrial use, the rest 44.8L brine then moved to the second 1 m² for free evaporation, the system will evaporate about 6.7 L/day. The total volume reduction in this case would be 28%.



Using Thiophene Supported on SiO₂ for Removal Cr(VI) from Water

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Research Background: The main problem that affects our environment is pollution, because this processes making land, water, air and other parts of our environment unsafe and unsuitable to life. The exposure to heavy metals ions through ingestion or uptake of drinking water and foods can lead to its accumulation in animal's body and plants, as the human body exposure to high concentrations. Chromium (VI) is one of toxic, danger heavy metals, Chromium (VI) effects are to be a strong oxidizing agent, posing a high risk to humans and animals due to its carcinogenic and mutagenic properties, Objectives of this work is using Thiophene Supported on SiO₂ for Removal Cr(VI) from water, at the optimal conditions.

Methodology: (i) Synthesis, characterization of 3-Glycidoxypropyl-functionalized silica (MSiTh). (ii) Preparation of Chromium(VI) Solution. (iii) Determination the optimal conditions of pH, temperature, amount of adsorbent, concentration, and contact time for (MSiTh) to adsorb Cr (VI) efficiently.

Area of study :

The study was made in the lab, The study project is aimed at all wastewater treatment plants in Palestine for the disposal of heavy metals resulting from the factories

Such as the public water purification plant in Deir Sharaf and the wastewater treatment plant in Jenin and in the city of Ramallah and the purification plants that will be built in the future in cooperation with the Palestinian Water Authority.

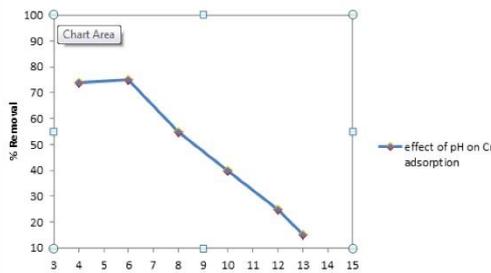


Figure 1: pH effect on Cr(VI) adsorption (C₀=10ppm, T=25°C, adsorbent dose = 0.04g)

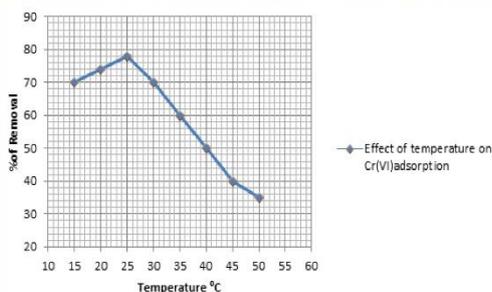


Figure2: The effect of temperature on Cr(VI) adsorption (C₀=10ppm, time = 60min, adsorbent dose = 0.04 gm, solution volume = 50ml)

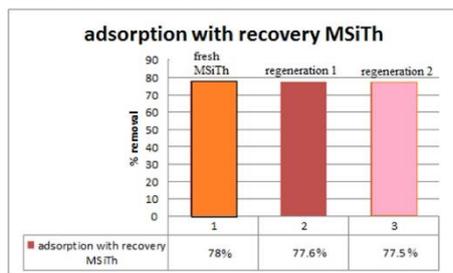


Figure 3: Percentage of Cr(VI) removal by the regenerated adsorbent compared with a fresh one at (Temp = 25°C, pH= 6, adsorbent dose= 0.04 g, sol. Volume = 10 mL, contact time = 30 min)

Results:

1. The adsorption of Cr(VI) onto MSiTh was successfully for removing Cr(VI) from the aqueous solution .
2. The results shows that MSiTh compound was able to remove Cr(VI) within 20 min at pH around 6 (figure1), temperature 25°C (figure2), with adsorbent dose =0.04g in 10ml Cr(VI) solution and the initial concentration 10ppm, the removal efficiency of Cr(VI) was 78% (figure2), also this efficiency was achieved at 24 hour with the same conditions.
3. The adsorption isotherm of Cr(VI) onto MSiTh was studied and the values of Langmuir maximum adsorption capacity Q_m=10.672mg/g, and RL =0.2375, indicate that the adsorption of Cr(VI) onto MSiTh is favorable . Also Freundlich model parameters value 1/n and n, showing that the adsorption of Cr(VI) onto MSiTh is favorable.
4. MSiTh silica gel compound has been used and has high efficiency to remove Cr(VI) from water, this efficiency is lower than other adsorbents that were used in other researches for removal of Cr(VI) at high pH, but it can be more effective at lower pH near water pH at 25°C.
5. The small positive value of ΔS indicates there are some structural changes take place on the adsorbent and entropy increases through the adsorption.
6. MSiTh compound has been able to remove Cr(VI) several times with high efficiency (figure3).

Summary: The adsorption experiments were applied for a range of pH (2-13), temperature, adsorbent dosage, initial concentration, and contact time. The results revealed that the percentage removal of Cr(VI) decreased with the increase of Cr(VI) concentration, pH and temperature, while the percentage removal increase with increase contact time and adsorbent dose. The removal efficiency for Cr(VI) adsorption was more than 75% after 24 hour this achieved at pH around 6, and temperature 25°C, using 0.04g weight of dose, at initial concentration 10 ppm for 10 mL Cr(VI) solution. The adsorption of Cr(VI) onto MSiTh was optimized under acidic conditions (pH< 7) at room temperature.



Designing of Reverse Osmosis Desalination Plant in Jordan Valley Using Optimal Energy Options With Less Environmental Impacts

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Research Background: According to World Health Organization (WHO) Az-Zubaidat's well water is not potable and need to be purified. The total dissolved solids(TDS) of Az-Zubaidat's well water is 2100 ppm, which is high and should be less than or equal to 1500 ppm.

Methodology: (i) Taking available options of conventional and nonconventional energies with their products and other information in order to see which techniques can be used. (ii) Define the different types of energy technologies from technical point of view and other configurations. (iii) Will be the study of the amount and suitable type of energy needed to run the project, the prices of the necessary equipment, the cost of maintenance will also be the work of testing in the laboratory to identify the amount of total dissolved solids of the source of water feeder for the project. (iv) Choose the least expensive method for the proper disposal of brine to minimize harm to the environment and also choose the best source of energy using HOMER software that will be used to operate the project.

Area of study :

Az-Zubaidat Village is a located with 35.4km north of Jericho City in Palestine. Az-Zubaidat Village is bordered by Marj Na'ja Village to the north, Marj al Ghazal to the south, the Jordan River to the east and Tubas City to the west. Az-Zubaidat Village is located under sea level with 275m, the average annual temperature is 23°C, the average annual humidity is 48% and the mean annual rainfall is 192mm. The capacity of Az-Zubaidat's well is 120m³/hr.



Fig.1 : Az Zubaidat location map, West Bank, Palestine

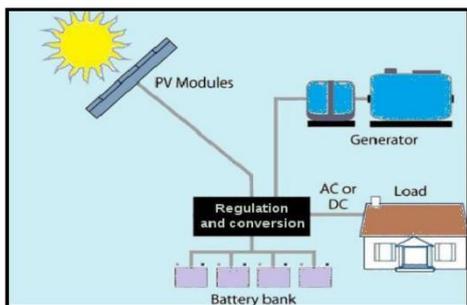


Fig. 1: Schematic diagram of Standalone system

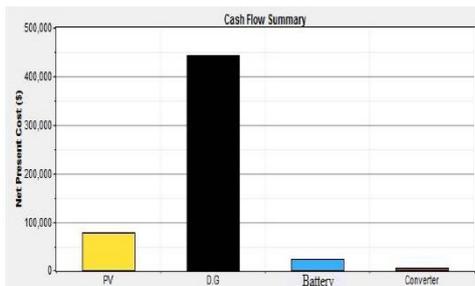


Fig. 2: Cash summary by component type of system of scenario 1

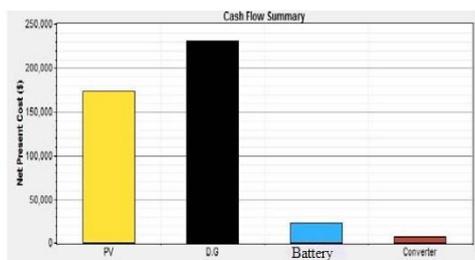


Fig. 3: Cash summary by component type of system of scenario 2

Results:

1. The analysis results from the Lead acid batteries scenario show that, among five hybrid systems for supplying electrical requirements, the most economical is PV modules with 25 kW, DG of 20 kW, 4 batteries, and a 20 kW converter hybrid system, which has a Cost Of Energy (COE) of 0.462 \$/kWh and the cost of potable cubic meter is 0.601\$/ m³.
2. The results from the Water distribution tank scenario show that the most economical system is PV modules with 55kW, DG of 25kW, 20 batteries, and a 45kW converter. The COE is 0.348\$/kWh and the cost of potable cubic meter is 0.479\$/ m³.
3. The least economic system components are PV modules with 150kW, 300 batteries. The COE of this system is 0.564\$/kWh and the cost of potable cubic meter is 0.710\$/ m³.

Summary: The objective of this research is to design a reverse osmosis desalination plant in Jordan Valley using clean and sustainable energy source. A reverse osmosis (RO) plant with an average daily drinking water production of 270m³/day is designed; the capacity of Az-Zubaidat's well is 120m³/hr. To investigate the optimal option of the previous configuration is tedious and time-consuming effort and impossible in some cases, so Hybrid Optimization of Multiple Electric Renewable (HOMER) software is utilized. HOMER software facilitates the sensitivity analysis and make it easier to evaluate the many possible system configurations and choose the best one.

The results shows that the configuration consists of PV, DG and battery storage system from the Lead acid batteries is the best as the cost of energy (COE) is 0.462\$/kWh and the cost of potable cubic meter is 0.601\$/ m³. Using water distribution tank as a storage system to reduce or exclude the battery energy storage system is analyzed in this research. The results shows that introducing storage tank to the configuration that includes PV, DG and battery reduces the COE to 0.348\$/kWh and the cost of potable cubic meter is 0.479\$/ m³.



Growth enhancement and alleviation of deleterious effects induced by salt stress in Faba Bean (*Vicia Faba*) by PGPB

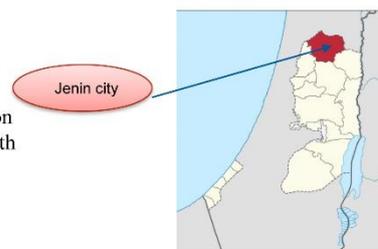
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An-Najah National University

Research Background: Salinity has been a threat to agriculture in some parts of the world for over 3000 years; in recent times, the threat has grown (Tim Flowers, 2006). Legumes have long been recognized as sensitive or moderately tolerant to salinity (Subbarao and Johansen, 1993). The reductions in growth from high salinity are the consequences of both osmotic stress including a water defect and the effects of excess Na⁺ and Cl⁻ ions on critical biochemical processes (Munns and Tester, 2008). Interaction of PGPB with several crops in saline conditions reduced the extent of poor growth and thus helps plants survive and improve performance in adverse conditions (Dimkpa et al. 2009). The inoculation of PGPB under osmotic stress conditions have beneficial effect are not only as a biomass growth increasing, but also as an improvement in water status (Nadeem et al. 2007; Kohler et al. 2009). The inoculation with *B. megaterium* also had a significant effect on reducing the salt injury which estimated by quantifying the percentage of necrotic leaf area with inoculated plants compared with non-inoculated (Adriana M et al., 2010).

Methodology: Intact seeds, homogeneous and identical in size and color, and free from wrinkles, were chosen. Grown in mix of sand and clay 1:1. The experiment design were 2*5*3 factorial including irrigation with four different salinity levels and one with fresh tap water (0, 2, 4, 6 and 8 ds/m NaCl), one inoculation treatments (inoculated with *B. megaterium*) with 3 replicates for each treatment for each Faba Bean variety in lines, with each line comprising of all treatments. Growth parameters, yield components, chlorophyll content and nutrient content (Na, Ca, N, P, K, Cl) and soil analysis.

Area of study and plant material (Jenin in the north of West Bank, Palestine):

The experiments were carried out in a greenhouse (in order to control irrigation without rainfall), at Jenin in the north of West Bank (Palestine) using (*Vicia Faba* L.) plant. Two varieties were used (Qertase and local); the Qertase have bigger seeds size, more surface area of leaves, more production of seed number and weight than local variety, the seeds were obtained from the local market and both are of the types grown in Palestine.



Picture 1: Jenin, West Bank

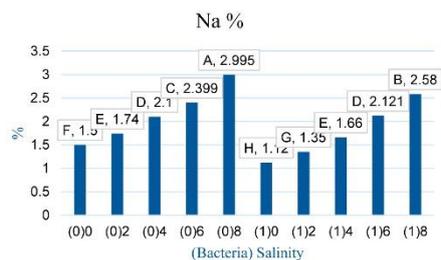


Figure 1. Effect of the interaction between salinity and *B. megaterium* on Sodium content of Faba Bean. 0: without *B. megaterium* 1: with *B. megaterium*, Salinity: (control, 2, 4, 6, 8) ds/m

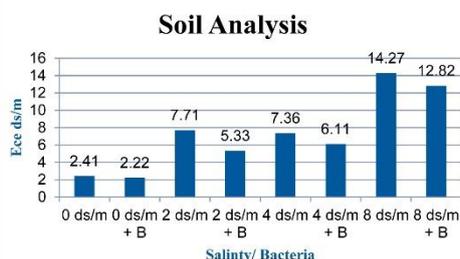


Fig. 2: Rate of evaporation of conventional and enhanced stills without the glass cover considering variable parameters.

Results:

- *B. megaterium* has significant effect in alleviating salinity stress on growth parameters (plant height increased 9%, number of leaves increased 10 %, fresh weight of shoot increased 21%, and fresh weight of roots 36%).
- *B. megaterium* increase bean production significantly even under high level of salinity (seeds number 21% and pods number 29%).
- The inoculation with *B. megaterium* significantly increased flowers number (27 %) and reduced the period required for flowering (from 66 days to 55 days), good indicator for early yield.
- The accumulation of Na and Cl in plant tissue significantly reduced.
- The bacteria improved plant absorption ratio for K, P, N and Ca was higher in plant inoculated with bacteria under high salinity level compared to non inoculated plants.
- Bacteria have a positive effect in reducing soil salinity (15 %).

Summary: Application of *B. megaterium* mitigates the effect of sodium chloride stress and improved the growth and yield in the present study. The inoculation with remarkably *B. megaterium* increased plant height, number of leaves, number of flowers, plant biomass, early flowering, improved chlorophyll content, root system and in contrast, alleviated sodium chloride accumulation in leaves, increased the absorption of K, Ca, P. Inoculated plants with *B. megaterium* displayed stronger ability to tolerate salt stress than non-inoculated plants. The study revealed that the soil salinity could be reduced by using *B. megaterium* with plants.



Water Tariff between Social Justice and Economic Efficiency

Anwar AlShaer
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Research Background: Water demand in Palestine is growing due to many reasons, mainly increasing in the number of population, increase number of households and growth of the sectors of economic. Meanwhile, water resources are decay either due to the climatic conditions or the domination of Israel on the Palestinian water resources. This create the needs to develop tools for managing water including a water demand function and water tariff system that trade-off between economic value of water and the ability of provider to cover their cost and to provide water in fair price to social strata especially poor one. The main objective for research is to derive demand equation for water in west bank

Methodology: The researcher followed the scientific methods in conducting the research, as follows: The researcher used questionnaire to collect numerical, nominal and ordinal data about households to satisfy thesis objectives. The questionnaire is designed in Arabic language in simple way and in used words to ease understanding the questions by households in order to get right answers from households. I used qualified field worker to perform the survey ,we interviewed 579 households, this sample was random sample at 5% error term .

Area of study

It study the water tariff in West Bank, exempting both Gaza and Jerusalem, Gaza due to the difficulty of surveying the people opinion about water tariff due to the Israeli siege since 2006, and Jerusalem because the water sector is managed by the municipality of Jerusalem which is following Israel.

Second: it addresses the water tariff from household point of view only and not include industrial or agricultural sector. This because we focus mainly to find justice price tariff for household sector. The main source of water is rain , and rain is un stable as in figure(1). In Palestine the problem is not limited to the water shortage only, but it arises principally because of the Israeli policies and instructions imposed on the Palestinian water sector, mainly the discrimination in the quantity of water provided to the Palestinian population in comparison with settlements which is illegally found in West Bank. These policies and practices affect the standard of living of Palestinian. There is an inequality in access to water between Israelis and Palestinians. For example, the Palestinian consumption is about 79 liters a day per person for 2014 – well below the 100 liters per capita daily recommended by the World Health Organization (WHO) – whereas Israeli daily per capita consumption is about 300 liters, is about four and five times as much.

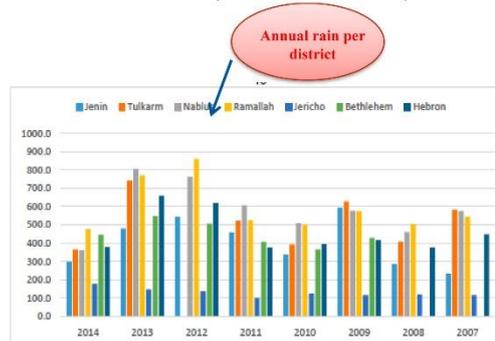


Figure 1: Annual rain fall per district , West Bank

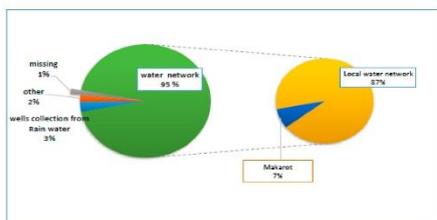


Fig. 2: source of water of connected household's to water network

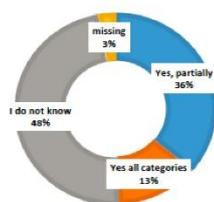


Fig. 3: House holds knowledge about water tariff items and details

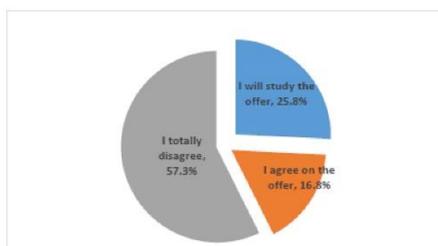


Fig. 4: opinion of households toward prepaid system (PWM)

Results:

we found that around 95% of households are being connected with water network, And the researcher analyzed the source of water for 95% of connected households to water network and the results summarized in figure (2). The average bill is around 100 NIS while the fair price from households perspective in around 67 NIS , satisfaction regards social indicators first satisfaction on the following indicators are :water tariff,48%, distribution of water, 50% subscription fees 62%,quality of provided water 65% and maintenance of water network 64% , as shown in chapter five . Loss in water network :accordingly to PCBS publications and WPA that there is around 40% loss of provided water, this mean that there is in efficient in providing and distribution water .

There is around 48 % of households suffering from maintenance in network and 59% facing problems in providing water to their homes

Affordability and willing to pay :there is a tendency to avoid commitment to pay for providers

The study shows that there is more than 48% from households didn't know well the tariff of water and its details, this mean that households haven't any idea about how to reduce their usage accordingly to tariff as shown in figure (3)

One of objectives of study is to know how the house holds look to prepaid system and what is the households opinion toward this system ,the researcher found that there is around 57% from households reject this system as shown in figure (4)

Summary: Palestine as some other countries face short in water problem and Palestine depend on main water resources which is ground water and rainfall source. But in Palestine there is a special case due to occupation , Israel control water resource and they manage it, in addition to that Israeli determine the quantity to be delivered to Palestinian and pose a significant obstacle to the Palestinian strategies for the development or exploitation of water sources.

Researcher determine the factors that affect the demand for water, which illustrated in the following equation:

$$\text{WatCons} = 2.933 - 0.080 * \text{price} + 0.94 * \text{FamSize} + 0.586 * \text{Income} - 2.14 * \text{Detailprice} + 0.11 * \text{WaterRation} + 0.005 * \text{SatisPrice} - 0.926 * \text{PrepaidCard} + \text{Ut}$$

From analysis in previous chapter we could set tools to be used in frame work and tools for water tariff to increase household's satisfaction and guarantee social justice in addition to recover the cost of providing water



The Assessment of Private Sector Participation through different Contracting Models on the Sustainability of Desalination Plants

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Research Background: Seawater desalination plants offer an abundant alternative resource to meet the growing need of water. But this technology is very costly ,needs huge resources to be implemented and requires proper understanding (good experience) ,for designing , planning and operating to make the system more sustainable and to produce fresh water . So governments such as Palestine which don't have the sufficient affordability to implement such large and risky projects as desalination plants , look for Public-Private Participation (PPP) expression which means getting the private sector involved in construction and operation of desalination plants through different contracting models.

Methodology: The adopted approach for selecting the optimal PPP contract was based on extensive literature review to abstract the most well-known PPP contracts that fit the Palestinian reality and several meetings with experts who have a good background about the desalination process, PPP contracts, sustainability ...etc., to finding the beneficial tool to collect the data. Structured interview designed to collect the data where it conducted with different sectors that related to water sector or concerned on investment in this sector ,and based on five indicators of sustainability ; financial, institutional, technical, socioeconomic, and environmental to classify each of the PPP contracts .Through the analysis process of the data collected using SPSS program, three points will be assessed; first, the importance rate for sustainability of each of five indicators (financial, technical, institutional, social, and environmental viabilities) for desalination plant in Palestine. Second, sustainability of each of the five indicators that effect on deciding the structural framework of PPP contracts. Third, the different contracting models.

Area of study (Gaza Strip):

Gaza strip is a region located in Palestine country. It's extended along the southwestern portion of the Palestinian coastal plains , that borders; Egypt on the southwest for 11 kilometers and Israel on the east and north along a 51 km. It has an area about of 360 km², the length is about 45 km on the western Mediterranean coast and the width varies from 7 km to 12 km (Gaza Municipality, 2014). Besides, it consists of five governorates ;North, Gaza, Middle, Khanyunis, and Rafah. With the population of 1.8 million , where Gaza strip considered one of the most densely populated regions in the world (over 4,500 people per km2) (Union for the Mediterranean Secretariat, 2011; Gaza Municipality, 2014 ; PCBS (2014)



Map 1: Gaza Strip , Palestine

Results:

Four steps evaluated to select the optimal PPP contract for Gaza strip Desalination plant :

1. The importance rate for the each types of sustainability using weighted average method found as shown in figure 1. 82% of the respondents evaluate the financial viability as the highest priority when selecting the PPP contract for the desalination plant. This might be explained by the high expected cost for the desalination plants .The second priority was given to the institutional viability with 76%. This is related to the importance of having a clear institutional framework to organize the PPP projects and to ensure that such projects are profitable for the private sector. Due to the political situation in Palestine. However, technical, socio-economic and environment viabilities are classified in the third ,fourth and fifth priorities with 72%, 62% and 59% respectively.
2. Evaluation of the sustainability of each of five indicators (Financial , Institutional, Socio-economic and environmental) against the different type of PPP contracts . See figure 2 , shows the financial viability against PPP contracts, where the Greenfield contract got the highest score that has the affordability to covered the project costs than other contracts.
3. Evaluation of PPP types (Traditional contract, Service and Management contract, Lease /Affermage contract, Joint venture contract, Green field contract (concession contract) and divestiture contract)based on sustainability indicators. See figure 3 , shows Traditional contract against sustainability indicators .
4. Finally, Overall evaluation of the different contracting model .See figure 4 , where the Green field contract (concession contract) got the highest weighted average among the other contracts .

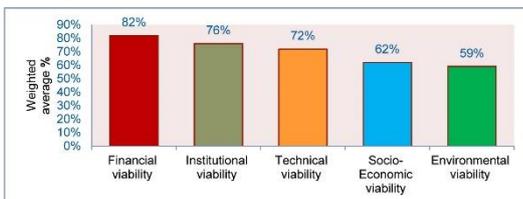


Fig. 1: The importance of each type of sustainability using weighting average

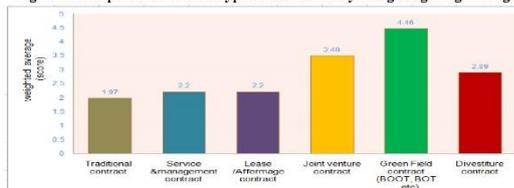


Fig. 2: Assessment of Financial Capacity to Afford the Capital Cost of Desalination

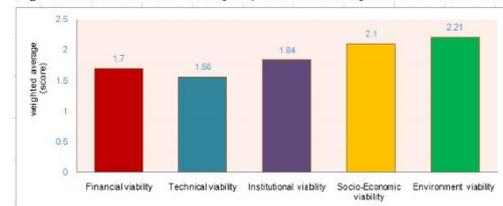


Fig. 3: Evaluation process for Traditional contract against sustainability indicators

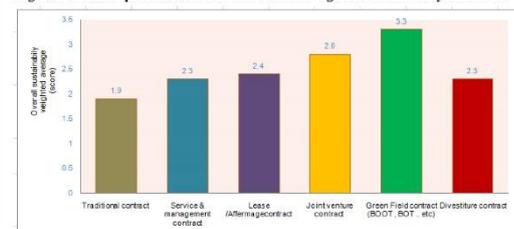


Fig. 4: Overall evaluation of the different contracting model

Summary : At the end , determining the optimal contract for desalination plant in Palestine and the extent to which the private sector might be involved either in establishing, operating and/or preserving the sustainability of the desalination plan. This was enabled by collecting data through using interviews structures that targeted with a sample of organizations in the field of water sector in West Bank and Gaza Strip. The selection process for the optimal PPP contract was based on five indicators: financial, institutional, technical, socio-economic, and environmental viabilities. After analyzing the data using the software SPSS, the concession contract (Green field contract) found that the most optimal choice (best) for the respondents with a 3.3/5 weighted average .that means this contract has the elasticity and the specificities to handle with the possible political, economic and social challenges that might face the desalination project in Palestine especially in Gaza strip



Multiple Criteria Decision Analysis (MCDA) to Identify the Setting Priorities of the Sanitation Sector in the West Bank

Baraa Jararaa, An-Najah National University

Executive Summary: Multiple Criteria Decision Analysis (MCDA) was chosen and used to identify the setting priorities of the sanitation sector in the West Bank. A six step criteria selection approach was developed based on an extensive review of Palestinian wastewater management policies and strategies as well as lessons drawn from regional and international experiences and practices. This criteria selection approach has resulted in nine criteria for MCDA: demography, water consumption and wastewater production, wastewater reuse, environmental factors, operational factors, risks of industrial waste, socio-economic factors, geographical factors, and political issues and aspects. Evaluative and comparative analyses were used during MCDA application and a mathematical relationship was found aiming at sector/area identification and priorities setting. MCDA and relationship developed through this research were applied to 64 communities in the West Bank which must be connected to sewage system by the end of 2030 (according to PWA sector strategy). According to MCDA and selected criteria, the 64 communities were ordered by priority to be approached by decision makers for development. MCDA application and results has shown that this model is suitable and successful in setting sanitation sector priorities and the developed nine selection criteria has significantly affected the decision-making process in the sanitation sectors in the West Bank.

Introduction: During the last two decades, millions of dollars have been invested in the sanitation sector in the Palestinian territory. Nonetheless, the sanitation sector is considered as one of the sectors that have been neglected over the past decades as only 28% to 32% of the populations are provided with sewage systems. Many researches and studies have been conducted over the sanitation sector in Palestine, and many plans and strategies have been developed in this field over the past years. However, none of such researches and strategies managed to set the priorities of the areas in need to solve the problem of wastewater disposal. It was found that the current sanitation projects selection approach and criteria for target areas are either based on the policies of the donor or on a non-scientific or unified criteria method and approach. Accordingly, Palestinian Authority and related organs do not take the right criteria and/or the right decision in identifying the priorities of the sanitation sector in the West Bank. Research aims at identifying and setting the priorities of wastewater management in the West Bank by using MCDA approach associated with clear and appropriate selection criteria.

MCDA Model: MCDA is a discipline aimed at supporting decision makers faced with making numerous and sometimes conflicting evaluations. MCDA aimed at highlighting these conflicts and deriving a way to come to a compromise in a transparent process. MCDA has been recognized as an important tool in environmental decision-making for formalizing and addressing the problem of competing decision objectives.

MCDA Application and Results: The research methodology goes through five phases. The first phase is data collection and second phase is criteria identification was determined through six steps as listed in the following figure No.1. The third phase is MCDA tools development through normalize the weights by give a score for each attributes weight through the intergovernmental agencies that form the Environmental Assessment Committee, as given the table and equation show in figure No.2. The criteria which significantly affect the sanitation sectors in West Bank and normalize weights to each criterion are illustrated in figure No.3. After that, we carry a value rating for each criterion by reference to the books, references, scientific papers and by reference to the owners of specialty in these attribute. The criteria are based on a scoring system of 1 to 5 points. The four phase is priorities settings through the following steps:

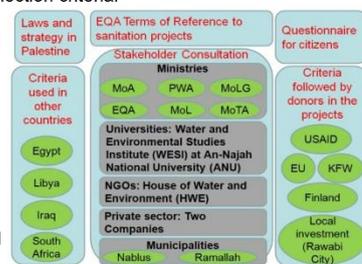


Fig. 1: Criteria Identification

$$w_i = \frac{Score_i}{\sum_{i=1}^m Score_i}$$

Calculate normalize weights to each attributes

Attributes	Weights	Normalize weight
1	W1	W1/ΣW
2	W2	W2/ΣW
3	W3	W3/ΣW
.	.	.
.	.	.
.	.	.
m	Wm	Wm/ΣW

Fig. 2: MCDA tools development through normalize the weights.

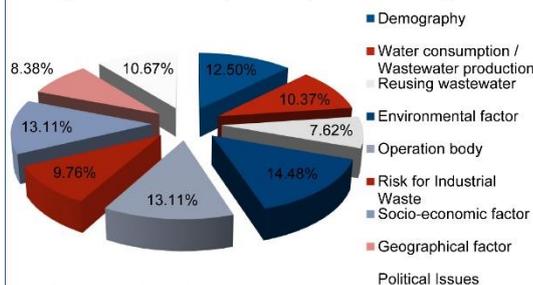


Fig. 3: Normalize weights to each criterion.

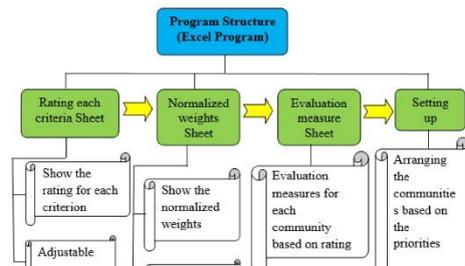


Fig. 4: An excel program relating the assigned criteria and priorities

A. Identify communities: We take the towns whose population is over 10 thousand people in accordance with the directives of the PWA to resolve the problem of sanitation in the towns and villages with the population of over 10 thousand people by 2030. Communities that are expected to have a population of more than 10,000 people in 2030 are 97 communities (according the projected population use census of 1997 and 2007). We except 33 communities because they contain sewage systems or in the implementation stages.

B. Application of MCDA Tools: MCDA tools will be applied to the 64 communities that have been selected. First, we score for each criterion to the selected communities. Secondly, we normalize the weights of criteria and give the score for each community. C. Evaluation measure for each community. D. Setting priorities for each community based on evaluation measure (score of each community). The communities which most need to solve the problem of sewage are: Dura, Silat al-Harithiya, El-Far'a Camp, 'Attil, Deir al-Ghusun, Deir Abu-Da'if, Birqin, Meithalun, Al-Yamun, Kafr-Dan and Qabatiya.

Final phase is Sensitivity and Certainty Analysis. Weights of the criteria are identified through qualitative interview with the Environmental Assessment Committee. These weights were subjected to change of time and space due to various socio-economic political and developmental changes and conditions. In order to conduct sensitivity and certainty analysis of data related, a specific case, an excel program relating the assigned criteria, and priorities were developed. Program output would rearrange priorities according to the changes occurred in the assigned criteria. Figure No.4 shows the program structure. For the sensitivity analysis a fewer alternatives were assumed. The sensitivity program results show that the setting priorities for communities are changed when we changed the alternative criteria.

Implication and Recommendation: PWA should start to identify target areas to sanitation projects by taking all the right criteria to make right decision and oblige donors on it. We recommend the PWA use the MCDA method to identify the setting priorities of the sanitation sector, and can benefit from the mathematical relationships and MCDA that have been developed in this research. PWA and interested/related stakeholders need to expect future changes in identified priorities depending on changes in alternative criteria. PWA should start to plan to develop sanitation sectors in 33 communities and find sanitation systems to 64 communities by 2030. PWA should start putting a long-term plan and a five-year plan that would include serving 20 communities whose population is of more than 10 thousand people every 5 years. PWA should start preparing feasibility studies and master plans that contain estimated costs to the target communities.



Assessment of Reverse Osmosis Process for Brackish Water Desalination in the Jordan Valley

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- Research Background:** Cost studies have done a remarkable work in investigation and optimization of hybrid renewable energy for BWRO desalination systems. This study aims to analyze the feasibility of both BWRO stand-alone system powered by PV cells and hybrid RE unit located in Az Zubeidat village, by first assessing the water resources with the corresponding demand, then assessing the renewable energy sources available in order to decide optimal renewable energy sources suitable for desalination using RO technique, finally developing a reliable cost analysis approach for desalination system.

Methodology: (i) **Data Collection:** Data will be obtained from:

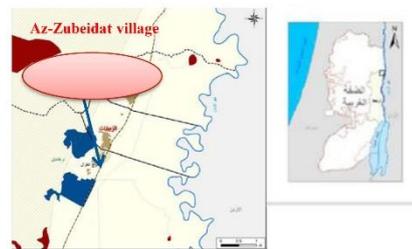
- 1) Geographical Information System (GIS) database
- 2) Water supply and demand data.
- 3) Data from Az Zubeidat desalination plant

(ii) **Economic Analysis:**

In this research, the BWRO system was analyzed economically using HOMER Pro[®] which is a microgrid software developed by the U.S National Renewable Energy Laboratory(NREL).

Area of study (Az-Zubeidat Desalination plant):

Al-Zubeidat village is one located about 35.4 km to the north of Jericho city. The village is about 275 meters above sea level (see Map 1: Az-Zubeidat village , Jericho, West Bank) The annual solar radiation is 5.37 kWh/m² . The village has a desalination unit which was constructed; the RO unit was implemented by both Al-Najah National University and the local contractor (General Environment Services - GES) with the Palestinian Water Authority (PWA) as supervisor and Middle East Desalination Research Center MEDRC as a donor.



Map 1: Az-Zubeidat village , Jericho, West Bank

Optimal System Type



Fig. 1: Graphical results of the sensitivity analysis of the PV system with and without batteries.



Fig. 2: Graphical results of sensitivity analysis between Diesel fuel price and solar radiation value for optimal Hybrid system.

Results:

- 1) Three separate scenarios were adapted, the first one is the current unit with PV/Battery system, as result showed whenever the solar scaled average is below approximately 5 kWh/m²/day it is more economic to use the PV system alone and the PV/battery system is used otherwise (see Figure1: Graphical results of the sensitivity analysis of the PV system with and without batteries). The maximum solar scaled average (8.19 kWh/m²/day) has the least COE (0.0234 \$/kWh) of all three solar radiation values, but the system should include the batteries to overcome the stability problems, and the minimum solar scaled average (2.28 kWh/m²/day) has the highest COE (0.0618 \$/kWh) of all three solar radiation values. Meanwhile; all of them do not work properly without batteries.
- 2) The second scenario was powering the system with diesel generator alone. Analysis showed that a 10kW generator with 1\$/W capital price, 0.7 replacement and 1.67 \$/hr O&M, the optimal system when the interest rate was minimum 0%, the price of diesel was minimum 1.3\$/l and COE of 1.25 US\$/kWh which is relatively high with large GHG emissions.
- 3) The third scenario was to operate the system for twice the time as it is using hybrid system consist of PV/Battery/DG with different sensitivity variables(see Figure2: Graphical results of sensitivity analysis between Diesel fuel price and solar radiation value for optimal Hybrid system) which gave an optimal configuration with the least COE of US\$0.424/kWh when the fuel price is minimum(1.3\$/l) and the solar scaled average is maximum(8.91kWh/m²/day), for both 6 and zero IR percent ,the best configuration compromises of 10 Kw diesel generator, a 27.2 Kw of PV modules and 24 batteries of 1.75 kWh capacities, and the system has 70% renewable energy fraction, the system Net Present Cost equals US\$ 99455 with yearly carbon dioxide production of 3501 Kg/yr.
- 4) As the IR increases, the COE increases.
- 5) As Diesel price increases, the COE increases.
- 6) PV/Battery/DG solution gives an average of 68% GHG reduction(see Table.1: Reduction percentage of the yearly GHG production when using PV/Battery/DG instead of using DG only.)

Summary

Three different scenarios were analyzed economically and environmentally using HOMER Pro , the third scenario was to operate the system for twice the time as it is using hybrid system consist of Photovoltaic/Battery/diesel generator (PV/Battery/DG) with different sensitivity variables which gave an optimal configuration with the least COE of \$0.424/kWh when the fuel price is minimum(1.3\$/L) and the solar scaled average is maximum(8.91kWh/m²/day) , for both 6 and zero Interest Rate(IR) ,the best configuration compromises of 10 kW diesel generator, a 27.2 kW of PV modules and 24 batteries of 1.75 kWh capacities, and the system has 70% renewable energy fraction with a 68% GHG reduction.

Pollutant	CO ₂	CO	Hydrocarbon	Particulate Matter	SO ₂	NO _x
Percentage decrease %	68.3	68.2	68.3	67.1	67	68.2

Table.1: Reduction percentage of the yearly GHG production when using PV/Battery/DG instead of using DG only.



Purification of Groundwater from Heavy Toxic Metals using Suspended Polydentate Supported Ligands

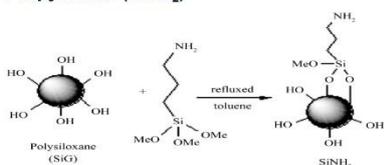
Bayan Khalaf¹, Shehdeh Jodeh¹, Ismail Warad¹
¹An-Najah National University

1. Research Background:

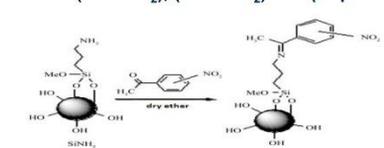
The increasing levels of heavy metals in the water resources and environment represent a serious threat to human health, living resources and ecological systems. This study aims to prepare several vehicles chelation polydentate supported ligands in order to be susceptible to imply conjunction with the highly toxic heavy metal ions in the water including Lead, Nickel and Cadmium ions, as the process of interaction between ligands and heavy metals depends on the circumstances surrounding conditions which are treated in this research. Metal ion uptake through complexation can be affected by hydrophilic-hydrophobic balance, the nature of chelate ligands and the extent of cross-linking of macromolecular supports. Ligand function also dictates reactivity, complexation ability and efficiency of polymer supported ligands in the present case expected to be good solution for such problem. This research involves the synthesis of new polysiloxane surfaces modified with ortho-, meta-, or para-nitrophenyl moieties. The resulting adsorbents have been characterized by SEM, IR, UV, ¹³C solid state NMR, BET surface area, B.J.H. pore sizes and TGA. These porous materials showed a very good thermal and chemical stability and hence they can be used as perfect adsorbents to uptake Cd(II), Pb(II) and Ni(II) from groundwater taking from Burqin village in Palestine.

2. Methodology:

2.1. Preparation of Silica-Immobilized Propylamine (SiNH₂)



2.2. Synthesis of Nitrophenyl-Substituted Silicas: (Si-o-NO₂), (Si-m-NO₂) and (Si-p-NO₂)

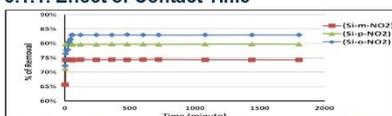


2.3. Batch experiments: In order to investigate the adsorption efficiency for each adsorption process. The effect of solution conditions on each adsorption process were studied. These conditions involve the effect of contact time, pH value, temperature, adsorbent dose and the initial concentration of adsorbate.

3. Results:

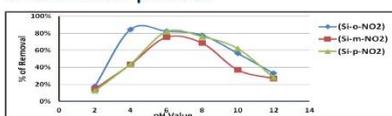
3.1. Adsorption of Cadmium

3.1.1. Effect of Contact Time



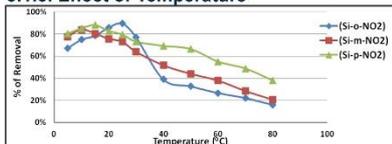
As shown here, the highest percent of Cd(II) removal was 82.98% for (Si-o-NO₂) after 50 minutes time of shaking.

3.1.2. Effect of pH Value



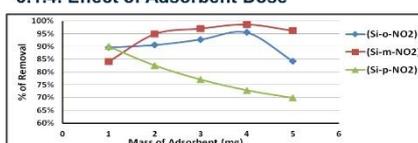
From the plot, (Si-o-NO₂) adsorbent has the maximum percent of Cd(II) removal that is 84.57% compared with that for (Si-p-NO₂) that equals 81.72% and (Si-m-NO₂) that equals 75.39%.

3.1.3. Effect of Temperature



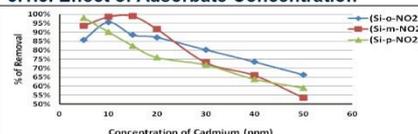
The percents of removal at each optimum temperature for the three adsorbents are 89.56% for (Si-o-NO₂), 83.95% for (Si-m-NO₂) and 87.94% for (Si-p-NO₂).

3.1.4. Effect of Adsorbent Dose



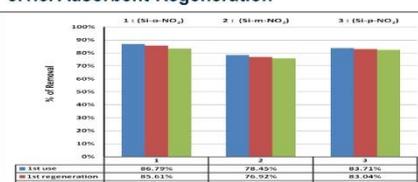
As shown above, the maximum percent of Cd(II) removal was 98.61% using 4 mg of (Si-m-NO₂).

3.1.5. Effect of Adsorbate Concentration



The maximum percent of Cd(II) removal was 98.99% for (Si-m-NO₂) by using 15 ppm as concentration of Cadmium solution.

3.1.6. Adsorbent Regeneration

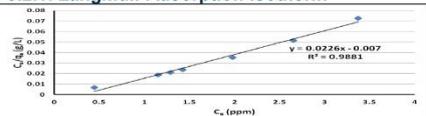


From the plot, the difference between the percents of Cd(II) removal after the first and second regeneration of each modified polymer is very low. This is strong evidence that the three synthesized adsorbents can be recycled, and hence be used for several times.

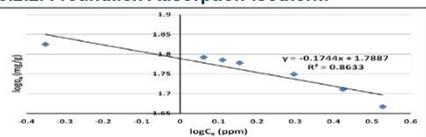
3.2. Adsorption of Cd(II) on (Si-o-NO₂):

Adsorption Kinetics and Thermodynamics

3.2.1. Langmuir Adsorption Isotherm

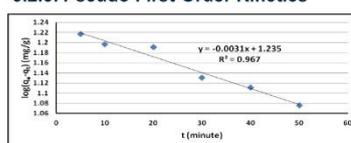


3.2.2. Freundlich Adsorption Isotherm

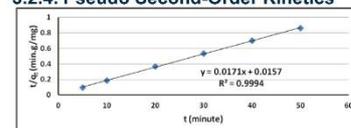


According to the values of R², adsorption of Cd(II) on (Si-o-NO₂) followed Langmuir adsorption isotherm such that, R² for Langmuir plot equals 0.9881 while R² for Freundlich plot is 0.8633.

3.2.3. Pseudo First-Order Kinetics

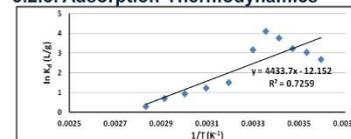


3.2.4. Pseudo Second-Order Kinetics



According to R² values, This adsorption process followed Pseudo Second Order Kinetics with R² of 0.9994.

3.2.5. Adsorption Thermodynamics



Adsorbent	Adsorption of Cd(II)	
	Adsorption Thermodynamics	
Si-o-NO ₂	ΔH (kJ)	ΔS (J/K)
Si-m-NO ₂	36.861	-101.032
Si-p-NO ₂	32.148	-85.052
Si-p-NO ₂	24.065	-54.221

The graph shows that adsorption of Cd(II) on (Si-o-NO₂) is endothermic process and non spontaneous.

Summary: The characterization of (Si-o-NO₂), (Si-m-NO₂) and (Si-p-NO₂) showed that these polymers have very good thermal and chemical stabilities, and hence they can be used as perfect adsorbents to uptake Cd(II), Pb(II) and Ni(II) from groundwater. The maximum extent of adsorption was for (Si-p-NO₂) polymer in the presence of lead ions. This adsorption needed only 1 minute of shaking to have 99.95% as percent of Pb(II) removal. For cadmium and nickel ions, the maximum percent of removal was 98.99% in the presence of (Si-m-NO₂) adsorbent. In addition, the results showed that all of these adsorption processes followed Langmuir isotherm and the mechanism of all of these reactions followed pseudo second-order kinetic model.

The thermodynamic parameters proved that all the adsorption processes are endothermic (ΔH > 0) and non spontaneous (ΔS < 0). The synthesized polymers were also regenerated, and the percentage removal before and after adsorbent recovery is determined.



MEDRC



Synthesis And Characterization Of Novel Porous SiO₂ Material Functionalized With C,c Pyridylpyrazole Acceptor For Sulphate Removal From Waste Water

Deena Khudaria, Prof Shehdeh joudeh, prof Ismael warrad
¹An-Najah National University

- Research Background.** Sulphate is a common constituent of many natural waters and wastewaters, and is sometimes present in high concentrations. Industrial wastewaters are responsible for most anthropogenic emissions. Certain industrial effluents may contain several thousands of milligrams per litre while domestic sewage contains typically less than 500 mg l⁻¹. The damage caused by sulphate emissions is not direct, since sulphate is a non-toxic compound. However, high sulphate concentrations can unbalance the natural sulphur cycle. This research involves the synthesis of pure modified porous polysiloxane SiO₂. The surface modification (MS) was characterized by elemental analysis, infrared spectra, and SEM. This porous material exhibits good chemical and thermal stability determined by Thermogravimetry curves and hence they can be used as perfect adsorbents to uptake sulfate from water.

Methodology: synthesis of the new modified silica gel (Si-RO-PzPyr) which we will use in this research can be summarized by reacting the activated silica gel with 3-glycidoxypropyltrimethoxysilane to form the epoxy-silica that acts as a precursor for further immobilization of the molecule containing the donor atom. The second stage involved the condensation of the C,C pyridylpyrazole salt with epoxy silica to give the target material MS as shown in figure 1

- Preparing stock solution of 1000 mg/L was prepared and different concentrations were prepared by dilution. Linear calibration curve between absorbance and concentration was constructed.
- Studying the effects of several factors on the complexation process such as; the effect of temperature, pH, contact time, dose and the effect of sulfate concentration as shown in the following figures (2-5)

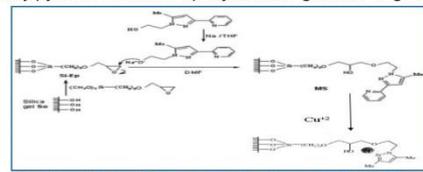


Figure 1- synthesis of the new modified silica gel (Si-RO-PzPyr)



Figure 2-effect of contact time

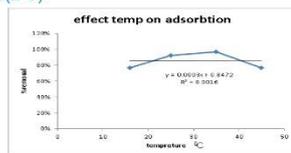


Figure 3-effect temperature on adsorption

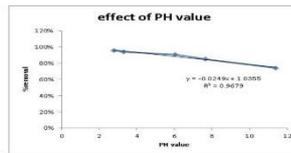


Figure 4- effect of PH value

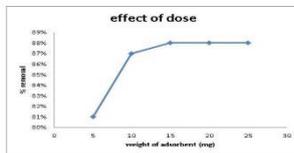


Figure 5-effect of dose

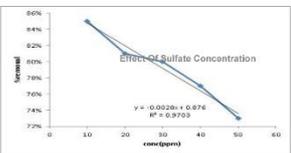


Figure 6-effect of sulfate concentration

- The best equilibrium isotherm model for the adsorption process was investigated according to the value of the correlation coefficient of Langmuir and Freundlich and Temkin isotherm adsorption model as shown in figures (7-9)

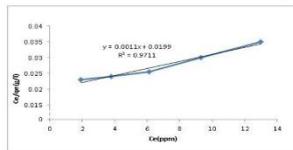


Figure 7-langmuir Adsorption Isotherm

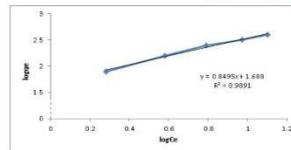


Figure 8-Freundlich Adsorption Isotherm

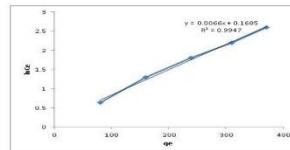


Figure 9-Temkin Adsorption Isotherm

- Also the kinetic of adsorption were investigated using pseudo first-order and pseudo second-order kinetics model as shown in figures (10-11). In addition, Van't Hoff plot for adsorption in order to determine the values of enthalpy change and entropy change, and hence determining if the adsorption process is spontaneous or not, and if it is exothermic or endothermic one in figure (12)



Figure 10-; Pseudo-first order plot of sulfate adsorption

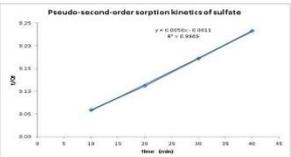


Figure 11-Pseudo second order adsorption kinetics of sulfate

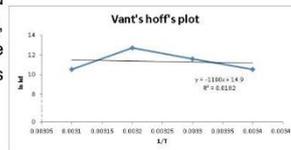


Figure 12-Van't Hoff plot

Results:

- (Si-RO-PzPyr) was able to remove sulfate within the first 30 minutes with high removal efficiency at pH around 2, 30°C Temperature, 0.015g weight of dose and initial concentration 10 mg/L
- Adsorption of sulfate by (Si-RO-PzPyr) was explained well by Temkin model. adsorption model has the highest value of regression (0.994) and thus the best fit.
- The adsorption reaction mechanism conformed with pseudo second-order kinetic adsorption model with correlation coefficient of about one.
- The thermodynamic parameter of adsorption sulfate on (Si-RO-PzPyr) is endothermic ($\Delta H > 0$) and spontaneous ($\Delta S > 0$).

Summary: In this study, it is found that the new modified polysiloxane polymer has very good thermal and chemical stabilities, and so it can be used as a good adsorbent to grab sulfate from wastewater.



Role of Hydroponics in Attaining Water and Food Security in Palestine

G. Bader¹, A Al- Tamimi ²
 Palastinian Water Authority¹, Al-Quds University²

Research Background:The study focused on the cultivation of barley and comparing that with the cultivation of barely in one of the farms in which the barley is grown in the rain-fed traditional way as a case study of one of the barely farms owned by a farmer of Tubas province. A comparison between the cultivation of strawberry using the traditional way and that cultivated hydroponically was also conducted .All this was preceded by conducting exploratory interviews with experts on hydroponics which included Academians, farmers and donors (financers). This study aims at the identification of the role of hydroponics in attaining water and food security as well as production of water and food by this technology.

Methodology: The researcher has followed the analytical descriptive methodology which is the best and most appropriate for this kind studies and which can achieve the goals of the study. The researcher collected the data from different sources: experts, private institutions, ministry of agriculture and he reviewed the previous literature on the subject. He then he designed an interview questionnaire and which was later statistically analyzed and the outputs were processed using the statistical SPSS band.

Area of study: The research sample was purposive and was chosen after a comprehensive survey of all hydroponics farms in the West Bank (map 1: West Bank) which are (73 farms).37 barley farms were chosen which were worthy of study in terms of the availability of equipments and its continuity that enables the conduction of research through an already prepared questionnaire on which 30 interviews were conducted.



Map1 : West Bank

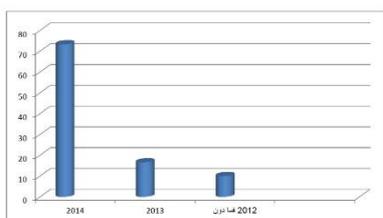


Fig. 2: Establishment of the farm

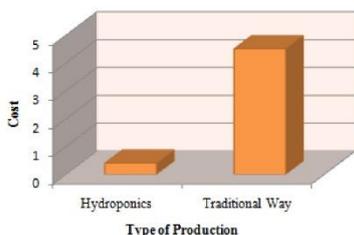


Fig. 2: the cost of production of 1 kg of fodder

Results:

The study has arrived at various conclusions (results) amongst which: This is kind of agronomy is new to the Occupied Palestinian territories of which (73.3%) have been built in 2014. Consequently (Fig. 2: Establishment of the farm) there is not much experience in this field amongst Palestinians. Nonetheless, most farmers have taken part in at least one training course. The cost of energy and operational burdens and cost of construction of this kind of farms was considerably high. The role of woman and that of the Ministry of Agriculture was poor in following and caring for this kind of farming. This might be due to the lack of technical teams. The feasibility study for this kind cultivation is very high compared with rain-fed cultivation (21 folds) and that the cost of producing a kilo of barely is 4 NIS. This kind of cultivation could be the optimal alternate for the production of feed (fodder) at reasonable prices, and the produced barely could be complementary nutrient for cattle at 50%- 70% in a safe and cost-effective way.

summary: This study has been conducted in the period between the months of September, 2014 and November, 2015 It covered the hydroponics farmers in the West Bank. At the end of the study, the researcher made some suggestions that supports this kind of agronomics and to promote its role in securing the water and food security. He emphasized that the government and private parties should support and embrace this idea and they should find solutions for the points of weakness and work to coordinate between these institutions and follow up on the projects after they have been implemented..

Acknowledgment:

I would like to acknowledgment the Federal Ministry of Education and Research (BMBF)/ SMART project. For funding the master work. And PWA staff for there supply



The Use of Economic Water Allocation Models in Regional Planning – Tulkarm Governorate a case study

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¹Birzeit University

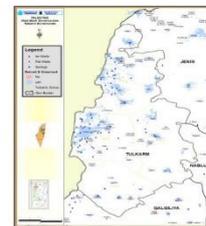
²Palestinian Water Authority (PWA)

Research Background: The shortage of water resources in Palestine in addition to the political situation makes the efficient and sustainable water resources management very difficult and faces many challenges to fill the gap between the demand and the existing and available supply. This study focuses on developing a model using the Multiyear Water Allocation System (MyWAS) tool which is an optimizing tool designed specifically for Palestine, Jordan and Israel. This model is a powerful and innovative tool that enables the cost- benefit analysis and can be used as a DSS to guide decision makers at all levels of water management

Methodology: (i) Data Collection and Manipulation: Tulkarm governorate was divided into four clusters: (Deir Al- Ghusun Cluster, Anabta Cluster, Tulkarm Cluster, and Al- Kafriyyat Cluster) (ii) Modelling of the Current Water Conditions. (iii) Scenarios Development: Three scenarios were adapted in order to study the different management options in Tulkarm Governorate (*the Status Quo scenario, the Full Application of the Oslo Agreement scenario, and the Water Spring Scenario*). (iv) Based on these three scenarios different management options were analyzed for the Tulkarm Governorate, and finally a comparison between these management options was made based upon an economic evaluation.

Area of study (Tulkarm Governorate):

The case study was Tulkarm Governorate in the northern part of West Bank (Map 1), which suffers from lack of water in the rural areas, land confiscation by the separation wall, high UFW in the water network system and deteriorated water quality in the water supply. The population of the Tulkarm Governorate is estimated at about 165,791 in 2010. The per capita average water supply in the governorate is about 76 l/c/d and the per capita water consumption is 46 l/c/d, (PWA, 2010). The UFW in the system is about 40% which is one of the highest in the West Bank.



Map 1: Tulkarm Governorate, West Bank

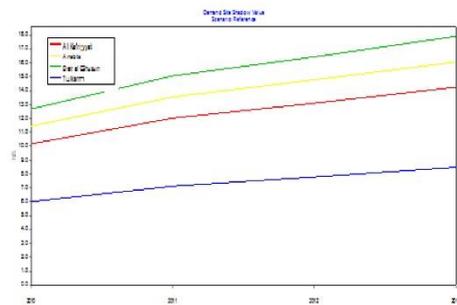


Fig. 1: Shadow Values for each cluster in Tulkarm Governorate in 2010.

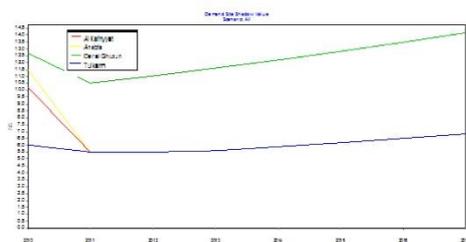


Fig. 2: Shadow Values for Status Quo Scenario until year 2017

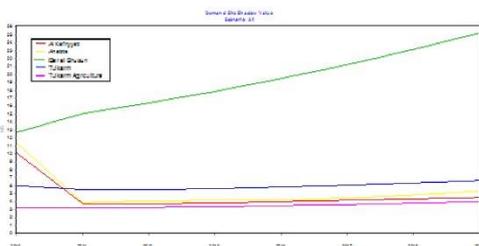


Fig. 3: Shadow Values for Water Spring Scenario until year 2017

Results:

- In the current situation the shadow values for each cluster had been obtained show large differences between clusters – notably Deir al Ghusun and Tulkarm, with a difference of about 6 NIS indicating the possible benefits in conveying water from Tulkarm cluster to Deir al Ghusun cluster. These shadow values means each cluster in the governorate is willing to pay this price to get one cubic meter of water as an extra. (Figure 1)
- Under the scenario of Status Quo until the year 2017 the management options that can be achieved are the rainwater harvesting, the water import from Mekorot, and to apply a demand management policy in the governorate. (Figure 2)
- Under the scenario of Water spring until the year 2017, the management options that can be achieved are developing new renewable water from Western aquifer Basin, Wastewater reuse, rainwater harvesting and demand management policy. (Figure 3)

Summary:

- Under the Status Quo scenario, it is obvious that the existing conditions cannot continue into the future as the shadow values reach to very high values around 85 NIS and more. The set of management options taken under this scenario were efficient in solving the problem as it lower the shadow values to around 6.5 NIS.
- The wastewater in Tulkarm governorate is a necessary management option in the three proposed scenarios, and accordingly the water reallocation from the agriculture sector to the domestic sector is very important and feasible.
- Rainwater harvesting is a preferable management option especially in the clusters that suffer from shortage of water, as it has low maintenance and operation cost.



The Effect of *Bacillus Megaterium* on Barley Tolerance to Salinity

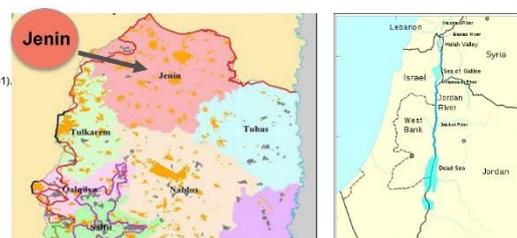
Jardaneh H,
An-Najah National University

Research Background: Salinity is abiotic stresses and one of the most important environmental parameters that affect on Barley growth and more harmful to crop plants. In Palestine the Jordan Valley is a fertile productive region, described as the food basket of Palestine. Groundwater originating from the Quaternary Aquifer System forms the main water resource in the Jordan Valley. The quality of this groundwater is threatened mainly by the high chloride concentration. The use of Plant Growth Promoting Rhizobacteria (PGPR) such as *Bacillus Megaterium* is a promising strategy to alleviate salt stress in horticultural crops and to maintain an acceptable level of productivity under higher salt concentrations (Fig. 1).

Methodology: (i) Plantation of three barley cultivars: Reehan, ICARDA 5 and Nabawi. Sum of 5 seeds per pot was used under greenhouse conditions. Salinity treatments: (ii) Irrigation with five salinity levels 0, 50, 100, 150 and 200 mM of NaCl after three weeks of seed germination (iii) Bacterial inoculation by irrigation of the soil with 1.5 ml/plant of *Bacillus Megaterium*. The experiment consists of two parts, one part with bacteria inoculation and the other part without bacterial inoculation. (iv) The response of plants to the treatments monitored for the following parameters; vegetative growth at maturity, including plant height, number of tillers, leaf area, leaf number, peduncle length, awn softness, total dry weight per plant, total fresh weight per plant and chlorophyll contents (V) Evaluation the mineral composition of shoot and roots: K⁺, Ca²⁺, Na⁺, Cl⁻, N, and P.

Area of study:

At National Agriculture Research Center (NARC) in Jenin area- West Bank in Palestine (Map1). The study conducted under greenhouse condition in order to evaluate the efficiency of *Bacillus Megaterium* on reducing the effect of salinity on Barley (Map 1).



Map 1: Jenin, West Bank, Palestine



Fig. 1: Barley with Bacterial inoculation



Fig. 2: Barley without Bacterial inoculation

Results:

1. *Bacillus Megaterium* enhanced the ability of plants to tolerate salinity stress and significantly reduces the effect of salinity on chlorophyll content in three landrace.
2. Texture influenced with salinity level as *Bacillus Megaterium* inoculation increased the level roughness of awns.
3. Reehan landrace was not affected by bacteria inoculation for leaf length, leaf number and width.
4. In Icarda 5 and Nabawi Landraces at 100-150 mM Bacterial inoculation reduced the impact of salinity on leaf length, width and number, root weight, shoot weight and plant height which are growth parameters
5. The Sodium accumulation levels decrease in shoot and root of plant which inoculated with bacteria..
6. Low Sodium accumulation in plant inoculated with Bacteria was observed at 200 mM NaCl especially in the shoot and root of Icarda 5 and Nabawi.
7. Bacterial inoculation reduces the accumulation of Chloride in shoot and root of Reehan and Nabawi.
8. Plant Growth Promoting Rhizobacteria increased the accumulation of Phosphorus and N in Reehan, Icarda5 and Nabawi at moderate to high salinity.
9. Bacterial inoculation have positive effect on the accumulation of Potassium in barley root at high level of salinity
10. Bacterial inoculation reduces the accumulation of Phosphorus in shoot at low and high salinity level however at salinity level 100mM the response was opposite.

Summary: In Palestine, Soil and water salinity is one of the most important environmental parameters that impact on the growth of barley and more harmful to crop plants. Although barley (*Hordeum vulgare L.*) is regarded as salt tolerant among crop plants, its growth and plant development is severely affected by ionic and osmotic stresses in salt-affected soils water (Fig.2). *Bacillus Megaterium* stimulate plant growth under saline conditions and improve nutrient uptake.



Synthesis of 1-(Pyrrol-2-yl) imine modified silica as a new sorbent for the removal of hexavalent chromium from water

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Research Back Ground : The water pollution of the most intractable problems faced by the countries of the world, without exception. Heavy metals can be defined as any metal or metalloids have density more than 4 g/cm³. One of the most important and toxic heavy metals in wastewater is chromium. Chromium (VI) is released from different industrial operations. The traditional separation and preconcentration methods for metal ions are liquid-liquid extraction, coprecipitation , and ion exchange. Chemically modified Polysiloxane is one of the most successful adsorbents, because this inorganic polymer support does not swell or shrink like the organic polymeric resin.

The aim of this study is to remove Cr (VI) from wastewater, using this prepared material as an adsorbent for the solid-phase extraction. The adsorption behaviors of the adsorbent with Cr (VI) has been studied.. Adsorption isotherms, adsorption kinetic and thermodynamics has been studied by varying the following three parameters: initial concentration of Cr (VI) solution, volume of the Cr (VI) solution, and adsorbent dose on the uptake of Cr (VI) from the solution.

Methodology:

A- Synthesis of adsorbent 1-(pyrrol-2-yl)imine-Substituted Silica (SiNPr) .

To prepare the (SiNPr), a mixture of pyrrol-2-carbaldehyde (1.5 g) and 3-aminopropylsilica (SiNH₂) (2.5 g) in 50 mL of dry diethyl ether was mixed and stirred for 24 h. At room temperature, the solid residue was filtered, acetonitrile, methanol and dichloromethane was used in Soxhlet extraction of the product for 10 h. The desired solid product was dried completely over more 24 h. The synthesis step is shown in Figure .1

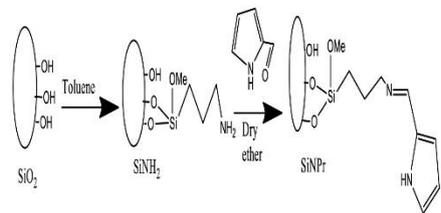


Figure 1: The synthesis step of (Si-NPr)

B- Recovery of Cr(VI) and reusability of Si-NPr

Recovery of Cr (VI) from the Si-NPr was achieved at room temperature. The first step was filtration to collect the adsorbent. The second step was washing the adsorbent with portions of 2M NaOH then washing with deionized water, and finally left the adsorbent to desiccate at room temperature for three days. 0.01g of the regenerated adsorbent was added to a 15 mL of 20 ppm Cr (VI) solution at pH 4 in order to compare the adsorption capability of the regenerated Si-NPr with fresh adsorbent..

Result:

A- Batch Experiments:

- Contact time effect on Cr (VI) adsorption :** During the first 5 min, rapid adsorption of Cr (VI) was detected (Figure 2)
- pH effect on Cr (VI) adsorption :-** At low pH such as 2 to 4 there was increase of the adsorption capacity for Cr (VI). When pH is further enhanced, a sharp decrease in uptake capacity of adsorption was noticed. (Figure. 3).
- Temperature effect on Cr (VI) adsorption :-** increasing the temperature above the room temperature (25oC) has effect on decreasing the adsorption capacity of modified surface. (Figure4)
- Cr (VI) concentrations effects :** the percent removal of Cr (VI) increases with increasing initial concentration of Cr (VI) until 20ppm. Above 20 mg/L initial concentration of Cr (VI), the percentage removal of Cr (VI) ion reduced. (Figure 5).

B- Recovery of Cr(VI) and reusability of Si-NPr

Figure 6 showed that regenerated adsorbent have good adsorption capability and excellent stability. Results confirmed the possibility of use of adsorbent again without reducing the efficiency of adsorption

Conclusion:

- Over 86% removal efficiency of Cr(VI) was achieved after 5 min. at solution pH around 4, 25°C temperature, 0.01 g weight of dose and initial concentration of 20 mg/L of 15mL Cr(VI) solution.
- It was found that adsorption of Cr(VI) using (Si-NPr) is explained well by Langmuir, Freundlich isotherm models, but adsorption of Cr(VI) onto (Si-NPr) fits most with Freundlich model.
- Si-NPr matrix removed Cr (VI) from wastewater and it was recyclable for a promising degree .

Acknowledgment:

I would like to acknowledgment to all my doctors, my parents and my friends and PWA For funding the master work

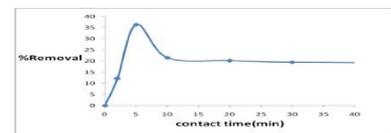


Fig. 2: Effect of Contact Time

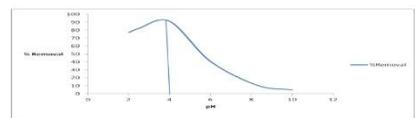


Fig. 3: Effect of PH

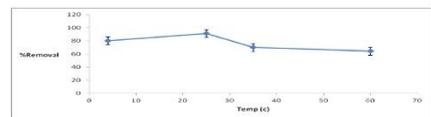


Fig. 4: Effect of Temperature

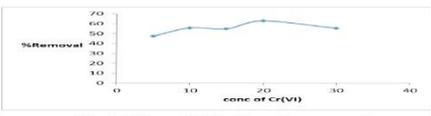


Fig. 5: Effect of Adsorbate Concentration

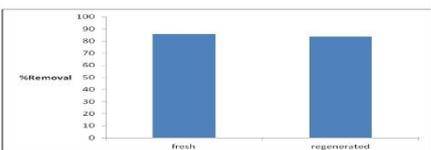


Figure 6: Percentage of Cr (VI) removal by recovered adsorbent



Life Cycle Assessment of RO Water Desalination System Powered by Different Electricity Generation Alternatives

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¹An-Najah National University

Research Background: As a need for a new water resource that meets the water consumption, RO desalination technology seems to be a suitable alternative as explained above. Therefore, it is important to evaluate the RO system, considering the environmental and economic effects of the system. Since the process energy requirement is high, the evaluation will be for RO system based on three different sources of energy which are PV, electricity generated from coal and electricity generated from natural gas, through a scientific methodology, figure 1 shows the LCA system boundaries of RO-PV system. In this study, the alternatives are environmentally-compared using the life cycle assessment (LCA) tool. This study will contribute to solve the shortage of fresh water in AL-Murashahat area by using Al-Fashkha springs water source.

Methodology: This work will be done by life cycle assessment (LCA) methodology; in general by four steps. (i) goal and scope definition, are designed to obtain the required specifications for the LCA study. (ii) inventory analysis, which includes collecting all data of the unit processes within a product system and relates them to the functional unit of the study. (iii) impact assessment phase aims at making the results from the inventory analysis (IA) more understandable and more manageable in relation to human health, the availability of resources, and the natural environment. (iv) the interpretation phase, which aims to evaluate the results from the inventory analysis or impact assessment and compare them with the goal of the study defined in the first phase

Area of study (Al- Fashkha springs):

The case study for this project will be Al- Fashkha springs where the desalination plant will be; the beneficiary of permeate water will be Al-Murashahat area.

Al- Fashkha springs are located on the northwestern shore of the Dead Sea at the foot of the escarpment cliff, and is 6.5 kilometers long and about 3 kilometers south of Qumran Wadi. The springs, which are 10 springs, emerge at 390 meters below sea level as shown in map 1.



Map 1: Location map of the study area

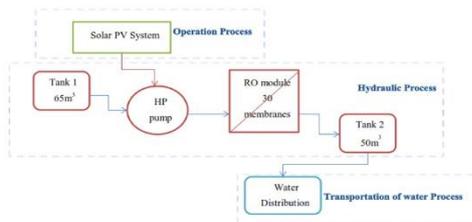


Fig. 1: LCA system boundaries of RO-PV system

Results:

1. For all systems, it was found that the water distribution process contributes most to the overall environmental impact followed by the operation process, as shown in figure 2 for RO-PV system, but because of using delivery water trucks (5 trucks per day for 20 years).
2. If the water distribution process is eliminated from the systems, the operation process will be the main contributor of the life cycle assessment for the three systems. Across all impact categories the RO-PV system has the least environmental impact. However the RO-coal electricity system has the largest environmental impact, this is due to the large amount of energy consumption and the used source of the energy (i.e. coal power station), as shown in figure 3.
3. The three systems recorded high results in marine aquatic eco-toxicity indicator. The RO-PV system seems the most friendly to the ozone layer. The highest impacts of human toxicity come from the RO-coal electricity system.
4. In conclusion the total cost of 1m³ water produced by RO-PV System calculated to be 1.8 \$/m³, however the total cost of 1m³ water produced by RO-electricity systems calculated to be 1.27 \$/m³ (coal or natural gas). The cost of water produced by RO-electricity systems (coal or natural gas) is lower than the cost of RO-PV system, this is due to the high cost of PV batteries in RO-PV system. Furthermore, the cost of water distribution between Al-Fashkha springs to Al-Murashahat area by delivery trucks for 1m³ calculated to be 7.14 \$/m³, which is constant for the three systems.

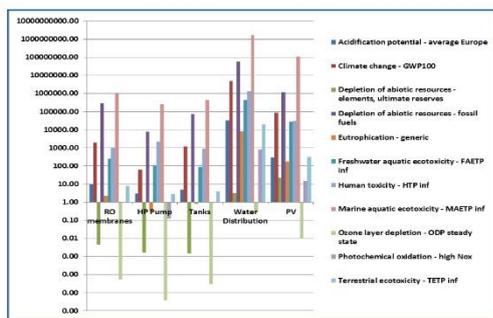


Fig. 2: The impacts of all processes together for RO-PV system

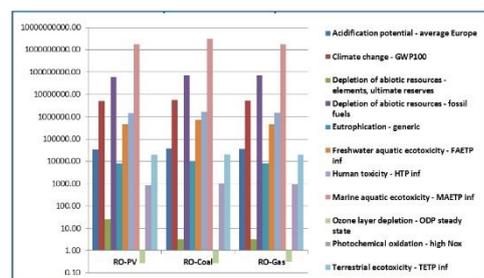


Fig. 3: Comparison between the impacts of all processes in the three systems

Summary: In this study a life cycle analysis was performed on three RO desalination systems. The first system is RO system operated by PV (RO-PV system). The second system is RO system operated by electricity generated from coal (RO-coal electricity system). The third system is RO system operated by electricity generated from natural gas (RO-natural gas electricity system). The open LCA software, Ecoinvent database was used, and the CML baseline LCIA method was chosen for the evaluation of systems impact on its 10 categories for functional unit of 50 m3/day.

Across all impact categories the RO-PV system has the least environmental impact, however the RO-coal electricity system has the largest environmental impact.



Evaluation of Groundwater Resources In Kufr-Dan Area Using Groundwater Modeling

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¹Palastinian Water Authority, ²Al-Quds University

Research Background: The shortage of the water resources in the West Bank, due to police, overexploitation and mismanagement, are of great importance. Ground water is the main source of drinking water in Palestine. It is also one of the most important resources for agriculture. The amount of water used for domestic purposes in the West Bank in 2015 was estimated at 119.6 MCM (PWA,2015), with an average daily water supply rate of 70 litres per person.

This study has been conducted in the village of Kufr-Dan which aims at studying the shallow aquifer in the area which is Eocene Aquifer.

There are 73 wells tapping the Eocene aquifer. Most of them are dry due to over pumping. From the conceptual model there is an amount of 2,500 m³/day that enters the northern part of the study area. Figure (1).

Methodology: This study used Groundwater Modeling System (GMS) to develop a conceptual model on the basis of data from cross sections that were taken from several boreholes after conducting a geophysical survey to calibrate a numerical Model, by using GIS Database, Profile Models and Water Budget.

Area of study:

Kufr-Dan village is one of Jenin governorate villages, located about 2.5 km west of Jenin city. It is an extension of Marj Ben Amer. Its area is about 7,500 donums which include 300 donums of urban area. Locate by Burqin village from the south; and Al-Yamoun village from the west. And it is about 160 meters above sea level. Figure (2).

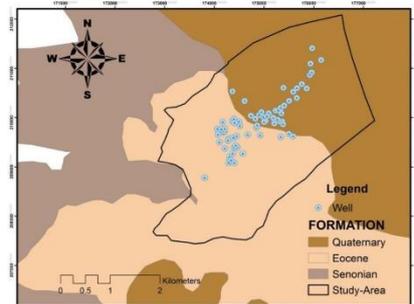


Fig. 1: Well locations in the study area and Boundary condition

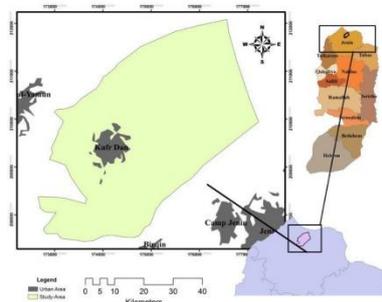


Fig 2: Kufr-Dan village , Jenin, West Bank

Water Table

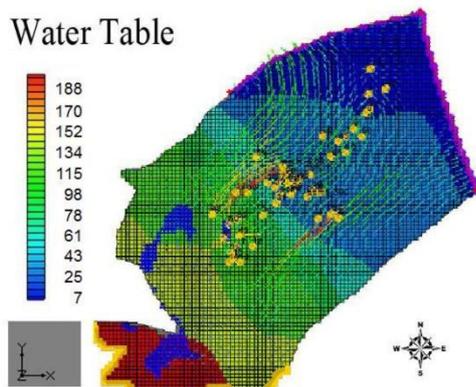


Fig. 3: The Conceptual model of study area for scenario of artificial recharge.

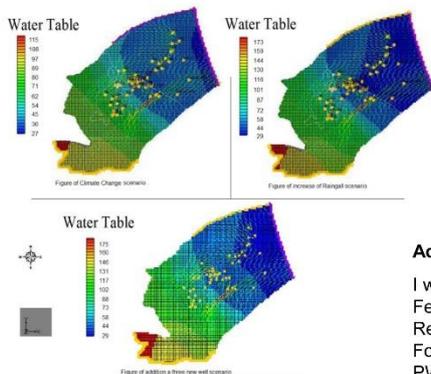


Fig. 4: The conceptual model of study area for the three scenarios

Results:

Groundwater flow direction is downward to the northern and northeast sides of the study area. The artificial recharge should be addressed by treated wastewater from nearby Jenin wastewater plan. which will produce roughly 3,570 m³/day treated water (Jenin Municipality, 2012), to inject and distribute it into the selected dry wells in the study area. The yield of the wells in the area has improved according to the suggested groundwater recharge, it is obvious that it is possible to pump water up to 4.85 MCM. Which is enough to meet the water demand of the farmers in the area. Figure (3).

Study use four scenarios based on (i) artificial recharge, (ii) climate change, (iii) increase of rainfall by 10% that is based on the previous years. (iv) and the final scenario is based on the addition of three new wells. Figure (4).

The total quantity of recharge water for model is determined from rainfall (88%) is 1.99 MCM, leakage from network water (0.5%) is 0.0125 MCM, the quantity of infiltration water from cesspits (1.4%) is 0.033 MCM, and the quantity of residual water that passes through irrigation (10%) is 0.23 MCM. The total input and output from model was 2.98 MCM/year 2012/2013. The wells abstraction from the model is 2.13 MCM/year which is about 70% of the aquifer budget.

summary:

Four scenarios have been applied based on the model, the best one is the artificial recharge that meet a water demand for irrigation in study area by improve well productivity and this will be improve the crops.

If stay the situation as it, can be increase the quantity of water in the area by drilling three wells in the north-eastern zone, with a capacity of 40m³/h for each well, so the total quantity of the wells is estimated at 2.9 MCM. But this amount does not meet the needs of farmers.

Acknowledgment:

I would like to acknowledgment the Federal Ministry of Education and Research (BMBF) SMART project. For funding the master work. And PWA staff for there supply



Impact of Using Desalinated Brackish Water on Chemical and Physical Characteristics of Heavy Saline Soil

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 Ministry Of Agriculture¹, BIRZEIT University²

Research Background: The impact of using desalinated water on soil properties still under investigation in the world despite of desalination water process is used since 50 years ago, the majority of the researches were conducted to study the economic visibility of using desalinated water as alternative of water resources over the world in different locations and conditions. In addition few researches focusing on impact of using desalinated water on soil fertility status on the sandy soils which is consider light soils to study the deficiency of nutrients on plants irrigated with desalinated water. The impact of using desalinated water for irrigation is not investigated before under the local conditions in Jordan rift valley with saline clay loam soils.

Methodology: The applied research was carried out at one of the effected lands of saline farms in Marj Na'aja village, where the desalination unit provided by MoA is located. Four types of water, based on TDS content were considered, namely: T1 Desalinized water with TDS of 200 ppm. T2 blended water with a final TDS of 750 ppm. T3 blended water with a final TDS of 1600 ppm. T4 Raw brackish water with TDS of 4500 ppm. Soil sampling were conducted two times at four depths of 0-15, 15-30, 30-45, and 45-60 cm, before the crop season and after the crop season to measure the soil chemical properties, in the experiment, plant tomato. Plant spacing 80 cm, drip irrigation system was used with emitter spacing of 80 cm and raw spacing of 1.2 m. amples at each depth with 10 cm distance between sequent in the X-Y direction.

Area of study: The research was conducted in Marj Na'aja village which is located to the Northern part of the Jordan Valley (32° 10' 56.74 N, 35° 10' 28.33 E) and about 40 km north to Jericho, and lays 270 m below sea level as shown in Figure . According to the soil analysis and land observation the soil is classified as saline soil with high content of sodium as a result of using low quality water with high TDS reaches 4500 ppm. The cropping pattern in the study region is mainly vegetables and some date palm and field crops. The total cultivated lands equal 111.3 hectare in which 93% of it is cultivated by vegetables and palm trees (MoA, 2010).



Map 1: Marj Naaja village , Jericho, West Bank

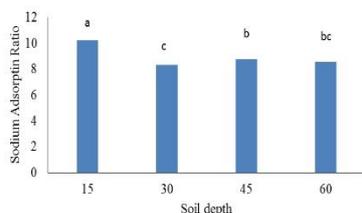


Fig. 1: Soil SAR for all depths in T1 (200 ppm)

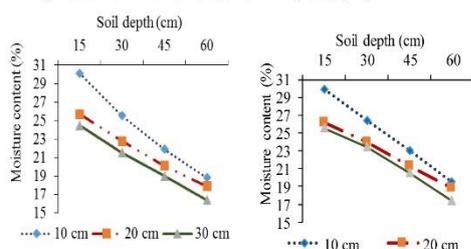


Fig. 2 Soil moisture content for T1 (200 ppm) and T4 (4500 ppm) / stage one

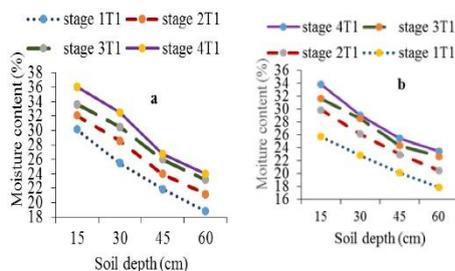


Fig. 3 Soil moisture content for T1 (200 ppm) at the different stages and depths for a: 10 cm horizontal space; b: 20 cm horizontal space

Conclusions:

1. Irrigating heavy saline soils with desalinated water increases the Sodium Adsorption Ratio (SAR). SAR was clearly increased especially in first 15 cm even worse than brackish water, SAR value was increased from 8.17 to 10.21 in the surface soil layer (15 cm) whereas SAR was slightly decreased in the T2 (750 ppm), T3 (1600 ppm) which was irrigated with blending ratio and T4 which was irrigated with raw brackish water with TDS 4500 ppm comparing with blank (Fig1).
2. Irrigating heavy saline soils with desalinated water increases water movement horizontally and decreases water movement vertically as compared with brackish water (fig 2 and 3).
3. Irrigating heavy saline soils with desalinated water negatively affected the soil structure in the surface layer (15 cm), even worse than brackish water, as soil structure was changed from granular and sub angular with medium size and moderate to strong grad, when irrigated with saline soil, to granular and crump with medium size and moderate grade.
3. The optimum blending ration found to achieve the avoiding of soil degradation properties as a result of using desalinated water on heavy saline soil properties is that with total dissolved salts of the irrigation water 1600 ppm.

Recommendations:

- Continuous and comprehensive researches should be continued in the same conditions to overcome any expected negative results on soil properties and plant nutrition.
- Calcium and Magnesium sources should be added or injected with irrigation system or direct to the soil.
- Improving soil physical properties and soil management practises to increase leaching process of the sodium and salinity out of the root zoon.
- Direct supervision form the soil and irrigation experts to follow the farmers whom using desalinated water for irrigation in their farms.
- Blending desalinated with brackish water to increase mainly calcium and magnesium content considered as is low cost strategy.



Engineering Management and Financial Analysis of Al Fashkha Springs Desalination Project

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¹Birzeit University

Research Background:

The Palestinian Water Authority (PWA) is developing plans to utilize Al Fashkha springs (brackish water) in the vicinity of the Dead Sea for domestic and agricultural uses. Much of the water in the Dead Sea springs is discharged haphazardly without any real benefit derived to the surrounding environment. Aimed at utilizing this discharge, this research investigates the utilization of construction of a desalination RO plant capable of desalinating the brackish water discharged from Al Fashkha springs with an overall capacity of desalinating 22 MCM/year. Moreover, this research suggests clear options of utilizing the desalinated water from the proposed project of Al Fashkha springs which entails the establishment of water conveyance systems for the benefited communities. In addition, the costs associated with the construction and operation of this project are considered as main constraint and have been investigated. Management models of the establishment and operation of such a large scale non-conventional project were also investigated and extended to PWA.

Methodology: (i) Data collection from relevant authorities, basically from PWA, including available reports, maps, studies, and the submitted PWA proposal to donor agencies for establishing the proposed Al Fashkha springs desalination project. (ii) Description of the existing baseline environmental conditions of the Al Fashkha springs was developed in support of taking water samples from the springs and creation of visual GIS maps representing the different environmental aspects of the area. (iii) Laying out conceptual design for the conveyance systems of the desalinated water from Al Fashkha springs that was done in constant stakeholder consultation. After setting out the conceptual designs, detailed hydraulic designs were developed. (iv) Establish management framework for running such a non-conventional large scheme project. (v) Selection of the desalination technology and the conveyance system for the desalinated water associated with its capital and running costs was done after evaluating the developed options. Moreover, the management framework for the project was set out and finalized.

Area of study (Al Fashkha springs):

The study area is considered as a part of Jordan Rift Valley. The Jordan valley contains one of the richest water resources in the West Bank which is Al Fashkha springs. They are located in a nature reserve and archeological site located in the north-west shore of the Dead Sea (400 m below mean sea level) and about 3 km south of Qumran wadi. They are composed of ten brackish springs within close proximity to each other; the volume of brackish water discharged by these springs could be around 80 MCM per year which runs eastwards towards the Dead Sea.

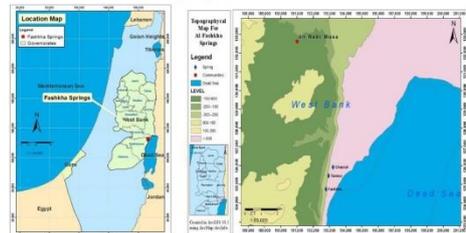


Figure (1): Location map of Al Fashkha springs

Results:

1. Available records show that Al Fashkha springs have relatively high values of Total Dissolved Solids (TDS) ranging from 1500 to 5000 (mg/l) making them considered as brackish water. During the course of this research work, three water samples were taken from Al Fashkha springs and were tested at PWA and gave the following average results: TDS (2087 mg/l), Salinity (1700 mg/l) and EC (3810 μ S/cm). These results show that the water of Ein Al Fashkha is considered as brackish water.
2. The Al Fashkha – Jericho selected conveyance route has an overall estimated length of (20.5 km) and estimated elevation difference of (150 m) with an overall estimated construction cost of (\$6 millions) associated with daily operational non-stopping pumping costs of (\$17,000) based on the capacity of the plant to desalinate and pump 22 MCM per year (60,000 m³/day). The calculated overall cost (desalination and conveyance) per cubic meter is 0.85 \$/m³.
3. The Al Fashkha – Al Ubedeyya selected conveyance route has an overall estimated length of (24.5 km) and estimated elevation difference of (950 m) with an overall estimated construction cost of (\$8.8 millions) associated with daily operational non-stopping pumping costs of (\$29,000) based on the capacity of the plant to desalinate and pump 22 MCM per year (60,000 m³/day). The calculated overall cost (desalination and conveyance) per cubic meter is 1.06 \$/m³.
4. Build-Operate-Transfer (BOT) contract is suggested to govern the management of this project. The BOT agreement is suggested to be signed between potential Consortium of international companies (Al Fashkha Springs Desalination Company) and a government agency, which is the Palestinian Water Authority (PWA) or the potential National Water Company. The agreement is proposed to have a period of 25 years. The production of the Plant will be sold to the PWA or the potential National Water Company within the project site where the water company then distributes to the respective community via the established regional water utility through the constructed conveyance system.

Summary:

Al Fashkha springs are considered one of the richest water sources in the West Bank with an estimated overall discharged volume of 80 MCM per year which runs eastwards towards the Dead Sea. Sampling results of Al Fashkha springs show that the water of these springs is considered as brackish water the following average results: TDS (2087 mg/l), Salinity (1700 mg/l) and EC (3810 μ S/cm). This research assessed the financial feasibility and proposed management model of the utilization options of the PWA proposed reverse osmosis desalination project for Al Fashkha Springs which has an overall capacity of desalinating 22 MCM/year. In this research, and after discussion and agreement with PWA, two options of utilizing the desalinated water have been analyzed including the "Al Fashkha - Jericho" in Jericho Governorate and "Al Fashkha – Al Ubedeyya" in Bethlehem Governorate. The overall calculated cost (desalination and conveyance) per cubic meter for the Al Fashkha – Jericho option is 0.85 \$/m³. While for the Al Fashkha – Al Ubedeyya option is 1.06 \$/m³. The BOT agreement is suggested to be adopted for running this project. This research has shown that the proposed Al Fashkha Springs Desalination Project could be a realistic option for PWA to consider in the future as it will create a new vital water resource that will alleviate the local water supply/demand gap particularly in the southern West Bank.

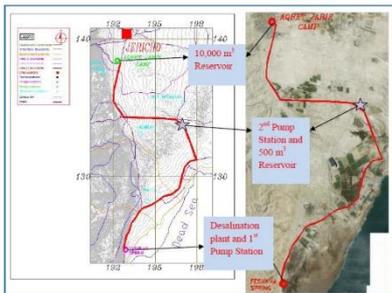


Figure (2): Al Fashkha – Jericho Option



Figure (3): Al Fashkha – Al Ubedeyya Option

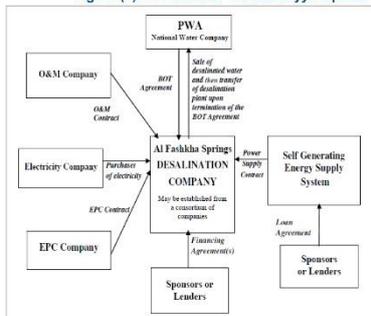


Figure (4): Proposed Management Model of Al Fashkha Springs Desalination Project



Small Scale Waste Water Treatment Plants in West Bank: Comparative Study

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Al-Quds University

Research Background: Palestinian territories are suffering from water shortage. High population growth generate a large amount of wastewater with sanitation problems, which causes diseases related to the contamination in drinking water, so the demand for clean water is growing. The wastewater situation in the West Bank is not quite as alarming, but is serious nonetheless. Roughly (91%) of the population relies on septic tanks for temporary storage of wastewater, none of which is treated. The majority of these septic tanks are emptied through private-sector vacuum trucks which discharge their contents into the closest Wadi. Of the 9 percent that is collected by sewers and sent to one of seven treatment plants, only that of al Bireh Municipality is functioning properly. The result is that roughly 25MCM of untreated wastewater per year is discharged into the environment at over 350 locations.

Objectives : The main objectives are:

- 1- To identify the small scale wastewater treatment plants that is operational in West Bank.
- 2- To analyze the efficiency of treatment of selected small scale WWTPs.
- 3- To analyze the economy of treatment of selected small scale WWTPs that can help the decision makers to identify the appropriate WWTP technology for Palestine.

Area of study: In this work, a comprehensive contrast between small scale waste water treatment plants that are located in deferent regions in Palestine utilizing different technologies is presented. During this investigation, eleven WWTPs have been visited. Two of these plants were found not functioning, four were found in bad conditions, and five plants were found functioning properly. Wastewater grab samples from the influent and effluent were taken from the selected plants once every month during the experimental period from January 2010 to December 2011.



Figure 1:, West Bank map

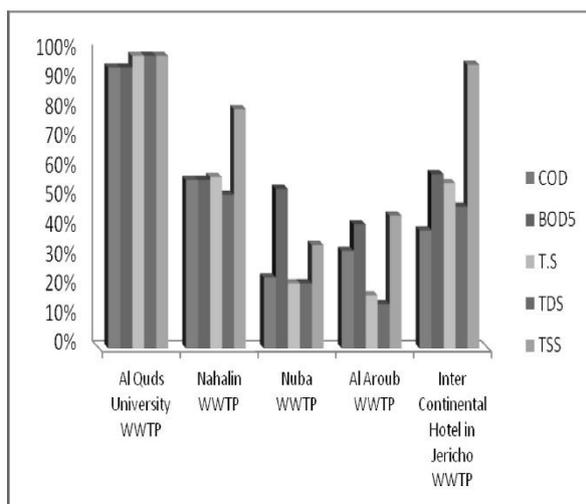


Figure (2): Comparative between the efficiency of the visited WWTPs

Table(1) Cost of treated one cubic meter of waste water

Name of the WWTP	Type of the technology used	Capacity of the WWTP	Cost/ m ³
Al Quds University	Reverse Osmosis	50 m ³ / day	10 Nis
Nahalin	Activated Sludge	50 m ³ / day	2.5 Nis
Nuba	Wetland	120 m ³ / day	0.7 Nis
Al Aroub	Wetland/ Duck weed	50 m ³ / day	1.0 Nis
Inter Continental Hotel In Jericho	Activated Sludge	2000 m ³ / day	2.0 Nis

Results:

- 1- The cost of treating one cubic meter by Reverse Osmoses technology was 10 Nis, this cost is for the three unit of treatment in Al- Quds University WWTP (Ultra filtration Hollow Fiber, Ultra filtration Spiral Wound, and Reverse Osmosis),
- 2-The cost of treating one cubic meter by the Activated Sludge Technology was between 1.7- 2.5 Nis,
- 3- The cost of treating one cubic meter by the Wetlands was about 0.5 – 1.0 Nis. This was only the operation and maintenance cost.

If we compare the cost of the treating waste water with the efficiency of the plants we find that the best technology that can be used to treat waste water was the activated sludge

Summary: Based upon this work and the experimental work done, the following points can be concluded.

- 1- The unfair distribution of water resources and the denials of the full control of the Palestinians over their natural water reservoirs had make most of the Palestinian municipalities and villages suffering from the shortages in fresh water supply especially in summer.
- 2- Wastewater in Palestine has a high reuse potential. New recycling techniques should be employed to make use of the wastewater discharged.
- 3- The reuse of treated wastewater in agricultural production in Palestine is still on the pilot scale and the Palestinians lack the proper experience in using this resource in a safe and sound way.
- 4- If we compare the cost of the treating waste water with the efficiency of the plants we find that the best technology that can be used to treat waste water is the Activated Sludge (AS).



Palestinian Water Regulation to Promote Good Governance, Case Study in Jerusalem Water Undertaking

Marwan "Mohammad Said" Abd-Alrahman Bdair, Dr. Abd Alrahman Al Tamimi, Al-Quds University

Research Background: The research aims to identify the role of the regulatory functions of the Palestinian water sector in promoting of good governance, taking the case study Jerusalem Water Undertaking. Through which it will recognize the reality of the application of the Palestinian water sector regulation and its role in promoting good governance, also study the relationship between the regulation of the water sector tools and their role in promoting good governance in Palestine will be studied.

Methodology: The research used the descriptive approach, analytical, qualitative study of mixed-style, future studies i.e. Delphi studies style, focusing on the impact of the independent variables on the dependent. The study offers a detailed description of the procedures followed by the researcher in the implementation of the research, how the information was collected and documents from sources and interviews.

Area of study: Jerusalem Water Undertaking is located in the Ramallah and Al-Bireh Governorate (Map 1). The service area extends over an area of 600 km², which currently includes the cities of Ramallah and Al-Bireh, 10 other cities and municipalities, more than 43 villages, 5 refugee camps and the northern part of Jerusalem. The number of subscriptions is approximately 61,000, serving a population of approximately 370,000, and for the remaining sites in the governorate, receives water through West Bank Water Department (Jerusalem Water Authority website, 2016).



Map 1: Jerusalem Water Undertaking, West Bank

Results: the study found (table 1) that there is a positive role for regulatory functions and their tools of the Palestinian water sector in the promotion of good governance. The results show that the theme of "The role Palestinian water sector regulatory function in promoting good governance" and the most important item from this discussion is the "new water law", followed by the second theme "The role of handling complaints of citizens in the promoting of good governance", followed by the theme of "The role of water tariff, technical and financial indicators, finally, "The role of community participation of regulatory function in the promoting of good water governance". The results have been applied on the case study which is Jerusalem Water undertaking; where it was found that there was similarity of the results in terms of the role of the water sector regulation in the promotion of good governance.

Table 1: identify the role of the Palestinian water sector regulation functions in promoting good governance arranged the themes and their most important element,

Number theme	Elements of the regulation function to promote good governance	Rate of Evaluation
1	The role of the regulatory function of the water sector in Palestine in promoting good governance	4.28
element	The new Water Law has added value to the regulation of the Palestinian water sector to promote good governance	4.47
2	The role of regulating the handling of citizens' complaints to promoting good governance	4.25
element	addressing citizen complaints is supportive of raising the satisfaction of the recipients of the service lead to the promotion of good governance	4.53
3	The role of monitoring technical performance indicators in the promotion of good governance	4.19
element	Monitoring technical performance indicators promotes efficiency and sustainability of water system for water service providers that promote good governance	4.53
4	The role of water tariffs in promoting good governance	4.17
element	efficiency in economic pricing of higher consumption levels to promote water conservation here is a role to play in achieving sustainability of the water sector by achieving economic	4.42
5	The role of monitoring financial performance indicators in promoting good governance	4.07
element	Enhancing financial sustainability that sustains the services provided promotes good governance	4.47
6	The role of community participation in the organizational function in promoting good governance	3.88
element	The community participation of the organizational function must be institutionalized	4.32

Conclusions: there is a gap in the current Palestinian legal framework of water sector regulation, and that the legal modifications contain in the new Water Law No. (14) Year 2014 on water, it was of utmost importance in the role of the water sector regulation in the promotion of good governance, through the separation of mandates and tasks within the new restructuring of water sector. There is a role for regulation tools, from handling of complaints, monitoring technical and financial performance indicators, role of water tariffs, and role of community participation in the regulatory function of promoting good water governance.

Recommendations: The study performs several recommendations including, bridging the gap of the legal framework in water sector regulations, through the issuance of some legal decree by law, accelerate the establishment of National Water Corporation and Regional Water Utilities, and the Palestinian government to solve the problem of indebtedness of government institutions and camps. The water service providers have to do some actions to achieve the goals of regulation tools, including separation of water complaints center, re-adjust water tariff through economic pricing levels for high consumption, and improving technical performance indicators, most importantly of which is to reduce the non_revenue water and overall performance.



Prediction of Pipes Break in Water Distribution System Using Data Mining Tools “Case Study Nablus Municipality”

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Arab American University- Jenin

Research Background: The water loss from water distribution networks is one of the most serious problems leading to water shortage in Palestine. Some studies showed that the rates of water loss resulting from it are higher than 30%, while other studies argued that in some Palestinian areas this percentage reaches up to 50%. Pipe breakage is one of the main causes of water loss from water distribution networks. Municipalities in all governorates in the West Bank seek to solve this problem by trying to detect and repair broken pipes in the shortest time possible. researchers presented different techniques that can be applied to improve the entire water management value chain, from data collection to analysis and interpretation. Solutions presented include regression models, data mining algorithms, stochastic processes and genetic programming techniques.

Methodology: (i) understanding the nature of water distribution system and its parts and components.8 (ii) Collection the information related to main pipes and its maintenance. (iii) The data preprocessing, normalization and selection the variable as a prelude to modeling. (iv) three different classification algorithms are used to build seven prediction models for breaking pipes and to classify the pipes according to their breaking possibility into two classes that is Yes or No. (v)The performance evaluation of these models to find the bset and reliable model in the anticipation of pipes' breaks from these models.

Area of study (The water distribution network of Nablus city):

Nablus is a city in the northern West Bank, Located between Mount Ebal and Mount Gerizim. it is one of the largest Palestinian cities. The area of it is 28.6 km². The center of this city is about 550 meters above sea level. The annual rainfall is about 660.1 mm while the humidity is about 61% their.



Map 1: Nablus City, West Bank

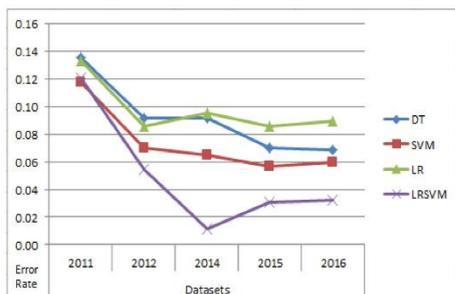


Fig. 1: Error Rate for Models.

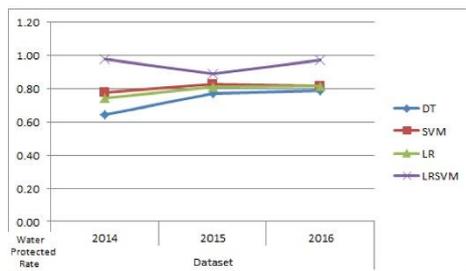


Fig. 2: Water Protected Rate from Loss Water for Models.

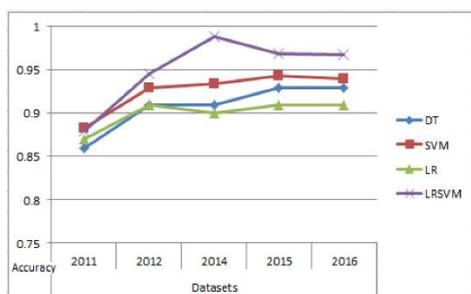


Fig. 3: Accuracy for Models.

Results:

1. Building a new integrated database for pipes in water distribution networks in Nablus, which contains all the data related to all pipelines in the network as well as maintenance data.
2. Building seven binary classification models to predict the break of the pipes based, on the Decision Tree, Logistic Regression and the Support Vector Machine algorithms.
3. When comparing the performance of research models, it was found that the LRSVM model is the most reliable model in the anticipation of pipes' breaks because it gave the best values for most of the calculated performance measures as its error rate varied between 0.01 and 0.12 as shown in Figure 1, and it may be able to save up to 0.97 water from the amount of water lost from the network as shown in Figure 2, with an accuracy rate that may reach 0.99 as shown in Figure 3.
4. This research presented an integrated database for the water distribution network in Nablus.
5. The research models presented the variables that affect the broken pipes, which are Pressure Zone values, type of network and pipe age, material and diameter.

Summary: The water distribution network in Nablus contains from 4810 main pipes, approximately 26% of the water supplied in the network is lost. The pipe breakage is one of the main causes of water loss from water distribution networks.

this research seek to reduce water loss that resulting from broken pipes by solving the problem of broken pipes before it occurs by built a prediction model that combining the Logistic Regression and Support Vector Machine techniques, which is called LRSVM model, which is can be able to save up to 0.97 water from the amount of water lost from the network, with an accuracy rate that may reach 0.99.



Assessment of Vulnerability and Risk Mapping at Marsaba – Feshcha Catchment

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Research Background: This study focuses on Marsaba-Feshcha Basin as one of the most important basins in the West Bank that connected to the Dead Sea due of its location in eastern aquifer and karstic formation. For M-F basin a groundwater vulnerability map have been demonstrated which shows the areas with potential for groundwater contamination on the basis of hydro-geological conditions. The research uses a GIS-based and myObservatory approach called the PI method, which takes into consideration the nature of karst aquifers. Inherent geological, hydrological, hydrogeological, climatological and vegetation data, in terms of thematic layers, were collected and used in the creation of the groundwater vulnerability map of the Study area. Also, the risk map has been constructed in this research by using ArcGIS and myObservatory software based PI map.

Methodology: The European approach has been used in this study in PI method. In this study PI map has been demonstrated by using ArcGIS software, while the risk map demonstrated by using ArcGIS in comparative myObservatory software. The PI Method is a GIS-based approach to mapping intrinsic groundwater vulnerability. The P factor indicates the effectiveness of the protective cover. While I factor expresses the degree to which the protective cover is bypassed as a result of lateral, surface and subsurface concentration of flow, especially within the catchment area of a sinking stream. The map shows the spatial distribution of the vulnerability factor (π), which is obtained by multiplying the P and I factors. myObservatory has been used as collaborative platform for data ecosystem. The myObservatory can use shapefile or raster form in calculation process and it is dynamic data, data that can be used from multiple sources, also have the same Google Earth maps without needing to take any image from Google Earth and georeference it, and survey can be done in the field with offline application that can be uploaded later when it is connected to the network.

Area of study : Marsaba-Feshcha is located in the West Bank to the west of the Dead Sea and the Lower Jordan Valley. Most of Marsaba-Feshcha population is found in the following major cities: Ramallah, Jerusalem and Bethlehem that are all located in the western part of the Eastern Basin. The study area is located in the Eastern Aquifer Basin.

The replenishment and the outcrops of the water bearing layers of Lower Cenomanian-Turonian are located in the western part of the basin. There, the average rainfall is approximately 600-700 mm/year. To the east the rainfall reduces sharply with precipitations of 50 to 150 mm/year and potential evaporation of up to 2,600 mm/year. Marsaba-Feshcha has two regional aquifers of fresh water, the upper and the lower. The salinity of the lower Aquifer is high and total salinity of Feshcha springs is between 1500-6000 mg/l CL⁻ and the total discharge 60-65 MCM/yr. Wadi Al-Nar which is located in the study area, is considered an open area for pollution sources because of its karstic formation. The pollution resources in this area are cesspit tanks, dumping sites and gas station.

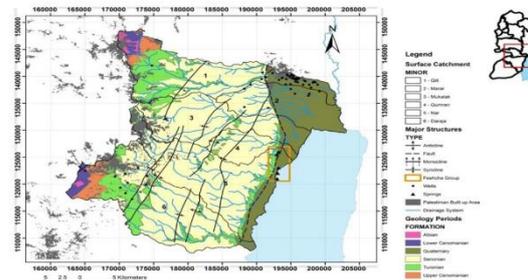
Results:

• Vulnerability Map

The protection factor (π) (Figure 1) was calculated by multiplying the P and I factors. The range of values for (π) was subdivided in five classes of natural protection and vulnerability respectively. According to land use activities, it can be clearly seen that most areas under irrigated vegetables farming are of low vulnerability, while those under permanent cropping, i.e. grapes, olives, citrus and fruits, are of moderate to low vulnerability. Most of the study area ranges with moderate to very low groundwater vulnerability.

• Risk Map

1. ArcGIS : Risk Map of the study area that can be classified as low or very low risk area corresponding to the pollution source but majority with low risk level of groundwater contamination (Figure 2).
2. myObservatory: Risk Map of the study area that can be classified as low or very low risk area corresponding to the pollution source but majority with low risk level of groundwater contamination (Figure 3).



Map 1: Marsaba-Feshcha basin

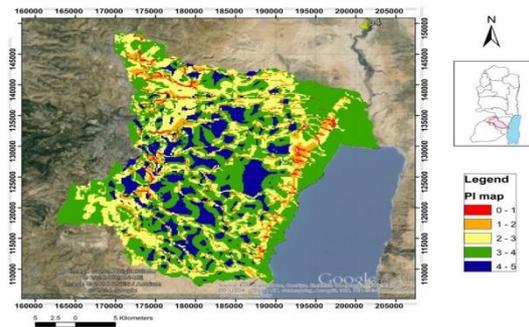


Fig. 1: Vulnerability Map According to the PI Method

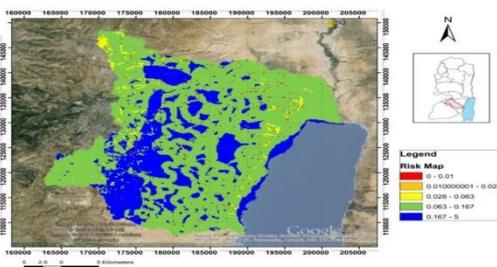


Fig. 2: Risk Map of M-F Basin using ArcGIS

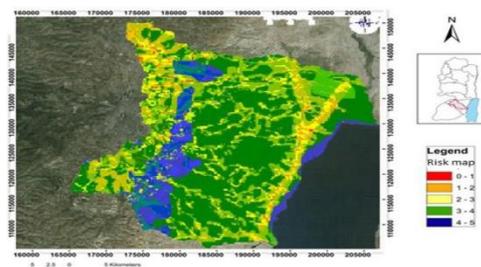


Fig. 3: Risk Map of M-F Basin using myObservatory

Summary: The vulnerability map by using PI method shows the intrinsic vulnerability and the natural protection of the uppermost aquifer. Most of the study area ranges with moderate to very low groundwater vulnerability.

The conducted analysis in this research was identified as well as classified the Hazards and its source, the high vulnerable areas to contamination and the high risks areas regarding to groundwater contamination. According to the analysis, the sensitive risks resulted from the wastewater generated from the urban and agricultural areas.

The risk assessment scheme used for risk map of M-F basin is based on the intrinsic vulnerability map constructed using the PI method and the hazard map and focuses on risk assessment for the groundwater resource. The first part used ArcGIS and Risk Map of the study area that can be classified as low or very low, the second part used myObservatory and it shows Risk Map of the study area that can be classified as low or very low risk.



Evaluation of Operational Stress Conditions on a Pilot Scale MBR for Wastewater Treatment and Reuse

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Research Background: In the absence of legal control of industrial discharges into public sewerage networks, the generation of heavily polluted industrial wastewater with the variable volumetric flow and chemical composition constitutes a major challenge for the Palestinian municipalities. One of the larger seasonal industrial wastewater is olive mill wastewater (OMWW), the total amount of OMWW which produced in the West Bank is about (120000) cubic meter annually, all of this heavily polluted wastewater discharged into Wadi or into sewage network without permissions. These discharges could be the major sources of groundwater pollution or make a disturbance in WWTP operations.

Research Objectives: The main goal of the research was to evaluate the operation stress on a pilot scale MBR system under normal and compare with heavy polluted (OMWW).

- (i) Investigate the process performance and reclaimed water quality under normal operational conditions, the baseline data.
- (ii) Study the influence of stress conditions on the MBR operational performance.
- (iii) Investigate the impacts of toxic loading (phenols and COD) from olive oil mill wastewater on MBR process performance and removal rates of COD and nitrogen

Methodology: (i) Identification of flat sheet MBR pilot with brief literature review about MBR technology. (ii) determined the physical, chemical and biological parameter that will be observed . (iii) obtain realistic baseline data analyzed parameter that reflects the character of the used wastewater lab analysis was made at steady state condition.(iv) based on previous step, sudden sock loads (OMWW) add to system as abnormal condition for the MBR system with monitoring and lab analysis to measure effect on performance of pilot.

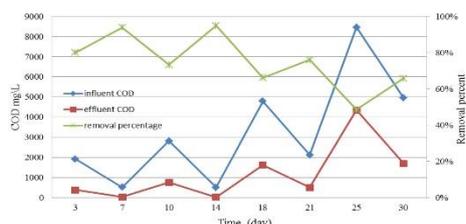


Fig. 1: Influent and effluent COD concentration and removal percentage under abnormal condition.

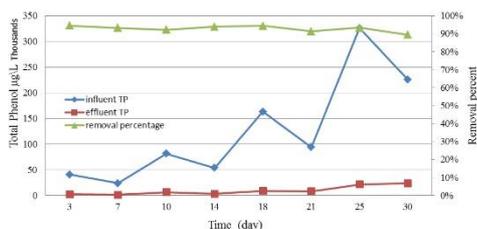


Fig. 2: Influent and effluent TPh concentration and removal percentage under abnormal condition

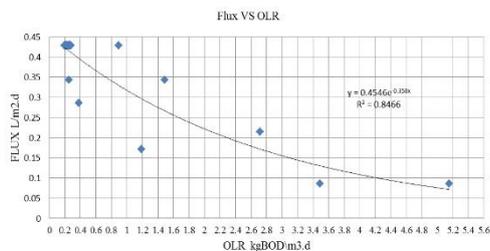


Fig. 3: comparing FLUX with increasing OLR.

Results:

1. Results analysis of MBR on process performance and effluent quality of Pilot scale is complying with set local effluent limits for agricultural irrigation.
 2. The Hydraulic Retention Time and Mixed liquor suspended solids could be the most critical process parameters that may affect on the efficiency of MBRs.
 3. The membrane biofouling became higher when the OLR increasing and removal rate for COD decreasing reverse with increasing OLR.
 4. under abnormal condition, the MBR system was stable until the OMWW doses reach up to 2.5% (20 L) of the volume of reactor except for phenol.
 5. Olive mill wastewater dosing has impacts process performance for removal rate of (Phenol, D.O., BOD, and pH) and the reclaimed water could not use for irrigation.
 6. $F = 0.637 + 0.005 \times OLR - 0.052 \times MLSS - 1 \times TSS \times [10]^{-1} - 1.16 \times TDS \times [10]^{-6} - 0.016 \times HRT$
- F is Flux (L/m².d), OLR is organic loading rate (kgBOD/m³.d), MLSS is mixed liquor suspended solid (g/L), TDS is total suspended solid (mg/L), and HRT is hydraulic retention time (day). This equation could help to predict clogging and the parameters could lead to biofouling before it happened according to data in the field.

Summary: There is comparison between the removal rates for normal and abnormal conditions for these parameters COD, BOD, TSS, NH₄⁺, TKN and total phenol, the removal percentage was (94%, 90%, 93%, 93%, 71% and 98%), removal percentage for highly organic load conditions COD reduce by 35%, BOD almost 50%, TSS and NH₄⁺ unchanged with 93%, TKN almost unchanged, but total phenol reduced by 9%. According to these analytical results of MBRs the effluent quality of Pilot scale is complying with set local effluent limits for agricultural irrigation grade (A) also, it has a good process performance of diluted OMWW treatment.

The flux of the MBR was affected after the OLR became higher exponentially, which is reduced 0.43 to 0.087 L/m².d, as a result of increased trans-membrane pressure increasing. Statistical analysis shows that HRT and MLSS the most important parameter effect of MBR fouling.



Functionalized C,N-bipyrazole receptor grafted onto silica surface for As adsorption and its antibacterial activity.

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¹Palastinian Water Authority, ²Al-Najah National University.

Introduction : Attention in the world is growing with respect to the idea of accumulation of heavy metals in the environment. These metals are considered as a threat to both human health and environment, especially when their tolerant levels are exceeded. Arsenic (As) is naturally present at high levels in the groundwater of a number of countries. Arsenic is highly toxic in its inorganic form. Contaminated water used for drinking, food preparation and irrigation of food crops poses the greatest threat to public health from arsenic. Long-term exposure to arsenic from drinking-water and food can cause cancer and skin lesions(1). As heavy metal pollution has become one of the most serious environmental problems today. The treatment of heavy metals is of special concern due to their recalcitrance and persistence in the environment so many methods of treatment of heavy metals were extensively studied. These technologies include chemical precipitation, filtration, ion-exchange, flocculation and adsorption, in this research adsorption on new chemical adsorbent (C,N-bipyrazole with a 3-glycidoxypropyl-trimethoxysilane silylant agent) onto a silica surface in short(SG2P) was used.

Methodology: This study used polluted water made in laboratory by adding As₂O₃ (arsenic oxide: 197.841 g/mol) was used to prepare 1000ppm arsenic solution, many parameters were checked on adsorption process(PH, temperature, concentration, time contact and adsorbent dosage).

Micro-broth dilution method was used to determine antibacterial activity and minimum inhibitory concentrations (MIC) of SG2P against two bacterial reference strains.

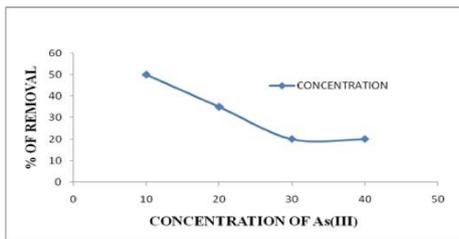


Fig. 3: effect of concentration on As(III) adsorption process.

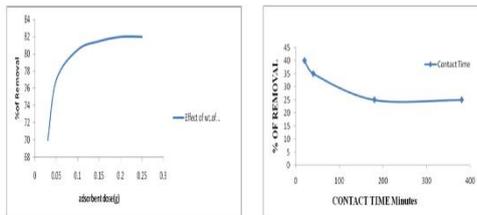


Fig. 4: effect of adsorbent dosage and time contact on As(III) adsorption.



Fig.5: Bacterial growth inhibition in broth micro dilution tray.

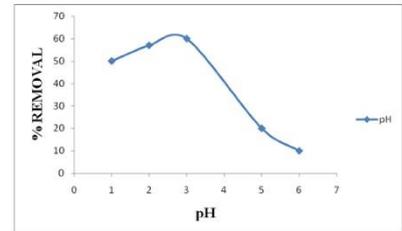


Fig. 1: PH effect on As(III) adsorption P

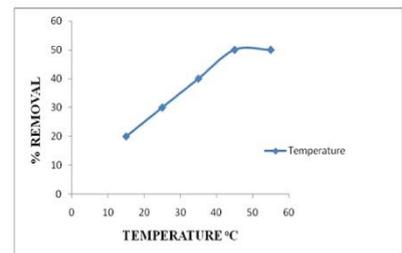


Fig. 2: effect of temperature on As(III) adsorption process.

Results:

Studying parameters showed different percentage on adsorption pH as it increases as PH, temperature to a certain line as in figure (1,2,4).

And it showed decreased level in adsorption as concentrations increase as in figure(3), where the optimal time was recorded around 20 minutes.

Adsorption of As(III) by SG2P reached 50% in special recorded parameters, which is a proof of effective adsorption process using silica-compound confirming research hypothesis.

In biology part in checking antibacterial activity of SG2P, as the minimum inhibition concentration of SG2P was 1.5625 mg/ml which meant that SG2P possessed antibacterial activity against examined bacteria.

conclusion: The adsorption of As(III) onto SG2P was successfully tested for removing As(III) from the aqueous solution, SG2P is considered as a good alternative in removal of heavy metals from contaminated solution, it is a promising method for waste management and environmental treatment.

Studied adsorption parameters as pH, initial concentration of metal ion, temperature and contact time have an effect on the removal of As(III) by SG2P. The optimal percent removal of As(III) ions by SG2P was 50%. The suitable conditions for adsorption at pH 5.0, initial concentration of 10 µg/L, temperature (35° C - 40° C) and contact time (20 minutes) and SG2P has a low antibacterial activity against both Staphylococcus aureus, Escherichia coli.



Generating Fresh Water from Highly Concentrated Salty Water Using Thermochemical Cycles

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¹An-Najah National University

Research Background: By using desalination plants, large amounts of potable water will be produced but also large amounts of highly concentrated salty water will be created. So there is an urgent need to find a suitable way to solve this problem, or reduce its effect. Actually, until now there is no efficient way of management of brine. Moreover, while the cost of RO produced water has continued to drop in the past decades, brine disposal can simply double the cost of constructing and operating of reverse osmosis facility.

Methodology: (i) Preparing specific amounts of samples of four different hydrated salts, which are calcium chloride (CaCl₂·6H₂O), sodium sulfate (Na₂SO₄·10H₂O), magnesium chloride (MgCl₂·6H₂O), and Alum (Potassium aluminum sulfate KAl(SO₄)₂·12H₂O) (ii) Complete drying of all samples was done using an oven at 120 ° C (iii) A special chamber (closed glass box) was made, to do the hydration experiments in it (iv) Every sample was tested in the steam box to do the hydration reaction, and the oven for many cycles.

Area of study (Al-Zubeidat RO Desalination plant in Al-Zubeidat village):

The objective of this thesis is to find a management solution for the brine water that is produced from reverse osmosis plant in Az- Zubidat village. The project takes this plant as a case study because it is the largest and most famous desalination plant in West Bank. Az-Zubeidat village is located at an altitude of 275m below sea level with a mean annual rainfall of 192mm(see Map1: Az-Zubeidat village, Jericho, West Bank). The average annual temperature in this 10 area is 23 °C, and the average annual humidity is approximately 48%.

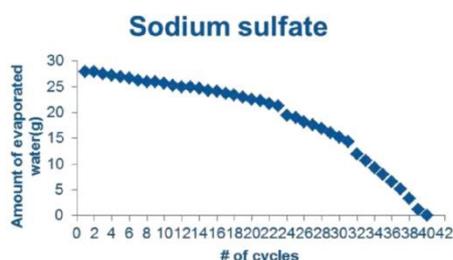


Figure (1): Number of cycles performed on Na₂SO₄·10H₂O and amount of released water for each cycle

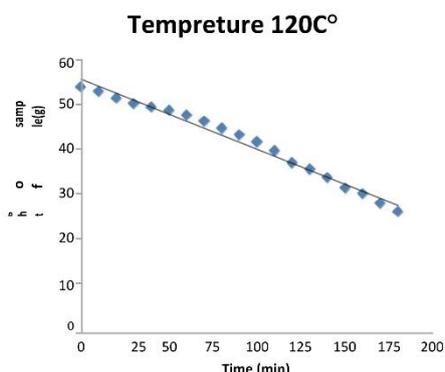


Figure (2): Dehydration of 50g Na₂SO₄·10H₂O at 120 ° C

Results:

1. When the cycles were done at 120 ° C MgCl₂ and Alum (KAl(SO₄)₂·H₂O) served for three cycles and then failed, also the cycles of CaCl₂ were 9 cycles. On the other hand, Na₂SO₄·10H₂O took 39 cycles before (see Figure 1: Number of cycles performed on Na₂SO₄·10H₂O and amount of released water for each cycle).
2. Special attention was given to sodium sulfate, that's because the required cycles for it were much more than other
3. Dehydration of sodium sulfate was done at 120 ° C, but also at three other temperatures 150 ° C, 170 ° C, and 200 ° C) in order to know the relationship between temperature and the required time for complete dehydration rate of
4. At 120 ° C; the required time for 50g of Na₂SO₄·10H₂O to be 22.1g (completely free of water) was 180 min. Moreover, the rate of dehydration at 120 ° C was 9.00*10⁻⁵ M/s(see Figure 2: Dehydration of 50g Na₂SO₄·10H₂O at 120°C).
5. At 150 ° C; the required time for totally drying of 50g of Na₂SO₄·10H₂O was 90 min. additionally, the rate of dehydration at 150 ° C was found to be 12.00*10⁻⁵ M/s.
6. At 170 ° C, the time for complete dehydration of 50g Na₂SO₄·10H₂O decreased to 30 min. And the rate of reaction at 170 ° C was 2.25*10⁻⁴ M/s.
7. At 200 ° C the drying time of the same sample (50g Na₂SO₄·10H₂O) was only 20 min. The dehydration rate at 200 ° C was 1.50*10⁻³ M/s.
8. For dehydration of Na₂SO₄·10H₂O; as the temperature increase, the dehydration time decrease. On the other hand, the rate of reaction increases with increasing the temperature.
9. The activation energy of the hydration reaction was 54176.46 J/mol.
10. The activation energy of the hydration reaction was found to be 31875.9 J/mol.

Summary: from the results it is clear that the sodium sulfate can generate large amount of fresh water, that is because a sample of sodium sulfate decahydrate contains about 56% water, and it can produce all this amount of fresh water by dehydration. Accordingly, a sequential cycle can be done for sodium sulfate, each cycle consists from two steps; dehydration and then hydration. In the first step, when a sample of Na₂SO₄·10H₂O is heated at 200 ° C for example, it will lose about 56% of its weight in the form of water vapor. So this vapor can be cooled by brine water, and so we get fresh water. The second step is hydration of Na₂SO₄, in this step sodium sulfate can be passed over the brine water channel in order to absorb fresh water to transform to Na₂SO₄·10H₂O.



Growth enhancement and alleviation of deleterious effects induced by salt stress in Faba Bean (*Vicia Faba*) by PGPB

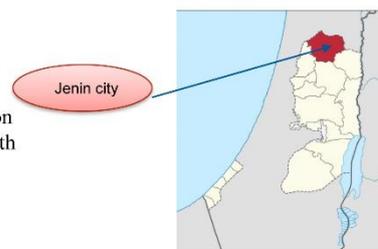
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Research Background: Salinity has been a threat to agriculture in some parts of the world for over 3000 years; in recent times, the threat has grown (Tim Flowers, 2006). Legumes have long been recognized as sensitive or moderately tolerant to salinity (Subbarao and Johansen, 1993). The reductions in growth from high salinity are the consequences of both osmotic stress including a water defect and the effects of excess Na⁺ and Cl⁻ ions on critical biochemical processes (Munns and Tester, 2008). Interaction of PGPB with several crops in saline conditions reduced the extent of poor growth and thus helps plants survive and improve performance in adverse conditions (Dimkpa et al. 2009). The inoculation of PGPB under osmotic stress conditions have beneficial effect are not only as a biomass growth increasing, but also as an improvement in water status (Nadeem et al. 2007; Kohler et al. 2009). The inoculation with *B. megaterium* also had a significant effect on reducing the salt injury which estimated by quantifying the percentage of necrotic leaf area with inoculated plants compared with non-inoculated (Adriana M et al., 2010).

Methodology: Intact seeds, homogeneous and identical in size and color, and free from wrinkles, were chosen. Grown in mix of sand and clay 1:1. The experiment design were 2*5*3 factorial including irrigation with four different salinity levels and one with fresh tap water (0, 2, 4, 6 and 8 ds/m NaCl), one inoculation treatments (inoculated with *B. megaterium*) with 3 replicates for each treatment for each Faba Bean variety in lines, with each line comprising of all treatments. Growth parameters, yield components, chlorophyll content and nutrient content (Na, Ca, N, P, K, Cl) and soil analysis.

Area of study and plant material (Jenin in the north of West Bank, Palestine):

The experiments were carried out in a greenhouse (in order to control irrigation without rainfall), at Jenin in the north of West Bank (Palestine) using (*Vicia Faba* L.) plant. Two varieties were used (Qertase and local); the Qertase have bigger seeds size, more surface area of leaves, more production of seed number and weight than local variety, the seeds were obtained from the local market and both are of the types grown in Palestine.



Picture 1: Jenin, West Bank

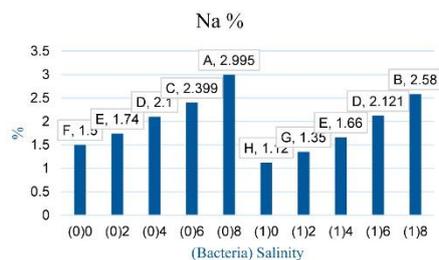


Figure 1. Effect of the interaction between salinity and *B. megaterium* on Sodium content of Faba Bean. 0: without *B. megaterium* 1: with *B. megaterium*, Salinity: (control, 2, 4, 6, 8) ds/m

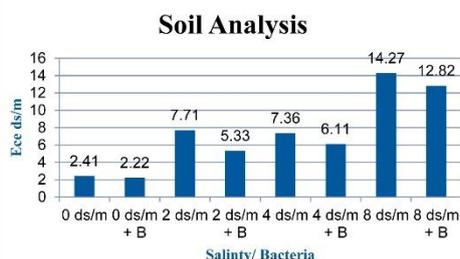


Fig. 2: Rate of evaporation of conventional and enhanced stills without the glass cover considering variable parameters.

Results:

- *B. megaterium* has significant effect in alleviating salinity stress on growth parameters (plant height increased 9%, number of leaves increased 10 %, fresh weight of shoot increased 21%, and fresh weight of roots 36%).
- *B. megaterium* increase bean production significantly even under high level of salinity (seeds number 21% and pods number 29%).
- The inoculation with *B. megaterium* significantly increased flowers number (27 %) and reduced the period required for flowering (from 66 days to 55 days), good indicator for early yield.
- The accumulation of Na and Cl in plant tissue significantly reduced.
- The bacteria improved plant absorption ratio for K, P, N and Ca was higher in plant inoculated with bacteria under high salinity level compared to non inoculated plants.
- Bacteria have a positive effect in reducing soil salinity (15 %).

Summary: Application of *B. megaterium* mitigates the effect of sodium chloride stress and improved the growth and yield in the present study. The inoculation with remarkably *B. megaterium* increased plant height, number of leaves, number of flowers, plant biomass, early flowering, improved chlorophyll content, root system and in contrast, alleviated sodium chloride accumulation in leaves, increased the absorption of K, Ca, P. Inoculated plants with *B. megaterium* displayed stronger ability to tolerate salt stress than non-inoculated plants. The study revealed that the soil salinity could be reduced by using *B. megaterium* with plants.



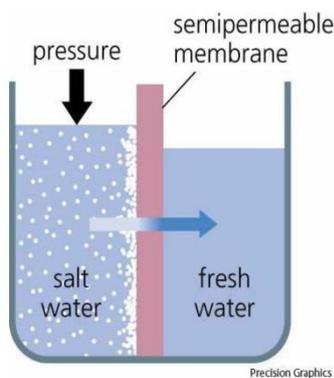
Water Desalination, Supplied Water Costs, Total Costs and Benefits

Riad Mohammad Dissi
 1Birzeit University

Research Background: The Palestinian population is increasing rapidly while the water resources are decreasing in quantity and deteriorating in quality. There is a need to think out of the box and find or create other sources of clean water supply despite the turbulent situation and the spectre of the Israeli occupation. New technologies for water desalination made it efficient and effective to entrepreneur in this field by testing the reverse osmosis technology.

Methodology: The main concepts established were to define the best methods of reflecting the willingness to pay while assessing the various factors influencing it., to assess the level of awareness that people have. Furthermore, the relation between the water price and the quantity used as the methodology of the research will depend on two main issues: Questionnaire: I will formulate a questionnaire about water tariff and distribute it over the relevant parties at the water sector organizations. Based on the literature review I will make a feasibility study about the brackish water desalination based on the available data. Feasibility Study. Questionnaire. SWOT Modeling the tariff for desalination. Industry case (Jericho and Seema)

Area of study (Ramallah and Al Bireh Area) :The study targeted the households in Ramallah and AlBireh, and the camps that exist in these two cities and the villages around them, which are served by the Jerusalem water under taking, so the sample is a random sample.



Results:

- 1- Implementation of autonomous desalination technologies powered by renewable energy at eastern aquifer, River Jordan, Mediterranean sea.
- 2- Overcome water shortage and increase water supply by desalinating brackish water.
- 3- Better water quality.
- 4- Sustainable and reliable water supply.
- 5- Protecting water resources.
- 6- Savings in purchased water required to overcome the shortage.
- 7- Energy savings.

Summary: The research shows clearly that there is a significant segment of the Palestinian community that is willing to pay more money in order to have access to clean and sustainable drinking water supply. The costs of desalinated water could be covered from the water tariff while the earning profits.



Phytoremediation for Treatment of Brackish Water from Groundwater Wells

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Research Background: Phytoremediation is one of the methods that can be used to remediate water and land salt using plants. Brackish water contains significant concentrations of dissolved salts ions such as Na⁺, Cl⁻, Ca⁺², Mg⁺², K⁺¹, SO⁻², and CO⁻² and the range of TDS is 1500 – 10000 mg/L. In West Bank/ Jericho the amount of brackish water produced from groundwater wells are in the range of 12-18 million m³. In this research, Phytoremediation was applied as a method to treat the brackish water by using two tolerant plants species (**Barely and Malt**) plants. These plants were germinated with Plant Growth Promoting Rhizobacteria (PGPRs) strains *Pseudomonas putida* UW3 and *Pseudomonas putida* UW4.

Methodology: (i) Study the effect of (PGPR) on plants in terms of biomass production and photosynthetic activity under salt stress. (ii) Study the effect of PGPR on plants cells integrity: salt ions entry damage cell membrane, and increase its permeability will be studied. (iii) Study the effect of antioxidant hydrogen peroxide on seed germination rate under brackish water.

Area of study (Jericho Groundwater wells):

The **Jericho Governorate** is one of 16 Governorates of Palestine. It is located along the eastern areas of the West Bank, along the northern Dead Sea and southern Jordan River valley bordering Jordan. Rising salinity levels is one of the significant signs of water-quality degradation in groundwater. The alluvial Pleistocene wells in the Jericho area, Palestine show high salinity and a high susceptibility to contamination. Future exploitation and management of the water resources under these conditions will require an in-depth understanding of the sources and mechanisms of contamination.



Map 1: Jericho, West Bank

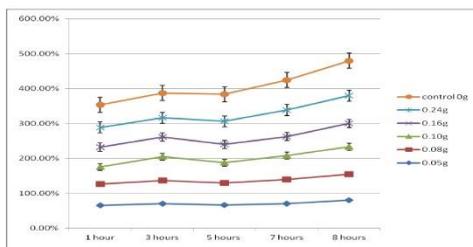


Fig. 1: Absorbance of bacteria grown in saline (0 g, 0.05g, 0.08g, 0.10g, 0.16g, and 0.24g NaCl)/20 ml tryptic soy broth (TSB) medium at 600 nm at each time.

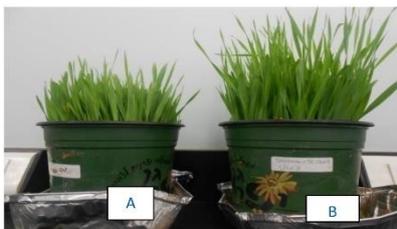


Fig. 2: Control Barley Plant irrigated with fresh water (A), Barley Plant with UW3+UW4 irrigated with 6000 mg/L (Right)

Trials	Fresh water	6000 mg/L of brackish water	10000 mg/L of brackish water
Control Barely plant	100%	8.98 %	150.08%
Barely plant treated with UW3	237.31%	249.40%	156.11%
Barely plant treated with UW4	156.11%	237.31%	288.83%
Barely plant treated with UW3+UW4	128.12%	267.67%	288.56%
Barely plant treated with UW3 + H ₂ O ₂	116.68%	237.31 %	249.40 %

Fig. 3: Biomass production (Sig in Red)

Results:

1. Measurement of PGPR growth under saline NaCl solutions: Different concentrations of NaCl – TSB solution were prepared, to test performance of PGPR salt tolerance on two plant species. Figure 1 show % of control –Absorbance for UW3 at λ = 600 nm in NaCl - (TSB) solution (0 g, 0.05g, 0.08g, 0.10g, 0.16g, and 0.24g). it showed UW3 germination were increased under saline condition at different time interval, until it reached maximum levels and it became constant without any incensement after 8 hours. This increase indicated that salinity tolerant performances of PGPRs were increased [Shan, 2009]. Moreover increased in growth had been shown for TSB medias containing (0.08g, 0.10g, 0.24g) to be as (74.55%, 78.31%, 79.68 %) respectively at 8 hours incubation, surprisingly, the least measurement of bacterial growth was obtained for 0.16g salts contained media (66.88%), and may be this related to some performance of germination of bacteria in the tube.
2. Figure 2 : Picture where (A) represent trial of control Barley plant irrigated with fresh water, (B) trials of treatment of Barley plant with UW3+UW4 irrigated with 6000mg/L. it showed leaves of Barley Plants that treated with PGPR as taller –thicker, and green darker color compared to untreated ones. Besides that, their roots were longer compared to untreated plants. Thus, PGPR affected photosynthetic activity even under irrigation with salt solution. For control trials without PGPR irrigated with two different concentration of brackish water, the colors of their leaves were visibly pale green. Some leaves turned to yellow and shorter -smaller. Some followed by premature necrosis. Even they reached their growth cycle end before crop coefficient. Beside it is shown in biomass production in Figure 3.
3. NaCl accumulation in plant tissue for total dry mass ranged from 36.3-8357.5 mg, and for Ratio of Cl/Na 0.6-1.01 for experimental results compared to theoretical atomic weight equal 1.5.

Summary:

Specifically, trials treated with PGPRs had showed significant improvements in salt accumulation for the plants (Barley and Malt) that used in these experiments, indicated that these two plants successfully can be used in phytoremediation process in combination of the PGPRs (*Pseudomonas putida* UW3 and/or UW4), with an advantage of Barley over Malt Plant. Results had showed that these PGPRs increase the cell membrane stability as demonstrated by less electrolyte leakage from plant cells relative to plants that were not treated with PGPR. Results from pulse amplitude modulated fluorometry (PAM) studies indicated that these plants which treated with PGPR had increased photosynthesis rate thus prevented salinity damage to photosystems compared to those untreated ones. Biomass measurements showed a significant mass increase for those plants treated with PGPRs compared with those control (untreated); which biomass production could enhance phytoremediation efficiency, as well as be used as forage food for animals.



Transport of nutrients and organic carbon by wastewater discharge in Al-Qilt catchments transboundary region / Jordan Valley, West Bank

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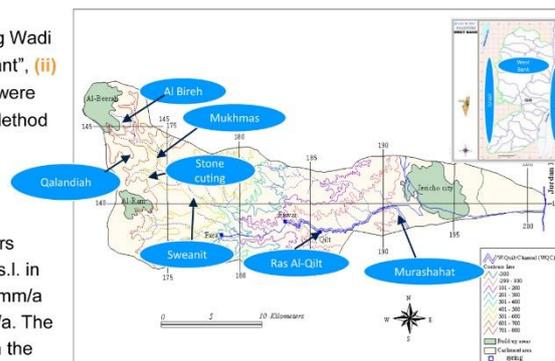
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Research background: Wastewater delivered to and transported by surface water run off will affect the groundwater quality (springs and wells) that are used for domestic and agricultural purposes in the studied area. Domestic wastewater and urban runoff will enrich beyond other substance the sediments with nutrients and organics carbon and increase the loads that can be transported.

Methodology: Surface water of batched sample from seven sampling points along Wadi Al-Qilt classified as: (i) effluents from treated wastewater "Al-Bireh treatment plant", (ii) untreated wastewater (iii) Wadis wastewater (iv) Water from springs. Samples were taken in June, 2008 and analyzed according to Water and Wastewater Standard Method (APHA, 2000) and (UFZ, Magdeburg, Germany) according to the Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung.

Area of study (Al-Qilt):

Al-Qilt's catchment in the West Bank at the western side of the Jordan Valley covers about 173 km² and is characterized by a steep relief with elevations from 800 m a.s.l. in the western part to -250 m b.s.l. in the eastern part. The rainfall estimated by 600 mm/a in the West and 150 mm/a in the East, average rainfall over catchment is 400 mm/a. The long term observations of flow for Wadi Al-Qilt ranges from 3.0 to 12.0 MCM/a with the continues base flow for the Ras Al-Qilt spring of around 300 L/s.



Map 1: Al-Qilt catchments, major city, topographical elevation, community, regional location, springs and sampling point

Results:

1. The relation between TOC, DOC and nitrate is shown in (Fig. 3) and (Fig. 1). High TOC and DOC from Al-Bireh effluents plants and stonecut are the reason for biological activities in which bacteria consume the nitrate in dinitrification process (Fig. 1) and decrease it. At lower TOC and DOC in combination in wadi Mukhmas, the nitrate concentration is increased.
2. As it is shown in Fig. 1 the limit for Palestinian guideline for artificial recharge to the groundwater of treated wastewater (PS) "Ref PSI 2003-742" (for NO₃, 15 mg/L and 10 mg/l for NH₄) is exceeded after the emission of untreated waste water (sampling points 2, 3, 4). As a consequence of the self cleaning process between stonecut and Ras Al-Qilt the concentration of Ammonia decreases significantly as well as the nitrate concentration.
3. PO₄ (Fig. 2) is the main phosphorous component with concentration between 10 and 20 mg/L (partial exceed of the limit for PS for PO₄ with 15 mg/L). Much lower concentration at the "Spring" indicates self purification processes like adsorption.

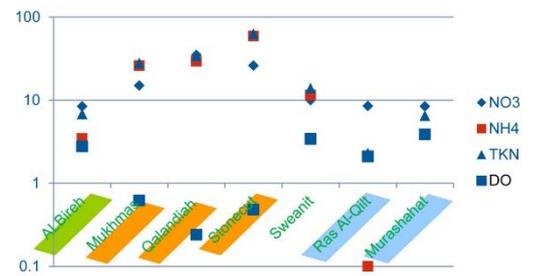


Fig. 1: Nitrogen balance variations in Wadi Al-Qilt. Units in mg/L.

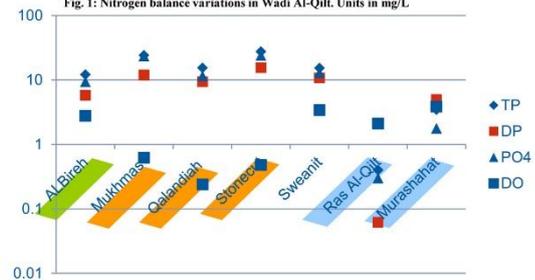


Fig. 2: Phosphorus variations in Wadi Al-Qilt. Units in mg/L.

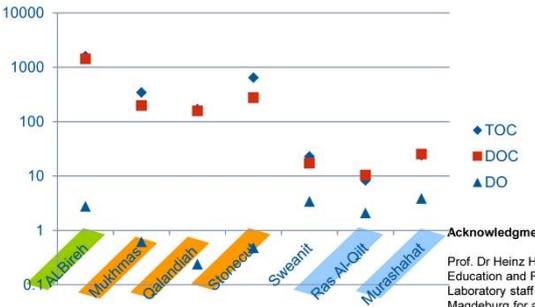


Fig. 3: Organic carbon variations in Wadi Al-Qilt. Units in mg/L.



Summary: Until now the self cleaning procedure of the wadi works good enough in the Karstic region to guaranty at the "spring" Ras Al-Qilt a good water quality according to PS in relation to the nitrate and phosphate. Nevertheless it can not be excluded that the water quality in Ras Al-Qilt decreases if untreated waste water continuously enter the catchment up stream.

Acknowledgments:

Prof. Dr Heinz Hötzel from SMART project supported by Federal Ministry of Education and Research (BMBF), University of Karlsruhe. Laboratory staff at Helmholtz Centre for Environmental Research (UFZ) in Magdeburg for analysis and cooperation. Eng. Ayman Jarar, Yousef Awayes, Waleed Abu Muhsen, PWA / Hydrological departments (Othman Sheha and Sami Daraghmah) Dr. Abd Al-Rahman Tamimi from Palestinian Hydrological Group (PHG), Palestine. SIDA, Rambolla Natura AB, SIWI and Jordan University



Improvement of large scale wastewater treatment plant using Epuvalisation technique and micelle clay complex column

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Al-Quds University

Research Background: The agriculture sector is the largest consumer for water supplies and the utilization of treated wastewater. Reuse of treated wastewater in irrigated agriculture would provide additional water supplies and it would reduce environmental pollution caused by untreated/poorly treated wastewater. One of the problems on Wastewater Treatment Plant is over loading which increase the fouling and coagulate the membranes which means short life time and more money is needed. In this research we are investigating the efficiency of Epuvalisation system using Rosemary and Geranium Plants and Micelle clay complex column in wastewater treatment.

Methodology: 1. Epuvalisation Technique as a biological wastewater recycling system based on hydroponic cropping techniques using Rosemary and Geranium Plants to treat Secondary Treated Wastewater.

2. Adsorption using Micelle Clay Complex Column (Octadecyltrimethylammonium-Bromide). The secondary treated effluent was pumped to the Hollow Fiber ultra filtration unit, then to micelle clay complex column. The MCXC permeate was collected in a tank and used to feed the Ultra-Filtration Spiral Wound.

Area of study (Al-Quds University Wastewater Treatment Plant):

Al-Quds University Wastewater Treatment Plant (AUWWTP) at Al-Quds University (Palestine), (AUWWTP) located to the southern east of Al-Quds University Campus, (AUWWTP) is a pilot wastewater treatment plant that consist of four treatment stages: Preliminary, primary, secondary and tertiary. It collects a mixture of black (from toilets), gray (from showers and sinks), and storm (rain) water, as well as waste water (from certain laboratories), which hosts approximately 13,000 students and staff members in the day time.

Table1:Physical and chemical quality of hydroponic recycled water after 10 days of Epuvalisation treatment, FW compared to TWW during the same period using Geranium Plants.

Cycle 5	FW		Percentage Removal (%)	TWW		Percentage Removal (%)
Test	Influent	Effluent		Influent	Effluent	
pH	7.4 ± 0.9	8.4 ± 0.1		7.3 ± 0.8	6.0 ± 0.0	
EC (µS.cm ⁻¹)	1257 ± 11.3	650 ± 0	48	2106 ± 11.5	1003 ± 6	52
TDS (mg.L ⁻¹)	627 ± 6	320 ± 0	49	1053 ± 6	500 ± 0	53
SS (mg.L ⁻¹)	2.4 ± 3	2 ± 0	17	81 ± 36	4 ± 0	95
TUR (NTU)	7 ± 10	5.5 ± 3.5	21	117 ± 57	7 ± 0	94
COD (mg.L ⁻¹)	188 ± 16	63 ± 21	67	282 ± 4	167 ± 4	41
BOD (mg.L ⁻¹)	43 ± 10	33 ± 1	23	71 ± 21	55 ± 3	23
Mg ²⁺ (mg.L ⁻¹)	13.5 ± 0.6	3 ± 0.4	78	19 ± 5	14 ± 3	26
Ca ²⁺ (mg.L ⁻¹)	124 ± 1	72 ± 13	42	151 ± 0	99 ± 0	34
K ⁺ (mg.L ⁻¹)	38 ± 43	10 ± 0	74	43 ± 26	14 ± 2	59
Na ⁺ (mg.L ⁻¹)	70 ± 4	28 ± 2	60	138 ± 3	129 ± 12	7
PO ₄ ³⁻ (mg.L ⁻¹)	39 ± 0	0 ± 0	100	61 ± 2	7 ± 0.5	89
Cl ⁻ (mg.L ⁻¹)	62 ± 26	39 ± 6	37	89 ± 88	36 ± 26	60
TN as NH ₄ ⁺ and NO ₃ ⁻ (mg.L ⁻¹)	4.4 ± 0	0 ± 0	100	24 ± 0	0.4 ± 0.3	98

Table2: Variation of physical, chemical and biological characteristics of influent of effluent of micelle clay complex column.

Volume L	pH	EC µS/cm	TDS mg/l	TSS mg/l	Turbidity FAU	COD mg/l	BOD mg/l
0	7.2 ± 0.2	1630 ± 10	810 ± 10	88	44 ± 5	240 ± 30	125 ± 25
20	7.9 ± 0.2	1400 ± 5	700 ± 10	0	0	195 ± 25	92 ± 10
50	7.6 ± 0.2	1300 ± 5	650 ± 10	0	0	173 ± 10	84 ± 10
100	7.5 ± 0.2	1260 ± 5	630 ± 5	0	0	153 ± 10	74 ± 10
200	7.4 ± 0.2	1250 ± 5	620 ± 5	0	0	135 ± 5	62 ± 5
400	7.4 ± 0.2	1200 ± 5	590 ± 5	0	6 ± 0.1	22 ± 5	15 ± 5
800	7.3 ± 0.2	1180 ± 5	590 ± 2	0	3 ± 0.1	13 ± 2	10 ± 2
15800	7.6 ± 0.1	1280 ± 2	640 ± 5	55 ± 0.5	79 ± 0.5	500 ± 5	255 ± 5
15900	7.5 ± 0.1	1220 ± 2	610 ± 5	17 ± 0.5	20 ± 0.5	358 ± 5	189 ± 20
16220	7.0 ± 0.1	1430 ± 2	670 ± 5	62 ± 0.5	91 ± 0.5	450 ± 5	231 ± 15
16700	7.0 ± 0.1	1320 ± 2	670 ± 5	8 ± 0.5	2 ± 0.5	413 ± 5	213 ± 5

Table3: Water Quality of Micelle clay complex column influent and effluent of UF-SW.

Test	Average Sample		Average Sample	
	Effluent of MCXC column	Effluent of UF-SW	Influent of MCXC column	Effluent of UF-SW
pH	7.6 ± 0.06	7.6 ± 0.06	7.4 ± 0.06	7.6 ± 0.06
EC (µS/cm)	1160 ± 6	1160 ± 6	1140 ± 6	1130 ± 6
TDS (ppm)	580 ± 6	580 ± 6	570 ± 6	560 ± 6
Turbidity (FAU)	0 ± 0.06	3 ± 0	0 ± 0	0 ± 0
COD (ppm)	32 ± 2.4	53 ± 9.2	48 ± 7	68 ± 26
SS (ppm)	0 ± 0	0 ± 0	0 ± 0	0 ± 0

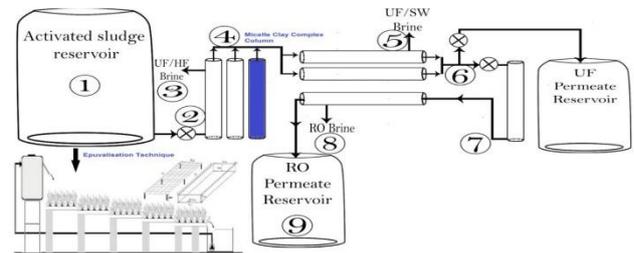


Fig. 1: Al-Quds University Wastewater Treatment Plant with the insertion of Epuvalisation system and Micelle Clay Complex Column, Al-Quds University.

Results:

The results of water quality analysis of both TWW and FW using the Rosemary and Geranium plants show a remarkable decrease of BOD, COD, EC, TDS, SS, K⁺, TN, Cl⁻ and PO₄³⁻. Table1 showed the Physical and chemical quality of hydroponic recycled water after 10 days of Epuvalisation treatment using Geranium Plants.

Plant growth parameters (plant height, fresh and dry weight, number of branches and flowers number) of Rosemary and Geranium showed no significant difference between irrigation with both media. The results of plant analysis of roots, leaves, stems and flowers showed that there is no effect for irrigation with the secondary wastewater in plant tissues.

The results have shown that the Epuvalisation system is a promising technique for wastewater treatment using the Rosemary and the Geranium plants.

Table2 show a percentage removal of COD ranged from 53 to 95% and the column becomes saturated after 15800 liter, due to low variation difference between influent and effluent of COD values. The percentage removal was 20%, which could be refer to the high accumulation of organic matter on the MCXC.

Table3 show no difference between influent and effluent of UF-SW. The results suggested that micelle clay complex can decrease the fouling as a results of organic matter removal, so we can use the effluent of MCXC directly for RO membrane without passing through UF-SW due to the water quality analysis for both effluents of MCXC effluent and UF-SW effluent which mean we can use MCXC instead of UF-SW.

Summary:

Rosemary and Geranium plants showed a good efficiency in term of purification, their ability in purifying the treated wastewater proved from the results of chemical analysis of treated wastewater during the cycles.

The results of MCXC shows efficient removal of COD during the operation time. The removal efficiency of organic matter varied between 53 to 95%.

Integrating micelle-clay complex after the UF-HF enhanced the water quality and decreased the fouling rate of the UF-SW membrane in the subsequent ultra-filtration unit. The results support/encourage the insertion of micelle clay complex column as pre-treatment stage before UF-SW and RO Al-Quds University WWTP and UF-SW could be replaced by MCXC.



Pretreatment and Chemical Cleaning Effects on Fouling Reduction in a Pilot UF Membrane Bioreactor Treating Wastewater from Birzeit University Campus

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¹Birzeit University

Research Background:

Current strategies and scientific research concentrate on interaction mechanisms between foulants and clean membrane surface as well as foulants and fouled membrane. The present study based on collecting and evaluating technical data on the factors behind UF membrane fouling. The major object for this study is to evaluate and reviewing the current studies about reducing fouling, and finding the effects of wastewater, and chemical treatment of UF membrane Pilot. Pre-treated wastewater can ensure the long-term stability of MBR facility by altering the size of the volunt and reducing the nutrients available for microbial growth. To reduce biofouling and retrieve the membrane flow of the MPR facility, chemical cleaning of membranes is critical. Thus, the interaction techniques between the chemical factor and the foulant layer formed on the membrane surface and potential problems in the chemical cleaning operation will also be examined.

Methodology:

- I. Data collection, literature review and description of current system.
- II. Sampling and lab analysis of influent, liquid waste streamshock loads and reclaimed water; sludge filterability tests and biomass characteristics
- III. Install micro strainer and/or mesh and chemical precipitation using local raw materials [charcoal, iron and stone cutting liquor] and predict the impacts on pollution loads reduction, then identify possible impacts on bioreactor design of the MBR and flux rate.
- IV. Data analysis and research results discussion.

Preparation and reproduction of the thesis.

Area of study (MBR pilot system at Birzeit University):

The recently installed MBR pilot system installed at Birzeit University will be used for this research study. The technical description of the flat sheet membrane bioreactor will be detailed in a second stage. The MBR system includes a pre-anaerobic stage followed by the main biological reactor, each has a working volume of about 1000 liters. Currently the MBR system is designed to treat about 1 m³ per day, which is feed by a dry pump installed at the balancing tank of the centralized sewage works serving BZU campus. The raw wastewater receives no effective pretreatment stage except a bar screen. The system has a chlorinating unit for the reclaimed water disinfection.

Research question and identified problems:

- 1) What are the causes behind possible fouling and reduction in flux performance of the flat sheet membrane installed in the MBR pilot?
- 2) What practical methods to apply for fouling reduction, considering high strength wastewater characteristics and possible pretreatment technologies?
- 3) What are energy savings achievable by avoidance of frequent cleaning?

Summary:

Ultrafiltration (UF) membranes are widely used in membrane bioreactor (MBR) facilities for wastewater treatment to cope with stringent effluent quality standards and protect public health and receiving environment. However, membrane fouling forms an essential problem in the process of its application and current research efforts focus on this issue. Current operational strategies to reduce UF membranes fouling in MBR facilities depend on deep scientific and engineering understanding of the interaction mechanisms between foulants and clean membrane surface as well as foulants and fouled membrane. The current study starts with compiling and evaluation of technical data form published studies pertaining to major factors behind UF membrane fouling. This research study aims at reviewing the recent studies about causes and mitigation measures of UF fouling and exploring the impacts of wastewater pretreatment and chemical treatment of UF membrane Pilot at Birzeit University. We argue that pretreated wastewater can ensure long life stability of the MBR facility through change in foulant size distribution and reduce in nutrients available for microbial growth. To reduce biofouling and recover the membrane flux of MBR facility, chemical cleaning of UF membranes is crucial. Hence, the interaction mechanisms between the chemical agent and foulant cake formed on the membrane surface and possible problems in chemical cleaning process will be also examined. Finally, future direction in research and development in the field of MBR fouling will be identified and the potential impacts on the annual operational costs of MBR facility will be estimated.



Performance Test and Techno-Economic Evaluation of a PV Powered Reverse Osmosis Brackish Water Desalination System in (BWDS) West Bank

By Samer Farid, Supervisor Prof.Dr. Marwan Mahmoud
An-Najah National University

Research Objectives

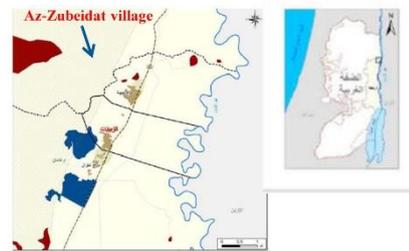
1. Provide the inhabitants of Az-Zubeidat village with potable drink water from the available BW by using solar energy.
2. Study and design (BW) reverse osmosis (RO) desalination systems powered by solar electric energy.
3. Determining the performance of BWRO desalination systems powered by solar electric energy under Palestinian weather and environmental conditions as well as determining the productivity of such systems during the different year seasons.
4. Testing the performance of the solar PV system powering the RO desalination system and investigating the optimal design of such systems according to salinity and daily solar radiation intensity.
5. Determination of the economic feasibility of using solar electric systems for desalination of BW in rural Palestinian villages lacking for electricity and potable water.
6. Identify the effects of BW desalination on the environment, health and social conditions in the potential sites of the West Bank.

Methodology: This research discusses the energy required, the techno-economic issues, and environmental analysis of the first BWRO desalination system operated by solar electric power (PV) in West Bank- Palestine. This system is built in Az-Zubeidat village–Jordan valley to demonstrate the applicability of solar energy in water desalination and to provide the inhabitants with the desalinated drink water.

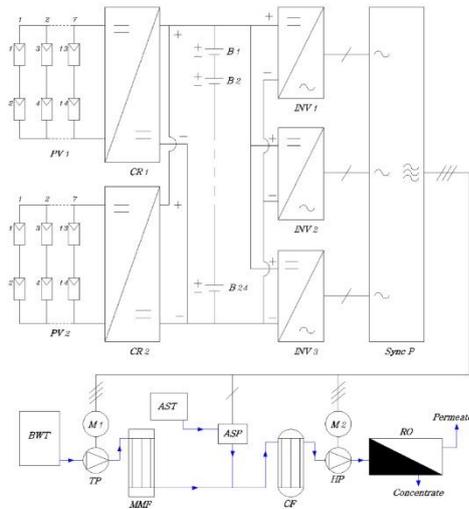
Area of study (Az-Zubeidat RO Desalination plant in Az-Zubeidat village):

Al-Zubeidat village is one of Jericho governorate villages, located about 35.4 km to the north of Jericho city. it is bordered by the Jordan River to the east, Marj Na'ja village to the north, Tubas city to the west and Marj al-Ghazal village to the south. This village is about 275 meters above sea level. The annual rainfall is about 192 mm and the average temperature is 23 degrees Celsius while the humidity is about 48% their (Map 1).

This village has a RO Desalination Plant with bout (10 m³/day) as a production rate.



Map 1: Az-Zubeidat village , Jericho, West Bank



Schematic diagram for Az-Zubeidat project.

Results:

1. A considerable volume of brackish water with an appropriate TDS value allowing to use it for RO desalination membranes is available in West Bank.
2. Since the RO desalination systems are considered to consume the lowest amount of energy, RO systems are very appropriate to be operated by solar electric power systems represented in PV.
3. Palestine enjoys a high solar energy potential amounting in average to 5.4 kWh/m²-day, therefore it is appropriate to exploit this energy in brackish water desalination using RO membranes.
4. This study has shown that 1m³ of permeate water produced from brackish water with a TDS 2681mg/L, requires 2.3 kWh which is represented at G_{av}=5.4 kWh/m²-day approximately in 450 W_p PV cells.
5. The economic analysis has shown that the cost of 1m³ of permeate water produced from brackish water with a TDS 2681mg/L is 3.17\$ with battery, and 2.33\$ without battery.
6. Battery bank represent 23% from capital cost of Az-Zubeidat project and 26.5% from all project cost during the total life time (20 years).
7. For remote area having only such brackish water as Az-Zubeidat village who depends only on potable water delivery trucks to secure its needs of drinking water, the annual saving would be 17740\$ when using RO brackish water desalination system powered by PV, for a daily capacity of drink water amounting to 10m³/day.
8. Environmental analysis shows that Az-Zubaidat system preserves the environment of production 4195 kg of CO₂ per year.
9. Az-Zubaidat project produce brine solution contains about 11274 kg/year.

Summary: Az-Zubeidat system produces 10 m³ of potable water per day, from Brackish Water (BW) with TDS of 2680 mg/L using RO technology powered by solar PV generator of 5.2 kW_p. Energy analysis shows that 1 m³ of produced potable water needs 2.3 kWh of electrical energy, which corresponds to 450 W_p PV modules. Economic analysis shows that the cost of 1 m³ of potable water produced by this system is 3.17\$ when using battery bank and 2.33\$ without using battery. This result is very reasonable compared with 5.07\$/m³ as cost of potable water delivered by trucks. The annual savings by using such system amount to 17740\$. Investigations on varying the recovery has shown that higher recovery results in higher power requirement of the high pressure pump and thereby higher energy consumption of the system, it increases also the TDS of permeate which results in higher probability of membrane scaling. Environmental analysis shows that using such a small system preserves the environment of production 4195 kg of CO₂ per year.



Enhanced Phytoremediation Of Olive Mill Wastewater "Zibar" Using Plant Growth Promoting Rhizobacteria (PGPR) With Barley and Clover

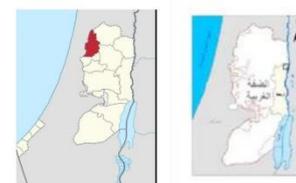
Abed Alqader ,S¹
An-Najah National University

Research Background. Olive mill wastewater (OMWW) has negative environmental impact. Utilization of OMWW in irrigation is difficult due to the toxic effect. Different phytoremediation methods were used to improve the use of OMWW in irrigation.

Methodology: 1-PGPRs were implemented to investigate their efficiency of improving the phytoremediation technique for plants irrigated with olive mill waste water.2- Two strains of PGPR (UW3, Pseudomonas putida(A). UW4, Pseudomonas putida(C) with unassigned one (B)) were used with Barley (*Hordeum vulgare* L.) and clover plants (*Trifolium* sp.).3- All trials were carried in a designed green house in faculty of agriculture at AnNajah national university in Tulkarem for 30 days.4- Plants irrigated with different concentration of OMWW (0%, 10%, 25%, and 50%).5- Seeds of both barley and clover irrigated by different concentration of olive mill waste water, showed significant differences in germination among the concentration levels of OMWW.

Area of study (greenhouse in An- Najah National university in Tulkarem city):

The Tulkarm governorate : is an directorial region and one of 16 Governorates of Palestine situated in the northwestern West Bank. The governorate's land area is 268 square kilometers. According to the Palestinian Dominant Bureau of Statistics, the governorate had a population of 172,800 inhabitants. The muhfaza or district capital is the city of Tulkarm.



Map 1:Tulkarem, West Bank

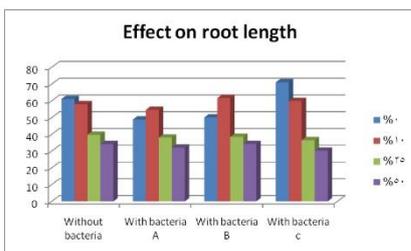


Fig. 1:Effect of bacteria and OMWW concentration(%) on root length of barley plant.

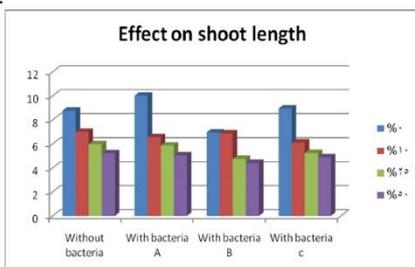


Fig. 2:Effect of bacteria and OMWW concentration on shoot length of clover plant.

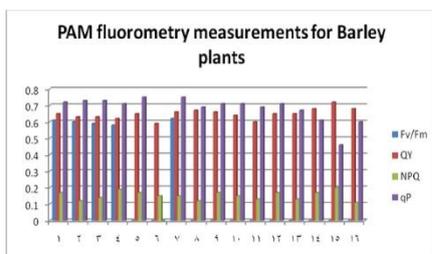


Fig. 3:PAM fluorometry measurements for Barley plants.

Results:It was notable that the OMWW has negative impact on seed germination of both plants. Neither barley nor clover plants treated with PGPRs had significant improvement in biomass compared with those irrigated with fresh water. Root length was decreased significantly with the increase of OMWW levels (57.8 and 58.5cm respectively). The OMWW application significantly reduced the shoot length. OMWW at 50% reduced the stem length (15.5 cm). A similar trend was observed with other measures (both fresh and dry weight of the plant). OMWW application was highly reduced both weights of stems and roots of both plant species. For clover plants, root length, shoot length, wet weight ($P=0.0057-0.0001$), were reduced, however, total dry weight, dry weight of roots, and dry weight of shoots ($p < .05$). The higher root length was observed with the control and 10% OMWW (25.22 and 23.98 cm, respectively). Regarding shoot, shoot length was reduced, the lowest shoot length was observed (4.879) at 50% zibar application. Wet weight of clover was differs significantly among the different concentration of OMWW and different type of bacteria used. Pulse Amplitude Modulation (PAM) fluorometry showed no improvement in photosynthesis. Barley plants their values of Fv/Fm were ranged from (0.55 -0.68), which mean that plant is under stress, and its photosynthesis not proceed as it should be, and NPQ values ranged (0.11-0.17). The same was for clover plants treated with PGPR (UW3), irrigated with fresh water, 10% concentration of OMWW, values of Fv/Fm are closed to 0.8 and NPQ are decreased to .07. Other Trails of clover plants values of Fv/Fm were XVI ranged from (0.62 -0.70), and NPQ values ranged (0.04-0.16).Which mean that plant is under stress, and its photosynthesis not proceed as it should.

Conclusion: Specifically, trials treated with PGPRs has shown no significant improvements in the plant growth for the plants (Barley and clover) that used in these experiments, indicated that these two plants cannot be used in this type of phytoremediation process in combination of the PGPRs (Pseudomonas putida UW3 and/or UW4).Results from pulse amplitude modulated fluorometry (PAM) studies indicated that these plants which treated with PGPR have no effect on the rate of photosynthesis. Biomass measurements showed no significant effect on mass for those plants treated with PGPRs compared with those control (untreated); so there is no phytoremediation efficiency. Concentration of OMWW less than 10% more suitable for this type of phytoremediation



Study the Effect of Reeds Tissues on the Adsorption of Heavy Metals and Bacteria from Sewage Water

Salman M¹, Abu Obiad A¹, Alkowni R¹

Introduction:

Environmental pollution is the greatest challenge facing human today. Water pollution is one of these greatest challenges, the removal of pollutants from water and soil has been long researched in the fields of environmental science and engineering in order to find ways of eliminating this serious problem in both, the developed and developing world .

Water contamination may include organic contaminants such as pathogenic bacteria and inorganic contaminants such as heavy metals.

Heavy metals are among the contaminants in the environment. Almost all human activities have produced heavy metals as the side effect beside the natural activities. Transportation of these contaminants from contaminated areas into non-contaminated areas by dust or leachates through the soil and spreading of heavy metals containing sewage sludge are examples of this pollution. Phragmites from purification plants in Sarra towards contamination of the ecosystems

Methodology: in this study *Phragmites australis* plant was collected from Wadi Al Bathan field. Plants were removed from the soil and washed, and the roots were separated from the stems and leaves. The other samples of phragmites were collected from the sewage wastewater treatment plant from Sarra. Washed, and the roots, stems, and leaves, were separated. All samples were oven dried at 37°C for one week. Then the leaves, root and stem of both plant samples were crushed separately.

This was followed by two parts of the experiment: The potential of *Phragmites australis* plant which collected from Wadi Al Bathan to remove (Fe³⁺, Cd²⁺, Cu²⁺, Ni²⁺, and Pb²⁺) from aqueous solution was studied and compared with other plant of Phragmites which was taken from sewage purification plant in Sarra. The antibacterial activity for the *Phragmites australis* was tested in the biological part.



Figure : Phragmites from Wdi Al Bata



Results:

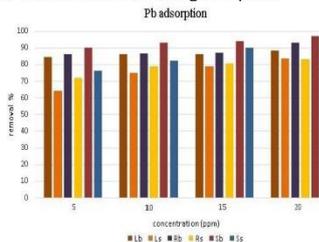


Figure : Effect of initial lead metal ion concentration on the % removal by both phragmites

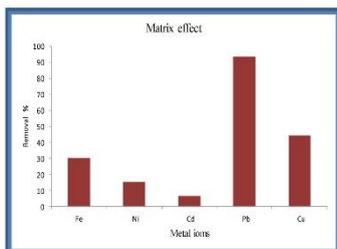
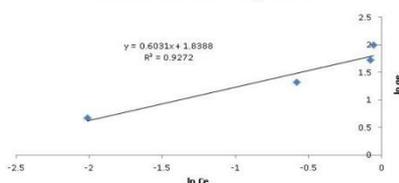


Figure : Effect of metal ions on the percent removal of each other by shoot samples, (Pb²⁺>Cu²⁺>Fe³⁺>Ni²⁺>Cd²⁺)

Freundlich model equation



The results show an efficient capability of *Phragmites Australis* and the other type phragmites which from Sarra in removing all metals were studied in this work. The removal of metals by both plants increases by increasing the amount of biomass.

The biomass was able to remove metal ions rapidly within 15-30 min. with high removal efficiency at pH around 7, 25°C temperature and initial concentration of 20 mg/L of metal ions. Around 97.3% removal efficiency of Pb²⁺ was achieved within the first 30 min. at the optimum condition. As can be seen from results the *Phragmites australis* (common reed) is more efficient, as it almost completely removed lead from the shoot sample.

Investigation the sorption behaviour under competitive conditions when several metallic species are present in the presence of all metal ions the percent removal of the metal ions was in the order of Pb²⁺>Cu²⁺>Fe³⁺>Ni²⁺>Cd²⁺.

Negative values of ΔG at different temperatures point that adsorption is spontaneous at these temperatures. The negative ΔH° denotes that this adsorption is an exothermic process. ΔH° value is lower than 40 KJ/mol which suggests that the nature of adsorption is a physical process.

The results of the uptake of Pb (II) by reed shoot fit well with the Langmuir adsorption isotherm more than Freundlich adsorption isotherm, and Pseudo second-order kinetic model fit better than pseudo first order model.

The results of all samples of antibacterial activity test reveal that is negative. This indicates that the plant extracts have no antibacterial effect on the Gram-negative and Gram-positive bacteria

Summary

Findings in this thesis show that *Phragmites australis* plants from Wadi Al- Bathan can absorb metals more than other phragmites which imports from other country; hence it is recommended to utilize them for pollution removal from water

Acknowledgment:

I would like to acknowledgment the Middle East Desalination Research Center (MEDRC) who funded the master work through the Palestinian Water Authority



Removal of Methylene Blue from Industrial Wastewater in Palestine Using Polysiloxane Surface Modified with Bipyrazolic Tripodal Receptor

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¹An-Najah National University

Research Background: Different pollutants from industries leach every day to soil and ground waters without treatment. This will lead to different health problems to both human beings and animals. Pollution caused by agents such as heavy metals and dyes are amongst the list which rendered the environment unwholesome and posed serious health concern to the populace. Industrial effluents are one of the major causes of environmental pollution because effluents discharged from dyeing industries are highly colored with a large amount of suspended organic solid. Untreated disposal of this colored water into the receiving water body either causes damage to aquatic life or to human beings by mutagenic and carcinogenic effect. The major problem here is to detect the concentration of one of the pollutants like methylene blue and try to remove it by adsorption.

Methodology: (i) synthesis of 3-aminopropylsilica (Si-NH₂) (ii) synthesis of Synthesis of N,N-bipyrazole-substituted silica (Si-NPz₂). (iii) This work is focused on the synthesis, characterization and applications of a new N,N-bis (3,5-Dimethylpyrazol-1-yl methyl)-3-aminopropyl Polysiloxane (Si-C₃H₆NPz₂) by the chemical modification of the pre-prepared functionalized silica gel for quantitative extraction and elimination of methylene blue (MB) from industrial wastewater. This new product (Si-C₃H₆NPz₂) can be synthesized by mixing and stirring for 7 days of the pre-prepared functionalized silica gel with an excess of 3,5-Dimethylpyrazole-1-methanol under mild conditions (room temperature and atmospheric pressure) using anhydrous acetonitrile as a solvent. (iv) (FT-IR) was used to confirm that the Dimethylpyrazole units have been immobilized onto the surface of the modified silica gel. (v) (SEM) technique was used to examine the Modified Polysiloxane surface. (vi) The thermal stability of polysiloxane derivatives (Si-C₃H₆NH₂), and (Si-C₃H₆NPz₂) were determined by thermogravimetric analysis. (vii) The adsorption experiments of MB dye were conducted for a wide range of pH, adsorbent dosage, temperature, initial concentration and contact time. (viii) The Freundlich, Langmuir and Temkin models are employed to analysis adsorption occurred in the experiment data of adsorption isotherms

Methylene Blue (3,7-bis(Dimethylamino)-phenothiazin-5-ium chloride):

Methylene Blue is a heterocyclic aromatic compound with molecular formula C₁₆H₁₈ClN₃S. Methylene blue (MB) is a cationic thiazine dye that is deep blue in the oxidized state while it is colorless in its reduced form leucomethylene blue. MB and leucomethylene blue exist as a redox couple in equilibrium and together form a reversible oxidation-reduction system or electron donor-acceptor couple as shown in Figure 2.

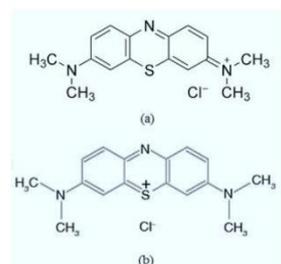


Figure 2: Molecular structure scheme of the methylene blue.

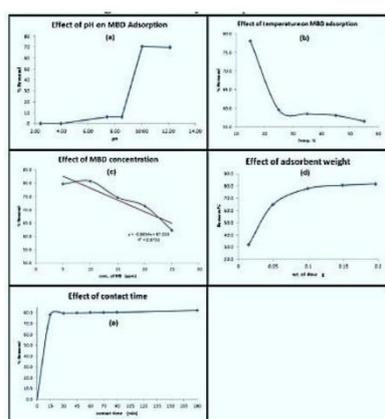


Fig. 3: The percentage removal of Methylene blue dye under different conditions. The adsorption experiments were conducted for a wide range of (a) pH (b) temperature (c) MB dye concentration (d) adsorbent weight and (e) contact time.

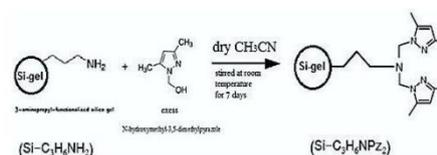


Figure 1: The synthesis route of modified polysiloxane

Results:

- SEM images of the Modified Polysiloxane surface show rough and porous nature, indicating that the materials present good characteristics to be employed as an adsorbent.
- FT-IR analysis confirms that the dimethylpyrazole units have been immobilized onto the surface of the modified silica gel.
- Thermogravimetric analysis (TGA) reflects the thermal stability of this new product.
- The increase of MB dye uptake as the pH value is increased. At low pH, the retention of MB dye by the (Si-C₃H₆NPz₂) is not significant since the ligand is entirely in its protonated form.
- Increasing the temperature above the room temperature has slightly influence on decreasing the adsorption capacity of the new modified surface. The maximum adsorption (78%) was achieved at 15°C. This indicates that the adsorption of MB dye on (Si-C₃H₆NPz₂) follows exothermic process.
- The uptake of MB dye was rapid at lower concentration (5-10 mg/L) and as concentration increase the amount of MB dye adsorbed was decreased. That is because, at lower concentration, the ratio of the initial number of MB dye molecules to the available surface area is low and the available sites are high but at high concentrations of dye, the available sites are fewer.
- Removal efficiency was increased sharply with increasing amount of adsorbent up to 0.1 g. Then removal efficiencies were not changed significantly with increasing amount of adsorbent.
- MB dye showed a fast rate of adsorption during the first 15 min, and then the rate of adsorption becomes almost insignificant after that due to consuming of the adsorbing sites.
- The sorption data fitted into Langmuir, Freundlich, and Temkin out of which Temkin adsorption model was found to have the highest regression value and hence the best fit. This isotherm contains a factor that taking into the account of adsorbent-adsorbate interactions which indicates the presence this interaction.
- The value of ΔH was higher than those corresponding to physical adsorption. This would suggest that the adsorption process is chemical in nature. The small positive value of ΔS° suggests that some structural changes occur on the adsorbent and the randomness at the solid/liquid interface in the adsorption system increases during the adsorption process.
- The results show that the pseudo second order kinetic model fits perfectly the experimental data with linear regression coefficients 0.9999. A pseudo second order suggests that this adsorption depends on the adsorbate as well as the adsorbent and involves chemisorption process in addition to physisorption.
- The comparison of the uptake capacity of the recycled adsorbent showed an excellent adsorption ability and has a good stability and can be reused many times without decreasing its extraction percentage.

Summary: The product (Si-C₃H₆NPz₂) was successfully prepared. The FTIR results confirmed that the Dimethylpyrazole units have been immobilized onto the surface of the modified silica gel. SEM images indicated that the Modified Polysiloxane surface presents good characteristics to be employed as an adsorbent. MB sorption using (Si-C₃H₆NPz₂) can be described using pseudo second order and Temkin isotherm model. Based on the results, the (Si-C₃H₆NPz₂) is able to remove MB rapidly within 15 min with high removal efficiency. Over 82% removal efficiency of Methylene blue dye was achieved after 180 min. at solution pH around 10, 20°C temperature, 0.25 g weight of dose and initial concentration of 15 mg/L of 50mL MB dye solution.



Desalination Processes for Drinking Water in Palestine: Optimization Using Decision Support System

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Research background: Palestine is going through a grave water shortage due to the Israeli domination of the water resources as per Oslo II Accords. Israel’s water consumption average is 350 liter per capita per day, compared to 76 liter per capita per day for the Palestinians, so desalination is one of the solutions for the water shortage problem. There are many types of desalination processes so its essential to find the optimal one for both brackish and sea water for drinking purposes, using solar energy to be friend to the environment.

Methodology:

- The 1st case study for brackish water in Zbaidat village the Data were collected from literature review for Reverse Osmosis and Nano Filtration, then they were both designed using Reverse Osmosis System Analysis Software. The results were used in Multi Criteria Decision Analysis to find the optimal desalination technique.
- The 2nd case study for seawater in Gaza Strip the data were collected from literature review for Reverse Osmosis, Multi Stage Flash and Multiple Effect Distillation .MCDA was used to find the optimal desalination technique. The optimal technique was designed using ROSA software

Area of study:

- 1- Zbaidat is a village which lies 35km north of Jericho City and bordered by the Jordan River to the east, Marj Na’ja village to the north, Tubas city to the west, and Marj al Ghazal village to the south (Map 1).
- 2- Gaza Strip lies on the eastern coast of the Mediterranean Sea. More than 90% of the population of the Gaza Strip depends on desalinated water for drinking purposes. About 90% of the groundwater is unacceptable for drinking as a result of contamination by nitrate and chloride (Map 1).



Map 1: Location of the two case studies.

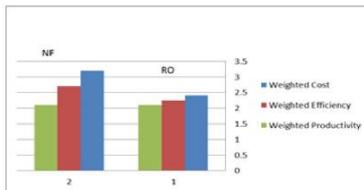


Fig. 1: Optimal Desalination Technology for Zbaidat Village.

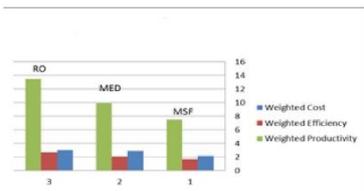


Fig. 2: Optimal Desalination Technology for Gaza Strip.

Results:

1. Many countries suffer from water shortage, especially Palestine due to the occupation that controls the water resources.
2. As the Nano filtration desalination structures are considered to consume the lower quantity of energy than Reverse Osmosis systems in desalinating Brackish Water, it is very suitable to be activated by solar electric power methods represented in Photovoltaic, since Palestine enjoys a high solar energy potential. And NF is more efficient as in Fig(1) in this case Study.
3. The Reverse Osmosis is the optimal technique for Seawater desalination in Gaza Strip, since it needs the lowest amount of energy than thermal techniques(MSF, MED), but the energy there is not sustainable so the PV used in this study, also RO is the most productive technology, cheap and efficient as in Fig (2).
4. The permeate quality of both brackish and sea water conforms to the World Health Organization and Palestinian Water Authority standards of drinking water.

Summary: Palestine suffers from water shortage problem, there is a good potential for addressing the water shortage problem in rural and remote areas through sustainable saline water desalination technologies. In Palestine two types of water can be desalinated, brackish and sea water that differs in the total dissolved solids content, and this is reflected on the final cost of the desalination. So the optimal technology was found, depending on productivity, efficiency and cost, and the quality achieves the standards of the WHO and PWA for drinking purpose and the least cost for the consumer also achieved. NF was the optimal for the brackish water, and the RO for seawater.

Acknowledgments:

Brendan Smith from MEDRC Water Research project supported by The Middle East Desalination Research Center, Muscat, Sultanate of Oman

Dr. Subhi Samhan, PWA, Palestine.
 Dr. Abdelhaleem Khader, Palestine, Nablus, An Najah National University



Removal of chromium from tannery wastewater using nanoparticles

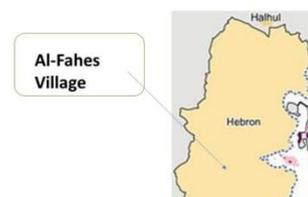
Kanan A, Nassar N, Khderat W
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Research Background: Global demand for water continues to increase while freshwater sources are becoming scarce. Industry is the main consumers of fresh water and hence scientific advances in fields of nanotechnology are merging as a cost-effective technology for cleaning up industrial wastewater. Here in Palestine, the tanning of skins is one of the important industry that relies heavy on fresh water for the tanning process. Hence, significant amount of wastewater is generated, which is typically discharged back to the environment without any proper treatment.

Methodology: (i) Study will be conducting a literature review to get updated on the advanced application of nanotechnology and look into the current treatment technology that typically employed for tannery wastewater treatment. (ii) Statistical data on the current tannery effluent in Palestine will be collected to gain an idea about technology scaling up. (iii) Synthesis of nanoparticles from locally sourced materials (iron oxide, rust) will be employed. (iv) Test the prepared nanoparticles on the cleaning up wastewater effluent. After that, optimum method that can be both cost-effective and efficient will be adopted

Area of study (tannery stations in Al-Fahes village)

The area of study is West bank in general and Al-Fahes village, located to the south of Hebron city (map.1). This area was chose especially because of the increasing population growth, the shortage of water supplies and has a many tannery wastewater stations. In tanning industry, the chromium concentration in terms of total chromium in the exhaust chromium liquor, with a volume of 4% to 6% of the total wastewater volume discharged from the tanning process, ranges from 1,500- 5,000 mg/L.



Map 1: Al-Fahes village, Hebron, west bank

Table(1): The effect of different types of adsorbent on removal on chromium from wastewater

Type of Abs	CE	Removal%
AC	0.116	58
Sand	0.134	67
Nps+PEI	0.126	63
Sand(SEF)	0.194	97

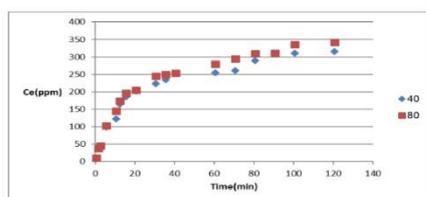


Fig.1: effect of time on the removal with different concentration of initial chromium solution

Result:

The removal percentage and the adsorption capacity of chromium from the tannery wastewater was increased by

- Using sand embedding with iron oxide nanoparticles as adsorbent(table1)
- Using pH range from 8 to 9.5
- Chromium concentration range from 40 to 200 ppm
- Time of reaction between adsorbent and wastewater approximately 2hr (. 1)

Summary: In this study, polyethylenimine-functionalized iron oxide nanoparticles were embedded into silicon dioxide (sand), a commonly used filter aid, at <5 wt% to remove a dissolved chromium (Cr) from wastewater in batch and continuous flow column experiments. An array of characterization techniques, such as SEM was carried out for the sand embedded nanoparticles. The adsorption performance of the fixed-bed column was tested for sand, before and after embedding it with iron oxide nanoparticles, to determine the breakthrough curves under different operational conditions (e.g., inlet concentration of Cr, inlet flow rate, and bed height).



Efficiency of Magnetic CoFe₂O₄ Supported on Graphene for Removal of Cyanide from Wastewater

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¹An-Najah National University

Research Background: Different pollutants from industries leach every day to soil and ground waters without treatment. This will lead to different health problems to both human beings and animals. Cyanide is a very toxic compound that is released into the environment through the effluents of industrial activities such as metal plating, electronics, photography, coal coking, plastics, chemical fertilizer and mining. Cyanide is included in the priority list of hazardous substances and has adverse health effects on people as well as other living organisms. Exposure to small amounts of cyanide can be deadly irrespective of the route of exposure

Methodology: (i) Synthesis of CoFe₂O₄ Nanoparticles (ii) Synthesis of GO-CoFe₂O₄ Nanohybrids (iii) This work is focused on the synthesis, characterization and applications of a Modified Magnetic- CoFe₂O₄ Graphene oxide Nanohybrids (MGONH). This product of (M- CoFe₂O₄/ GO) can be synthesized by mixing of Iron(III) Chloride Hexahydrate and Cobalt(II) Chloride and stirred for 30 minutes. The interaction was continued for the same duration for five minutes and then cooled to the temperature of the room which was 25°C. The particles of nanohybrid were separated with a magnetic and cleaned with extra acetone and water. The precipitates were dried at room temperature for a day. (v) (SEM) technique was used to examine the Modified Magnetic- CoFe₂O₄ Graphene oxide. (vi) The thermal stability of Magnetic- CoFe₂O₄ Graphene oxide are determined by thermogravimetric analysis. (vii) The adsorption experiments of CN were conducted for a wide range of pH, adsorbent dosage, temperature, initial concentration and contact time. (viii) The Freundlich and Langmuir models are employed to analysis adsorption occurred in the experiment data of adsorption isotherms

Molecular structure scheme of the cyanide):

Cyanide is present as anion form CN⁻ in some compounds such as Potassium Cyanide and Sodium Cyanide, which are toxic compounds, with IUPAC name Cyanide Because of the Cyanide anion of high nucleophilicity, cyano groups are introduced into organic molecules by displacement of a halide group.



Figure 1: Molecular structure scheme of the Cyanide.

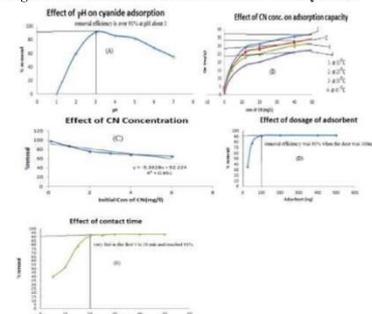


Fig. 2: The percentage removal of Cyanide under different conditions. The adsorption experiments were conducted for a wide range of (A) pH (B) temperature (C) CN concentration (D) adsorbent weight and (E) contact time.

Results:

- SEM images of the Modified (M- CoFe₂O₄/ GO) show rough and porous nature, indicating that the materials present good characteristics to be employed as an adsorbent.
- FT-IR analysis confirms that provide information on the redistribution of cations between eight surfaces and tetrahedral locations of the inverse spinel structure in GO.
- Thermogravimetric analysis (TGA) reflects the thermal stability of (M- CoFe₂O₄/ GO) product.
- Cyanide adsorption gradually increases with the increasing of pH and the removal efficiency is over 91% at pH about 3. The results show that as the pH increases up to 3, the adsorption of Cyanide will be less favorable. It is due to the electrostatic repulsion between the adsorptive anion and the surface of the GO.
- that the adsorption process is more suitable at 15 °C temperature. This is mainly due to low surface activity suggesting that the absorption between CN⁻ion and GO is a thermal reaction. With increasing temperature, attractive forces between the surface of graphene oxide and CN⁻ are weakened and then sorption decreases.
- that uptake of CN was rapid at lower concentration (0.11.5 mg/L) and as concentration increase the amount of CN adsorbed was decreased. At lower concentration, the ratio of the initial number of CN molecules to the available surface area is low and the available sites are high, but at high concentrations of CN, the available sites are fewer.

- Removal efficiency was increased sharply with increasing amount of adsorbent up to 100 mg. Then removal efficiencies were not changed significantly with increasing amount of adsorbent.
- The adsorption of CN on (MGONH) samples were very fast in the first 5 to 20 min and reached 91%.The adsorption rate becomes almost insignificant after that, because of use of the adsorption sites.
- The adsorption data fitted into Langmuir and Freundlich out of which Langmuir adsorption model was found to have the highest regression value and hence the best fit. This isotherm contains a factor that taking into the account of adsorbent-adsorbate interactions which indicates the presence this interaction.
- AS⁰ value is positive indicating that entropy increases on the surface / solid solution through the absorption process, And The negative AH⁰ denotes that this adsorption is an exothermic process, It is clear from the table that all values the Gibbs free energies (AG⁰) were negative and this shows the spontaneous nature of the adsorption process to different temp.
- The results show that the pseudo second order kinetic model fits perfectly the experimental data with linear regression coefficients 0.9999.
- The comparison of the uptake capacity of the recycled adsorbent showed an excellent adsorption ability and has a good stability and can be reused many times with little decreasing its extraction percentage.

Summary: The product (M- CoFe₂O₄/ GO) was successfully prepared. The FTIR results confirmed that the GO have been immobilized onto the surface of the modified M- CoFe₂O₄. SEM images indicated that the Modified M- CoFe₂O₄ surface presents good characteristics to be employed as an adsorbent.CN adsorption using (M- CoFe₂O₄/ GO) can be described using pseudo second order and Langmuir isotherm model. Based on the results, the (M- CoFe₂O₄/ GO) is able to remove CN rapidly within 20 min with high removal efficiency. Over 91 % removal efficiency of Cyanide was achieved after 60 min. at solution pH around 3, 15°C temperature, 0.25 g weight of dose and initial concentration of 15 mg/L of 50mL





Smart Irrigation and Pollution Monitoring System

Adnan Salman¹, Arcen Z. Najji¹
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Introduction

Demands on water resources are constantly increasing due to natural growth in population. It is predicted that world population will double in the next 50 years. In response, greater yields must be extracted from the current agricultural areas and more marginal lands should be prepared. In general, and in particular in Palestine region, agriculture is the largest consumer of fresh water, accounting for more than 80% of water consumption. Further, in Palestine the irrigation schedule is mainly conventional based on the farmer experience. This conventional irrigation approach cause inefficient use of water and over or under irrigation which can reduce the crops yield and Use recycled water . Shortage of water is not the only concern in this region, pollution is another major concern and it is expected to increase due to the increase of industry and population. Therefore, long term monitoring of water resources is vital. Anew unconventional efficient water management is required to meet the growing demand on fresh and clean water and to reduce wasted water which caused by ineffective water delivery. Further, new unconventional water resources are required to increase water supply and a smart long term pollution monitoring of water and soil is necessary to increase the yield and the quality of the crops. In this project, we propose a smart water management system based on advanced Information and Communication Technology (ICT). The proposed system has two main objectives 1) Smart irrigation scheduling based on soil moisture, temperature, and the crop characteristics and 2) long term pollution monitoring based on recent advances in sensors technology. In addition to the main objectives, the data gathered about the environment will be saved and shared for further data analysis and data mining to extract knowledge about the best agricultural practice..

Objectives

General Objectives:

➤ Establish a smart water management system that leverages ICT technology for agricultural applications to monitor and reduce water consumption and potential pollution.

Specific objectives:

➤ Employ smart ICT technology for efficient use of water in agriculture by minimizing water consumption due to evaporation and leakages.

➤ Employ smart ICT technology for long term monitoring of water quality and potential soil pollution.

➤ Save the environmental data, which collected from the sensors, and but it on the base station computer, for further data analysis and applications design to make the system accessible and adaptable.

Conclusion

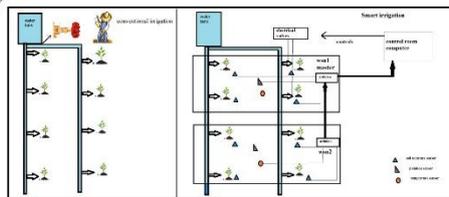
This project uses the wireless sensor networks (WSN) in agriculture to gather vital environment parameters such as temperature, humidity, soil moisture, and pollution in a regularized timely manner. Then software on the computer will investigate the data and make decision on the amount of water to be delivered to the plant.

Finally the result system will be expert as a farmer, fill the plant environmental requirements, and save money by minimizing water consumption, and increase the yield and the quality of the crops.

Wireless Smart Irrigation System



System architecture



In the proposed system, the land is divided into regions. A wireless sensor node is deployed in each region where it gathers data about its assigned region through several sensors installed in the region including moisture, temperature, wind, pH, and pollution sensors. Each sensor monitors a physical quantity. The data gathered by the wireless nodes are transmitted through an RF antenna to a gateway node, where it receives all different kind of sensed data in a timely manner. This data will be passed from the gateway to a computer. Then, a decision support system on the computer investigates the data and based on the type of crop, it decides and controls an irrigation schedule automatically of each region.

One major issue in the application of WSN in agriculture is the power needed by various sensor nodes distributed in the field. Wireless nodes use on board batteries that require recharge frequently to provide enough power for preprocessing and broadcasting data through the antenna. To supply the necessary power, small solar panel units for recharging the batteries can use. However, in the prototype of this project we will use the power supplied from the grid.

Demo

we presented a small model of smart irrigation system; it consist sensors to measure soil moisture, temperature, and air humidity, the sensors are connected to Arduino Uno microcontroller, which controls an electrical valve of water, to save the range of soil moisture.(220-300)

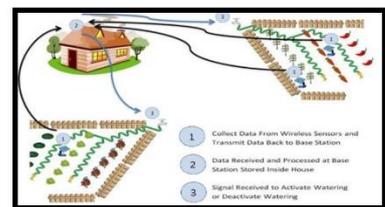


Examples of Results :

In normal soil (medium humidity): It needs some water, the system will turn the water valve on. soil moisture: 270 Watering your plants
 Humidity: 59.30 % Temperature: 15.10 C **After some watering: the soil still under saturation, the valve is on.**
 soil moisture: 249 Humidity: 59.30 Temperature: 15.10 C Watering your plants
After soil became wet: The soil has been saturated, the system turn the valve off
 Humidity: 59.30 % Temperature: 15.20 C soil moisture: 217 very wet soil
In dry soil: The soil is dry, the system turn the valve on Dry soil needs water
 Humidity: 59.30 % Temperature: 15.20 C soil moisture: 480

Project Description and Methodology

Recent advances in computing and wireless sensor technologies, allow monitoring and controlling the environment around us. Conventional agricultural irrigation scheme currently in use is a major water consumer where a significant amount of water is consumed through dissipation and drainage. Further, the conventional irrigation approach can result in over or under irrigation which can have a negative impact on the quality of the crops and the crops yield. Since irrigation scheduling is highly depended on weather condition, soil properties, and plant type, a smart automatic irrigation and monitoring scheme, that takes these factors into consideration, can result in a significant amount of water saving, increased crop yield, and better crops quality. In this project, we propose the use of a Wireless Sensors Network (WSN) and an automatic irrigation system to monitor pollution and regulate the amount of water delivered to the plant.



Wireless Sensor Networks in agriculture

A WSN is a distribution of various kinds of sensors to monitor environmental conditions, such as temperature, pressure, moisture, etc. through wireless connection; they pass their data to a gateway that is connected to a main computer for processing. Based on this information, a decision support system controls the sensors themselves and multiple processes in the environment to accomplish useful tasks. Also, the gathered information is typically saved and analyzed to extract knowledge and to improve the performance of different processes. This technology has proven its success in several applications such industrial processes, health monitoring, and agriculture.

We propose the use of WSN in agriculture to gather vital environment parameters such as temperature, humidity, soil moisture, and pollution in a regularized timely manner. Then software on the computer will investigate the data and make decision on the amount of water to be delivered to the plant. If the pollution sensors detected pollution above accepted threshold, a notification will be sent to the farmer. This automatic management of irrigation will not only reduce water wastage due to evaporation and drainage, but it will deliver the right amount of water to the plant avoiding over or under irrigation. The result will be a better quality of crops and an increased yield. Further, this smart irrigation will save farmers time and effort, and the necessary experience in the conventional irrigation..

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Palestinian National Authority
Palestinian Water Authority



المملكة الوطنية الفلسطينية
سلطة المياه الفلسطينية



Membrane based treatment technologies: Feasibility of Desalinated Brackish Water and Effluent Reclamation for Agricultural Use in Jericho area

By: **Jalal Bsharat**

Supervisor: **Dr. Eng. Rashed Al-Sa'ed**
Birzeit University

Background Research Questions Results

Rising salinity levels in Jericho area is one of the significant signs of water-quality degradation in groundwater.

Natural salinity in the alluvial Pleistocene wells in the Jordan Valley area

Anthropogenic influences due to increment of nitrate, bromide and sulphate, through agricultural chemical effluents or sewer pollution from adjacent septic tanks which are mainly constructed in top gravel in the Samara layer

Lack of sanitation services, limited access to freshwater sources, salinized soil and seasonal rainfall caused food insecurity and poverty in Jericho district

Proper management and application of innovative water and wastewater treatment systems using membrane based treatment technologies to enhance water independence, food security and economical development in Jericho district is NOT well known yet.



Figure 1. Salinity map in Palestine (PWA)

- Will the beneficiaries accept desalinated water as alternative water source for domestic, industrial and agricultural consumption?
- What should be the quality guidance for blending waters added post-desalination for stabilization?

Research Objectives

- Evaluating brackish water and reclaimed effluent quantities in the study area and evaluating the feasibility of membrane based treatment technology and other alternatives for brackish water desalination in the Jordan Valley.
- Assessing farmers' perception for using desalinated water and reclaimed influent in agriculture.
- Evaluating new alternatives to reduce water withdrawals from the country's overdrown natural storage bodies of potable water (the two main aquifers) to avoid their further degradation by saline water intrusion (some of it irreversibly) and, eventually, raising their levels to hydrological safe values.
- Reviewing of international standards and guidelines for water quality parameters suitable for irrigation and acceptable by farmers

- The research highlighted the current agricultural water issues in the Jordan Valley, and tried to explore new feasible alternatives for brackish water desalination in order to utilize abundant brackish water in the Jordan Valley.
- To lower the cost, RO was combined with other alternatives such as utilizing the grid off solar PV, blending the brackish water with treated effluent or flood water harvested from Wade's run-off.
- It has been proved that blending brackish water with treated effluent is a feasible alternative by considering the fact that JWWTP will generate 3.5MCMY when operated at ultimate capacity and this alternative can be optimized to include other areas in the Jordan when additional 15 MCMY conveyed to the Jordan valley from other cities.
- The research recommended RO-PV as replication of published studies recommendations and the results of RO projects in Palestine. RO-PV is recommended for its market availability and economic feasibility of energy cost. Coupling RO to the off-grid solar PV lowered the cost to an average \$ 0.083(USD)/CM for the Zbeidat desalination unit compared to \$ 0.346 USD/CM for Marj Na'ajeh RO unit supplied through the Electricity grid network. The average cost of desalinated water would still be cheaper if brackish water treatment combined with other alternatives such as blending with treated effluent or harvested run off.
- The research recommended that further studies is still needed on blending and reuse.

Research Problem Conclusion

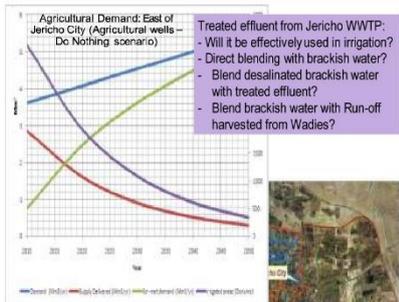
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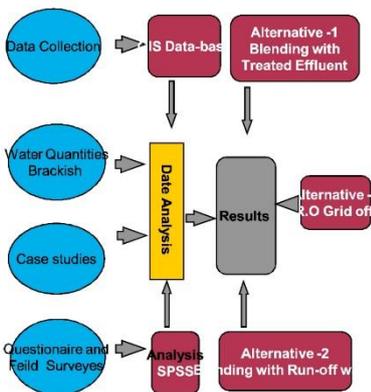


Direct use of brackish water in agriculture lead to

- low agricultural productivity
- Soil degradation/salinity
- Desertification, abandoning agricultural fields
- Poverty and food insecurity

- Integrated scheme combining desalination of brackish water with effluent reuse and Flood Run would be one of the most suitable solutions to improve the water resources in the Jordan Valley and bridge the gap between supply and demand.
- Water scarcity in many countries has brought about significant progress in the use of non-conventional resources (desalination and effluent reuse).
- Problem of brine disposal resulted from desalination process which depends on the degree of salinity of the raw water.
- Jordan and Israel experience has demonstrated that even desalination cost is still expensive but it can be considered as feasible alternative and can be incorporated in overall production costs (even for private initiatives)
- Cost of desalination of brackish water can be competitive but can't be assumed by all the end-users, even the agricultural industry.

Methodology



Recommendations

- The cost of desalinated water and treated effluent is still high to be handled by the farmers; this implies investigating new alternatives to support farmers and empowers their affordability.
- The desalination technology needs a comprehensive management system, to organize the desalination plants distribution based on brackish water availability, areas' needs and capacity.
- Monitoring program for the desalinated plants should be developed for evaluating the product and distributed water.
- To avoid the negative environmental impact, the disposal of brine should be considered and EIA should be performed.
- Awareness campaign targeting the consumers to increase their awareness about the drinking water recommendations and healthy water quality.
- Palestine is in a great need for capacity building in the field of water desalination technology.
- Desalination of inland brackish water raises problems even not well solved due to the brine discharges or brine disposal, and it's necessary to research more about this important topic.
- Further researches on feasibility of desalination and effluent reuse will be needed in order to improve the efficiency and minimize the cost.

Nanotech based filtration of advanced treatment of wastewater

Ahmed AL-Khaldi

Supervisor: Dr. Abdel-Fattah Hasan
Co-Supervisor: Prof. Amer El-Hamouz

Abstract

In this research a new innovative modification on the traditional tertiary filtration-treatment units using zinc oxide nano photocatalysis is suggested to improve the quality of the treated effluents. The value of this idea lies in using cheap nano materials in modifying the filtration medias which grantee longer operation time with less frequently need for backwash or regeneration of the filtration media what makes the filtration process more sustainable and economically convincing solution.

In this research, the nano zinc oxide catalysis was successfully lab synthesized from high purity graded raw chemicals (99.5%) and also from commercial raw materials (purity $\geq 95\%$). No significant difference in the size of the produced catalysis based on the purity of the raw material. Where, the zinc oxide nano photocatalysis was produced in size of 69 nm from commercial zinc sulfate heptahydrate and size of 29 nm from graded zinc sulfate heptahydrate. In the same manner, nano ZnO catalysis which was produced from commercial micro-sized ZnO have a size of 28 nm which is greater than the nano ZnO catalysis originated from graded raw micro-sized ZnO by just 11 nm.

Photocatalytic degradation ability of the produced nano catalysis was tested in batch experiments as powder or after pre-depositing it on the surface of activated carbon or recycled glass. The nano photocatalysis produced from commercial raw chemicals ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ and micro-sized ZnO) shows high degradation ability for the pollutants in the secondary wastewater with efficiency reaches 85% of total chemical oxygen demand (COD) in the powder batch, and exceeds this value to 97% in the batch of pre-deposited nano catalysis on the surface of the recycled glass.

Carbon and recycled glass were tested as nano photo catalysis carrier. The activated carbon didn't show the sought after results where the nano catalysis easily escaped to the solution in the batch experiment moreover the black imperial structure of the AC obstructed sun light and ultraviolet light which activate the photo catalytic reaction causing deficiency in activation of the nethermost photocatalysis. Unlike AC filtration media, the filtration media made of crushed glass allows the UV to penetrate its structure and therefore activating the pre-doped nano photo catalysis even in the bottom layers of it.

Finally, the results of this research are the milestone of other researches in order to develop a self-cleaning filtration media.

Nano Crystalline Cellulose Modified with Imine Functional Group for Waste Water Purification

Mai Suhail Abd Al-Raouf Azar

Supervised by: Prof. Shehdeh Jodeh, Dr. Othman Hamed

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Abstract:

Cellulose is the most abundant natural product; it has unlimited number of industrial applications. It reacts like alcohol and can be converted into various polymers with various functionalities the present work reports Nano crystalline cellulose (NCC) based imine polymer was prepared and used as an adsorbent of lead and copper ions from waste water. The polymer is water insoluble and carries a functional with high affinity for metals. These properties make it excellent candidate for application is in wastewater purification. The polymer was prepared from cellulose which was extracted from olive industry solid waste(OISW) and converted to cellulose nano crystalline, then oxidized to di aldehyde using sodium periodate, the produced di aldehyde was then converted to imine by reacting it with 1,2-diaminobenzene. The produced polymer was subjected to analysis by various of spectroscopic methods. The efficiency of the prepared NCC amine based polymer toward lead and copper ions was investigated as a function of adsorbent dose, temperature, pH and time.

The cellulose amine polymer showed a good efficiency toward the copper and lead at optimum conditions (0.1g, 25°C, pH7, time 15minute).

Keywords: *cellulose nano crystalline; Copper; Polymer; FT-IR; Wastewater.*

Innovation Initiative Grant -I2

Ghadir Hanbali



Biography

Dr. Ghadir Hanbali, Part time lecturer in Chemistry department at An-Najah National University, was born in Nablus (Palestine) on March 23, 1993. She obtained her B.Sc. degree in applied chemistry from An-Najah National University in 2014. During 2014 - 2016, She worked as a teaching assistant in the department of chemistry. In 2016, She obtained a master's degree in the field of chemistry with GPA of 4.00 out of 4.00. She obtained her PhD degree in the field of Organic and analytical Chemistry, from An-Najah National University in November 2020. Her PhD research was in part done in Jülich Forschungszentrum in Germany. Her researches in both master and PhD are funded by MEDRC and also obtained innovation initiative research grant (I2) during her PhD study. Ghadir participated in many scientific papers; she published more than ten paper. Her researches are mostly concentrated on purification of water such as removal of heavy toxic metals using synthetic material that have very good adsorption efficiencies towards these toxic materials. Her main goal in this life is to work to serve its community and to become a researcher working to solve the problems facing the environment, especially the problems of the water sector. She attended and presented in many international scientific conferences inside and outside Palestine and participated in many projects.

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<p>Enhanced Ibuprofen Adsorption and Desorption on Synthesized Functionalized Magnetic Multiwall Carbon Nanotubes from Aqueous Solution. (I2 research name: Nanomaterials Application in Removal of Pharmaceutical Drugs from Water)</p>	
Authors and Corresponding	<p style="text-align: center;">Ghadir Hanbali¹, Shehdeh Jodeh^{1,*}, Othman Hamed^{1,*}, Roland Bol², Bayan Khalaf¹, Asma Qdemat³ and Subhi Samhan⁴</p> <p>¹ <i>Department of Chemistry, Faculty of Science, An-Najah National University, P. O. Box 7, Nablus 00001, Palestine; g.hanbali@najah.edu (G.H.); bayan.kh107@hotmail.com (B.K.)</i></p> <p>² <i>Institute of Bio and Geosciences, Agrosphere (IBG-3), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany; r.bol@fz-juelich.de</i></p> <p>³ <i>Jülich Center for Neutron Science and Peter Grunberg Institute, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany; qdemat@fz-juelich.de</i></p> <p>⁴ <i>Palestinian Water Authority, Ramallah 00001, Palestine; subhisamhan@yahoo.com</i></p> <p><i>* Correspondence: sjodeh@hotmail.com (S.J.); ohamed@najah.edu (O.H.); Tel.: +970-599590498 (S.J.); Fax: +970-92345982 (S.J.)</i></p>
Abstract	<p>In recent years, concerns have been raised about the occurrence of active raw materials and pharmaceutical ingredients that may be present in water, including wastewater, in the pharmaceutical industry. Wastewater treatment methods are not enough to completely remove active pharmaceuticals and other waste; thus, this study aims to assess the use of a multiwall carbon nanotube after derivatization and magnetization as a new and renewable absorbent for removing ibuprofen from an aqueous medium. The adsorbents were prepared by first oxidizing a multiwall carbon nanotube and then deriving the oxidized product with hydroxyl amine (m-MWCNT–HA), hydrazine (m-MWCNT–HYD), and amino acid (m-MWCNT–CYS). Adsorbents were characterized by Raman spectroscopy, Fourier Transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM and TEM), Brunauer–Emmett–Teller surface area analysis (BET), thermogravimetric analysis (TGA), and vibrating sample magnetometer (VSM). Batch adsorption studies were conducted to study the effects of pH, temperature, time, and initial concentration of the adsorbate. Adsorption isotherm, kinetics, and thermodynamics studies were also conducted. The results show that the optimal pH for nearly complete removal of Ibu in a short time at room temperature was 4 for three adsorbents. The adsorption followed the Langmuir isotherm model with pseudo-second-order kinetics. The percentage of removal of ibuprofen reached up to 98.4%, 93%, and 61.5% for m-MWCNT–CYS, m-MWCNT–HYD, and m-MWCNT–HA respectively. To the best of our knowledge, the grafted MWCNTs presented in this work comprise the first example in the literature of oxidized MWCNT modified with such functionalities and applied for ibuprofen removal.</p>
Key words	<p>magnetic multi-wall carbon nanotube; adsorption; kinetics; isotherm; ibuprofen</p>

Rinad Hamed



Biography

Researcher Rinad Hamed a PhD candidate at the Department of Chemistry at An-Najah University in Nablus. Rinad is one of The MEDRC fellow at Ms. Degree and the winners of MEDRC initiative I1 and I2 projects which was run in March 2018 and March 2020. Rinad has been developing an innovative solution that would enhance the efficiency of water management and make use of the readily available brackish water. The solution uses brackish water as a main source of irrigation and as a replacement to fresh water. Seeds are treated using plant growth-promoting rhizobacteria (PGPR) to produce enhance its growth under harsh environment conditions and can induce changes in the physical properties of soil, which was implemented as lab trail through her master thesis , then it was carried out as field trial by initiative I1. Throughout this initiative I2 the research will be carried out testing new crops and combined with Cold Plasma technique to test its efficiency on plant growth, beside a feasibility study will also be carried out.

Publication and Papers

- MSc Thesis: **“Phytoremediation for treatment of brackish water at Jericho ground wells”**, Supervised by: Dr. Shehdeh Jodeh, Dr. Raed Al kowini.
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Enhanced PGPRs and phytoremediation introduce new NEXUS Approach	
Authors and Corresponding	<p>Dr. Rinad Hamed Dr. Shehdeh Jodeh Dr. Raed Al kowini</p>
Abstract	<p>Water considers as a main component for different sectors, but nowadays the consumption of its resource increased which cause a shortage. This issue alerts researcher to find other alternative resources for fresh water rather than depleting it. Some of these solutions were economical feasible and sustainable, and some of them were not and even can't be adapted everywhere.</p> <p>These solutions were related directly to water research or cross linked with other sector targeting water sector, for instance agriculture sector is known the main consumer for water resources, therefore, researcher shift their innovation toward improving agriculture technique that able to save water or utilize other water resource as brackish or treated waste water.</p> <p>Accordingly, to this, MEDRC aimed also to address new innovation set up by master and Ph.D. candidate at Palestine. One of these researches we carried by using a coated seed with certain strains of PGPR and irrigated them with brackish water, the role of these PGPR's enhance Plant growth under saline condition, and yield higher productivity.</p> <p>The research was implemented in two phases, first phase at lab trail and second phase at field trial. The results reveal significant performance of these coated seeds with PGPR under harsh conditions.</p> <p>This paper will integrate the previous funded research work by MEDRC. The research studies the utilizing the existence huge amount of brackish water at Jericho District Palestine, where this water had been using at agriculture sector through cultivating a coated seed with PGPR (Plant Growth Promoting Rhizobacteria).</p> <p>These coated seed irrigated with brackish water showed its efficiency to overcome the salinity stress condition and to yield higher biomass compared to uncoated seed or even coated seed irrigated with fresh water. The shift in this paper will concentrate into two streams the first stream is scaling scale up the research trial for lab to filed trial aiming to make it as start up for a business project on the other hand this coated seed with by combined with a new technique called cold plasma and study its effect in terms of growth.</p>
Key words	PGPR, Coated, Cold Plasma

Younes Massad



Biography

Thanks to the swift progress of my bachelor degree. Recently, I undertook my M.Sc. in Chemistry from An-Najah National University with Prof. S. JODEH as a supervisor where we could prepare and characterize a Functionalized MWCNTs for the purpose of waste water treatment from Pesticides (Synthesis of Functionalized Multiwall Carbon Nanotube: Application in Removal of Malathion from Water). During my study, I participated in many local and international conferences in Palestine, Morocco and Lebanon in the field of environmental Chemistry and Wastewater Treatment.

Moreover, I also was honorably granted a scholarship by Al-Maqdisi Project in which we made a quantitative analysis in the field of air quality in Deir Ballout, Palestine. Another one was under the supervision of Prof. A. CHAKIR in GSMA laboratories at the University of Reims in France, where we could use FT-IR and GC-MS in Characterization of some Volatile Organic Compounds to study its effect on Ozone degradation

Publication and Papers

The Efficiency of Removal of Organophosphorus Malathion Pesticide Using Functionalized Multiwall Carbon Nanotube: Impact of Dissolved Organic

Matter (DOM). (Submitted)

Jodeh, S., Chakir, A., Massad, Y. et al. Assessment of PM2.5, TVOCs, comfort parameters, and volatile organic solvents of paint at carpenter workshop and exposure to residential houses in Deir Ballout in Palestine. Int. J. Environ. Sci. Technol. (2020)

Email : Younes.massad20@gmail.com

<p>Determination of contraceptive hormones in Nablus Wastewater Treatment Plant and its Irrigation effect on Tomato</p>	
<p>Authors and Corresponding</p>	<p>Younes Massad, Shehdeh Jodeh*</p>
<p>Abstract</p>	<p>In this study, the determination of various contraceptive hormones which is estrogenic hormones, commonly used for birth control and treatment of certain hormonal disorders and cancers, in wastewater is described. Increasing concerns have been raised on endocrine disrupting chemicals like the sex hormone natural 17-β estradiol (E2) and 17α-ethinylestradiol (EE2), the more since traditional wastewater (WW) treatments appear to be ineffective for their removal. The treatments tested for EE2 removal were also evaluated in terms of toxicity, through the determination of biochemical responses. The sex hormones 17 α-Ethinylestradiol (EE2) and 17 β-Estradiol (E2) is among the EDC with the highest estrogenic potency, bioaccumulation potential, detection frequency and resistance to biodegradation (Sukriono and Aris 2014). For these reasons, EE2 was included in the European Union watch list of emerging aquatic pollutants (Ringeval, Schuller et al. 2015).</p> <p>In this study we present a high-performance liquid chromatography (HPLC) method which has been elaborated to analyze such a steroid hormones, as oral contraceptives E2 and EE2 in unfiltered influents and effluents of sewage treatment plants (STPs). HPLC separation of these hormones was achieved in 20 min.</p> <p>Liquid chromatography was carried out using a PerkinElmer binary LC pump 250 (Perkin-Elmer) equipped with a Rheodyne 7125 injector with a 100 mL loop. The two estrogens were analyzed using (25 cm, 4.6 mm i.d.) column filled with 5 mm (average particle size) Alltima C18 packing (Alltech, Deerfield, IL, USA) with a precolumn (Supelguard 2 cm, 4.6 mm i.d.) supplied by Supelco. Analysis was carried out using a solvent gradient. The initial composition of the mobile phase was 35% of acetonitrile and 65% of water. The gradient was programmed to linearly increase the amount of acetonitrile up to 45% in 10 min, then adjusted to 50% immediately, and then to increase up to 60% in 15 min. To clean the column the amount of acetonitrile was kept constant at 100% for 5 min. The flow rate of the mobile phase was 1 mL/min. The retention time for these two estrogens was 16.70 min for E2 and 18.39 min for EE2.</p> <p>References</p> <ul style="list-style-type: none"> • Ringeval, F., B. Schuller, M. Valstar, S. Jaiswal, E. Marchi, D. Lalanne, R. Cowie and M. Pantic (2015). Av+ ec 2015: The first affect recognition challenge bridging across audio, video, and physiological data. Proceedings of the 5th International Workshop on Audio/Visual Emotion Challenge. • Sukriono, D. and M. S. Aris (2014). "Otonomi Desa dan Kesejahteraan Rakyat." Malang: transisi.
<p>Key words</p>	<p>17-β-Estradiol (E2), 17-α-Ethinylestradiol (EE2) , High performance liquid chromatography coupled with mass spectrometry (HPLC/MS)</p>

Ghassan Albarghouti



Biography

I received my Ph.D. in the field of organic chemistry from The Hebrew University of Jerusalem in 2017 under the supervision of Professor Dmitry Tselikhovsky. I finished my master degree in water science and technology under the supervision of Professor Rashed Al-Sa'ed and a bachelor degree in chemistry from Birzeit University. Between 1996 until 2012 I worked as a Lab technician and teaching assistant at the Department of Chemistry/ Birzeit University. Between 2010 and 2012, I joined late Morris Srebnik lab/ The Hebrew University of Jerusalem as part time researcher in medicinal organic chemistry. In 2016, I got a position at Birzeit University as organic chemistry lecturer and researcher in the Department of Chemistry. Since I finished my master degree, I had research interest in environmental organic chemistry including treatment of new emerging contaminants in the environment especially the non-biodegradable species like polyphenols in olive mill wastewater and pharmaceutical residues in wastewater and several research studies being conducted in these fields.

Publication and Papers

- G. Daghrah, R. Al-Sa'ed. **Treated Wastewater Impact on Al Qilt Catchment Area-Palestine**, Asian Journal of Earth Sciences. 2009; 2(3):58-70.
- G. Daghrah. **Water quality study of Wadi Al Qilt-West Bank-Palestine**. Asian Journal of Earth Sciences 2009, 28, 28-38.
- O. El-Sayrafi, G. Daghrah, R. Hussein, K. Swaileh. **Physico-chemical and microbial assessment of Ramallah municipal dump site**. International Journal of Environmental Studies. 2011, 68(4), 509-518.
- G. Albarghouti†, R. Kotalapodi†, D. Lankri, V. Valerio, D. Tselikhovsky. **Synthesis of spiranoid lactones via Wacker-Heck cascade cyclization**. "ChemComm, Chem. Commun., 2016, 52, 3095-3098 (Front cover).
- D. Lankri†, G. Albarghouti†, M. Mahameed, D. Tselikhovsky. **A Multifaceted α -enaminone - adaptable building block for synthesis of heterocyclic scaffolds through conceptually distinct 1,2-, 1,3-, 1,4- and C-O bond forming annulations**. J. Org. Chem., 2017, 82, 7101-7113.
- G. Albarghouti, S. Rayyan. **General method for the synthesis of substituted cyclopentenones via α -borylzirconacyclopentenones intermediates**. Org. Prep. Proced. Int., 2020, 52, 1-8.

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Exploiting Internet of Things for the Adaption of a Smart System for Chlorination	
Authors and Corresponding	Dr. Ghassan Albarghouti
Abstract	<p>Water is considered as an important issue in Palestine, thus solving water quality problems is of major concern for water scientists. The present water chlorination process is monitored manually which is a wastage of time and has a real threat to human health because of fluctuation of chlorine concentration. To have a water supply effectively disinfected, the residual chlorine concentration should be kept in the range 0.3 to 0.5 mg of chlorine per liter of treated water. Several chlorination failures were reported in Palestinian water supply systems and resulted in serious health problems due to disease-causing organisms as a result of the absence of smart monitoring system for chlorination process. Thus, there is a need to adapt smart management system to control the disinfection process in the water supply. To solve the existing problems associated with fluctuation of chlorine concentration in water networks, the present system plans and builds up a low cost model (lab scale) for controlling the concentration of chlorine in the water network. The developed model relies on a programmed framework, which reduces human work and time and increases water quality safety. The critical features in the design of the prototype are based on continuous data collection from the water network system for the concentration of residual chlorine using appropriate sensors and the ability to control the chlorination doses using a suitable software package. This framework will be developed to be fully programmed to utilize an Ethernet for wireless correspondence with the goal that the data can be exchanged to the administrator who is checking the framework.</p>
Key words	Chlorination, Disinfection, Water quality, smart management system

Mays Muhammad Nofal.
Palestine Technical University.
Master of agriculture biotechnology.
Works at: Palestine Ministry of Health

Biography

I am studying my M.Sc. in agriculture biotechnology in Palestine Technical University with Prof. Saed Khayat as a supervisor where we assume to find and isolate bacterial species which adapted to survive and grow under severe condition (severe high saline condition) in the samples which collected from different wells along Jordan Valley. Additionally, this will done using culture-independent method based on functional genes mainly, (dsrAB) gene will be used as a molecular marker to detect and confirm the presence of SRB in water samples.

Moreover, I have a bachelor degree in biology from University of Jordan and also a master degree in biotechnology from Bethlehem University (2014). Additionally, since the mid October 2020 of I'm working at the Palestine ministry of Health as a Biotechnology Lab Technician for Covid -19 Tests.

The diversity and efficiency of sulphate reducing bacteria in selected groundwater at West Bank, Palestine.

Authors and Corresponding

Mays Muhammad Nofal.

Abstract

W SRB perform a valuable ecological role in the environment. Since, SRB are anaerobic bacteria which can degrade organic matter using sulphate as a terminal electron acceptor. Furthermore, their important role in the biogeochemical sulfur cycle make it useful to develop a simple, low cost and eco-friendly technique to reduce salinity of groundwater. Specifically, in Palestine, Jericho area is suffering from a degradation in groundwater quality due to high level of salinity and this can be achieved by reducing SO₄²⁻. Therefore, understanding the biological diversity of SRB is critical for us to use it in sustainable manner and to benefit from their metabolic activity, as some of them have a capacity to degrade environmental pollutants.

In Palestine, the diversity of SRB in hypersaline environment is not well known. Only few studies shown the existence of SRB in West Bank especially, lower Jordan Valley from two groundwater wells). Comprehensive study covering most of the groundwater well in Jordan Valley area still unexplored. Other studies did not characterize or sequence the bacterial strain and none of those studies tried to test the efficiency of SRB in sulphate reduction. Therefore, we assume to find and isolate bacterial species which adapted to survive and grow under severe condition (severe high saline condition) in the samples which collected from different wells along Jordan Valley.

MEDREC - PWA Research
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MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2012:

NAME	PROJECT TITLE	PLACE OF STUDY
Riad Mohamad	<i>Water Desalination, Supplied Water Costs, Total Costs and Benefits.</i>	Al-Quds University
Rinad Jalal Yahya Hamed	<i>Phytoremediation for Treatment of Generated Brine Water from Reverse Osmosis Plant</i>	An-Najah National University
Adnan Nasser	<i>Removal of Heavy Metals from Industrial Wastewater by Sea Shells (Mother of Pearl)</i>	Birzeit University
Imad Ghanma	<i>Impact of Using Desalinated Water on Chemical & Physical Characteristics of Heavy Saline Soil</i>	Birzeit University
Ibtisam Abu Al Haija	<i>Impact of Irrigation with Desalinated Brackish Water on the Productivity and Fruit Quality of Tomato Crop Planted in Heavy Saline Soil in Marj Na'aja Village</i>	Birzeit University
Mazen Nazzal	<i>Assessment Study of using Brackish Water in Basil Plant Irrigation in the Jordan Valley</i>	Birzeit University
Mohammed Najjar	<i>Engineering Management and Financial Analysis of Al Fashkha Springs Desalination Project</i>	Birzeit University
Jalal Bsharat	<i>Feasibility of Membrane Based Treatment Technologies for Brackish Water Desalination and Effluent Reclamation in the Jordan Valley</i>	Birzeit University
Fahed Hussain	<i>Solar Desalination to Solve the Problem at the On-Site Level: A Case Study at Wadi Al- Maleh Village</i>	An-Najah National University
Samer Yousef	<i>Performance Test & Techno Economic Evaluation of a PV Powered RO & Brackish Water Desalination System in the West Bank</i>	An-Najah National University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2013:

NAME	PROJECT TITLE	PLACE OF STUDY
Sabreen Daghra	<i>Improvement of Large Scale Waste Water Treatment Plant using Micelle Clay Complex Column and Epuvalisation Technique</i>	Birzeit University
Ayaa Hisham Obeeis	<i>The Impact of Private Sector Participation through the Different Contracting Models on Sustainability of Desalination Plants</i>	An-Najah National University
Ola Omar Abd Alhadi	<i>The Cost Efficiency of Renewable Energy in Water Desalination</i>	An-Najah National University
Batool Mustafa Amarneh	<i>Comparison between Different Renewable Energy Applications using RO System</i>	An-Najah National University
Rawan Abu Eisheh	<i>RO Membrane Fouling Reduction by using CuZn Filter</i>	Al-Quds University
Shatala Abdul Basit Snober	<i>The Impact of Different Renewable Energies on Desalination from Economical and Environmental Aspects</i>	An-Najah National University
Mohammad Re'ad Froukh	<i>Monitoring Technology for Antiscalants in Desalination</i>	Al-Quds University
Afnan Fawaz Hamad	<i>Modeling of Solar Still Enhanced Tube Collectors for Brine Volume Reduction from Brackish RO Plants</i>	An-Najah National University
Ahmad Abd Allah Othman	<i>Engineering Management and Cost Benefits Analysis for RO Treatment Plant in Jordan Valley</i>	An-Najah National University
Wala' Jamal Aqel	<i>Reusing of Treated Waste Water in Concrete Industries</i>	Birzeit University
Israa Abdelfattah Sbaih	<i>Comparison Between Different Renewable Energy Application in Desalination</i>	An-Najah National University
Wala' Faheem Abdallah	<i>Techno-economic Analysis of using RO System for Water Desalination in the Jordan Valley</i>	Birzeit University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2014:

NAME	PROJECT TITLE	PLACE OF STUDY
Reem Hassan Omar	<i>In vitro Assessment of Salinity Tolerance in Cultivated Tomato (<i>Lycopersicon esculentum</i>)</i>	An-Najah National University
Ihsan Abu Ali	<i>Evaluation of different Pearl Millet Ecotypes under Saline Conditions</i>	An-Najah National University
Baha' Al Deen Ali Natoon	<i>Effect of Different Soilless Agriculture Methods on Growth and Irrigation Water Saving of Lettuce</i>	An-Najah National University
Hana' Mohammed Jardaneh	<i>Effect of Pseudomonas Extremorientalis on Barley Landraces Grown in Saline Stress</i>	An-Najah National University
Taj Matar Talal Salahat	<i>Salt Stress Response in Hydroponic Tomato Treated with Bacillus Licheniformis B2r</i>	An-Najah National University
Suha Samer Hudhud	<i>Investigation of Saline and Brackish Waters Desalination by Carbon Aerogel Technology</i>	An-Najah National University
Jamal Omar Mohamad Amarah	<i>Removal of Methylene Blue from Industrial Wastewater in Palestine Using Polysiloxane Surface Modified with Bipyrzolic Tripodal Receptor</i>	An-Najah National University
Ahmad Muhsen Al-Khalidi	<i>Self-cleaning Advanced-treatment Filter for Effluents (SAFE)</i>	An-Najah National University
Amani Jawad Atta Jabari	<i>Optimization of Energy Consumption in Wastewater Treatment Plants</i>	Birzeit University
Jumana I. Khatib	<i>Evaluation & Development of Onsite (grey) Wastewater Reuse and Treatment Guidelines & Standards for Palestinian Territory</i>	Birzeit University
Ahmed Hindi	<i>Assessment of Compatibility of Water Services Prices in Jerusalem Water Undertaking with the Tariff ByLaws and National Water Policy and Strategy for the Period 2013-2014</i>	Al-Quds University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2015:

NAME	PROJECT TITLE	PLACE OF STUDY
Beesan Jamal M. Bhais	<i>Monitoring of Constructed Wetland for Qrawa Bani Zaid Village</i>	Birzeit University
Amin Dawabsheh	<i>Costs-Benefits Analysis of Treated Wastewater Reuse for Irrigation in Hebron</i>	Birzeit University
Ghadeer Hanbali	<i>Synthesis of 1-(Pyrrol-2-yl)imine Modified Silica as a New Sorbent for the Removal of Chromium VI from Water</i>	An-Najah National University
Summer Omer Abed El Qadar	<i>Measuring Rate of Photosynthesis of Barley Using Olive Mill Wastewater (Zibar) Enhanced by Plant Growth Promotion</i>	An-Najah National University
Bayan Mohammed Khalaf	<i>Purification of Groundwater from Heavy Toxic Metals Using Suspended Polydentate Supported Ligands</i>	An-Najah National University
Banan Baseem Soudi	<i>Portable PV-Powered Water Disinfection and Desalination System for Nomadic Communities in Palestine</i>	An-Najah National University
Walid Al Zatari	<i>Wastewater Disinfection by Synthesized Aluminum Oxide Nanoparticles</i>	An-Najah National University
Ahmad Deeb Nemer Naem	<i>Functionalized SiO₂ With S-Donor Thiophene For Chromium (VI) Adsorption</i>	An-Najah National University
Sharhabeel Omar Jebrini	<i>Influence of Strigolactones on Growth and Productivity of Cucumber Plant Grown Under Salt Stress</i>	An-Najah National University
Deena Khudariah	<i>Synthesis and Characterization of Novel Porous SiO₂ Material Functionalized with C,C-Pyridylpyrazole Acceptor for Cr(VI) Removal from Waste Water</i>	An-Najah National University
Ala Ibrahim Abu Ayyash	<i>Characterization and Treatment of Al-Menya Landfill Leachate Using Biological – Physical Methods</i>	Al-Quds University
Jehad Abo-Al Rob	<i>Polymerase Chain Reaction for Detection of Waterborne Bacterial Pathogens in Potable Water in Tubas District</i>	Al-Quds University
Wisal Muhammed Khderat	<i>Application of In-House Prepared Nanoparticles for Tanneries Effluent Treatment</i>	Al-Quds University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2016:

NAME	PROJECT TITLE	PLACE OF STUDY
Fuheid Siam	<i>Removal efficiency of pathogenic microorganisms in four different Palestinian wastewater treatment plants: How to safe treated wastewater and bio-solids for agricultural reuse?</i>	Birzeit University
Marwan Bdair	<i>Regulation of water and wastewater to promote good Governance</i>	Al-Quds University
May Khalid Shawkat Zakarneh Saleh	<i>Data Prediction of pipe breaks in water distribution system using mining tools</i>	Arab American University
Sarah Asaad	<i>ZnO photocatalytic degradation of halo phenols in water using direct solar light</i>	An-Najah National University
Mnujeda Salman	<i>Study the effect of reeds tissues on the adsorption of heavy metals and bacteria from sewage water</i>	An-Najah National University
Nagham Taha	<i>Functionalized C, N-bipyrazole receptor grafted onto silica surface for As and Cu adsorption and its anti bacterial activity</i>	An-Najah National University
Mahmoud Shawahny	<i>Preparation of NCC-Bipyrazolic Tripodal receptor bonded to manganese for nitrate ions from water in Palestine removal</i>	An-Najah National University
Nahid Sawaftah	<i>Optimization of Calcium Sulfate Scale reduction using field magnetic</i>	An-Najah National University
Batool Abdaldayem	<i>ZnO photo degradation catalysis of pesticides water using solar light in pre-treated</i>	An-Najah National University
Inas Bashrat	<i>Quantitative removal of Nitrate from ground water using New Silica-immobilized ketoenol-pyridine receptor</i>	An-Najah National University
Ahmad Zubida	<i>Nitrophenol functionalized new absorbent material based on silica particles for cyanide removal</i>	An-Najah National University
Areen Ziad Naji	<i>Smart irrigation and pollution monitoring system</i>	An-Najah National University
Shimaa Titi	<i>Salinity Management for Barley Production using brackish water</i>	An-Najah National University
Saja Younis	<i>Pretreatment and chemical cleaning effects on fouling reduction in a pilot membrane Biometer-Treating waste water from Birzeit University</i>	Birzeit University
Ghosson Salah	<i>In vitro Assessment of Salinity Tolerance in Cultivated Tomato (lycopersicon esculentum)</i>	An-Najah National University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2017:

NAME	PROJECT TITLE	PLACE OF STUDY
Dina Alaker	<i>Influence of Salinity on Growth Performance and Chemical Composition of Selected Palestinian Medicinal Plants</i>	An-Najah National University
Ateed Afana	<i>Risk-based Management of Industrial Wastewater in Nablus City</i>	An-Najah National University
Mai Azar	<i>Nano Crystalline Cellulose Modified with Imine Functional Group for Wastewater Purification</i>	An-Najah National University
Hala Saleh	<i>Continuous Flow System ZNO-based Catalysts for Aqueous Chlorinated Hyrdocarbon Degradation with Solar Light</i>	An-Najah National University
Sawsan Fathi Abd-alsalam Anabtawi	<i>Complete Photo-Mineralization of Aqueous Gram+ & Gram- Bacteria and their Organic Content Catalyzed by Nano-ZnO</i>	An-Najah National University
Basima Shobaita	<i>Synthesis of Three Dimensional Cellulose Diamine Polymer for Wastewater Purification</i>	An-Najah National University
Bahia Abulail	<i>Facile Approach to Synthesize Chitosan-based Composite Characterization and Cadmium Ion Absorption Studies</i>	An-Najah National University
Zeinb Talei	<i>Experimental and Theoretical Study of the Kinetics of Alidye Hydrolysis in Alkaline Medium</i>	An-Najah National University
Rawan Khalaf	<i>Using Maghemite Nanosorbacts for Absorptive Removal of Alizarin Dye from Aqueous Solution for Wastewater Treatment and Catalyst Regeneration</i>	An-Najah National University
Alaa Hammad	<i>The Impact of Training in Raising the Efficiency of the Performance of the Straff of Water Service Providers in Palestine</i>	Birzeit University
Ala Masri	<i>Potentiality of Artificial Recharge Techniques in Al-Qilt Catchment Jericho District, Palestine</i>	Birzeit University
Azhar Hamdan	<i>Estimating Losses in Intermittent Supply System and Building a Geometric Network based on GIS Hydraulic Modeling</i>	Arab American University
Abdullah Murrar	<i>The Determinants of Financial Sustainability for the Palestine Water Service Providers</i>	Arab American University
Nael A. M. Zidan	<i>Towards a Sustainable Water Sector: Exploiting Internet of Things for Building a Smart Water Management System</i>	Arab American University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2018:

NAME	PROJECT TITLE	PLACE OF STUDY
Naba Abu Hafez	<i>Adsorption of ketoprofen from wastewater using decorate magnetic multi wall carbon nanotubes</i>	An-Najah National University
Rafat Raddad	<i>Nanocrystalline Cellulose Modifies With Imine Functional Group for Waste Water Purification</i>	An-Najah National University
Maysaa Izmeqna	<i>The Use of Economic Matrices Parameters for Water Evaluation & Planning in Regional Planning</i>	Al-Quds University
Ghadeer Sabaneh	<i>Amine Modified Silica for Waste Water Purification from Ibuprofen and Naproxen</i>	An-Najah National University
Mohammed Hussein	<i>Fecal Sludge Management-Septage Characterization and Pre-treatment in Nablus</i>	An-Najah National University
Doaa Seder	<i>Self-sensitization of the Herbicide Oxyfluorfen Degradation with Solar Light Catalyzed by Clay-supported Al-doped ZnO</i>	An-Najah National University
Hadeel Abu Dehmaz	<i>Cellulose Grafted with B-Cyclodextrin for Wastewater Purification from Metals and Organic Materials</i>	An-Najah National University
Ahlam Zyoud	<i>Photocatalytic degradation of organic contaminants by Alginate- supported ZnO nanoparticles</i>	An-Najah National University
Raed Shqier	<i>Assessment of TiO₂ as Photocatalyst for Complete Mineralization of Aqueous Bacteria and their Organic Contents</i>	An-Najah National University
Maryam Khrawish	<i>Extraction and modification of lignin from olive industry liquid waste and application in waste water purification</i>	An-Najah National University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2019:

NAME	PROJECT TITLE	PLACE OF STUDY
Laila Khalil	<i>Removal of Ibuprofen from Aqueous Solution Using (SiO₂-ZnO (CTAB), SiO₂-Fe₃O₄(CTAB)) Nanoparticles: Kinetic and Thermodynamic Study</i>	Birzeit University
Barakat Abu Fakheda	<i>Identification of Pollution for using XRF Technique for Soil and Sediments</i>	Al-Quds University
Israa Aqel	<i>Wastewater Use in Agriculture</i>	An-Najah National University
Israa Qasem	<i>The Effect of Pharmaceutical Compounds in Wastewater on Cucumbers</i>	An-Najah National University
Kholoud Nofal	<i>The Extent to which Water Governance Responds to Sustainable Development Goals</i>	Al-Quds University
Shireen Ammar	<i>Assessment of Service Quality in Palestinian Water Authority (PWA) - West Bank Water Department (WBWD) using SERVQUAL Model</i>	Arab American University
Ola Majadba	<i>Optimization of Date Palm Irrigation Needs by Applying Hydrus-2D Software Modelling</i>	Al-Quds University
Bashar Al Shawwa	<i>Water Diplomacy for Water Security in Palestine - The Jordan Valley as a Case Study</i>	Arab American University
Lara Bdier	<i>Assessment of Sanoplant as a Water Conservation Material) on Soil Characteristic and Crop Productivity</i>	An-Najah National University
Lama Omar	<i>Introduction and Assessment of Agro-technology (Imec) Application of Selective Permeable Hydrogel Membrane for Agriculture</i>	An-Najah National University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the Master's Research Fellowship Awards in 2020:

NAME	PROJECT TITLE	PLACE OF STUDY
Sohbi Yaghi	<i>Decreasing soil salinity for agricultural purposes using the activated sludge</i>	Al-Quds University
Haneen Abualrob	<i>Cellulose based foam with ionic functionality: synthesis and application as metals adsorbent</i>	An-Najah National University
Woroud Ahmad	<i>Metals content, occurrence and distribution in soil of Al-Qilt catchment.</i>	Al-Quds University
Ihab Malhis	<i>Evaluation of quantity and quality parameters of guar and buncum crops as a fodder irrigated with treated wastewater</i>	An-Najah National University
Shaher Khaldi	<i>Agriculture Engineer in ministry of agriculture in the National Agricultural Research Center (NARC)</i>	An-Najah National University
Derar Abueida	<i>Reverse osmosis membrane fouling reduction using kinetic degradation fluxion and chemical antiscalant (coagulants and flocculants)</i>	Al-Quds University

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of names who are granted in the 12 Research Fellowship Awards:

NAME	PROJECT TITLE
Abdullah Murrar	<i>Do Prepaid Meters Matter in Daily Water Consumptions and Financial Performance of the Palestinian Water Service Providers</i>
Rinad Hamed	<i>Plant Growth Promoting Rhizobacteria Enhance Salinity Stress Tolerance in Guar, Alfalfa, and Broad beans through ROS-Scavenging Enzymes</i>
Shehdeh Jodeh	<i>Synthesis of Magnetically and Magnetic Nanoparticles Decorated with 2-Aminopyridine Functionalized Graphene Oxide for the Absorption of Malathion from Aqueous Solution</i>
Bayan Khalaf	<i>Removal of Difenconazole from Wastewater Using New Synthesized Nanomembranes</i>
Rinad Hamed	<i>PGPRs; A Promising Business Startup for Sustainable NEXUS</i>
Ghassan Albarghouti	<i>Exploiting Internet of Things for the Adaption of a Smart System for Chlorination</i>
Ghadir Hanbali	<i>Nanomaterials Application in Removal of Pharmaceutical Drugs from Water</i>
Younes Massad	<i>Determination of Contraceptive Hormones in Nablus Wastewater Treatment Plant and its Irrigation Effect on Tomatoes</i>
Mays Nofal	<i>The Diversity and Efficiency of Sulphate Reducing Bacteria in Selected Groundwater in West Bank, Palestine</i>

MEDRC - PWA Research Fellowships Awarded 2012-2020

List of student's names who are granted in the PhD Research Fellowship Awards:

NAME	PROJECT TITLE	PLACE OF STUDY
Heba Nassar	Nitrate Ion Removal from Water using Nano-Copper Based Electrocatalyst	An-Najah National University
Ghadeer Hanbali	Scale Reduction by Magnetic Water Treatment	An-Najah National University
Bayan Khalaf	Purification of Water in Palestine from the most 16 Persistent Pesticides Using New Synthesized Nanoparticles	An-Najah National University
Abdullah Murrar	The Financial Sustainability of the Palestinian Water Service Providers	Arab American University
Fuad Al-Rammal	Water sustainability and the challenges of its application in the West Bank and Gaza Strip in Palestine	University-Fez - Morocco

MEDRC - PWA Instruments
for the University and
Municipalities at West Bank

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Introduction

Waste and brackish water is considered one of the most significant threats to regional ground water quality in the West Bank and Gaza Strip. Since wastewater collection and treatment facilities are restricted to a few cities/towns, and it is estimated that only about 30% of the Palestinian population (West Bank and Gaza Strip) benefits from sewer collection systems. In addition; the existing sewer systems are generally in poor physical state and leakage rates from sewage networks may be as high as 50%. In parallel the sea water intrusion considers major polluter for the groundwater aquifer at Gaza strip in addition it is major contaminant and polluter at Jordan valley.

The majority of the Palestinian population, especially in rural areas, uses cesspits or septic tanks for disposal of wastewater. Wastewater infiltrate from these cesspits to the groundwater aquifers since most of cesspits are constructed without concrete liner to encourage sewage infiltration to the ground in order to minimize emptying costs. Their capacity ranges 5-50 m³. Septic tanks are evacuated by vacuum tankers, the content (raw wastewater) usually discharge "with high contaminant concentrations of BOD, TSS, and Bacteria" to the open areas such as wades', irrigation channels, or even to solid waste disposal sites. Local authorities (municipalities) are rarely involved in assigning disposal locations. Moreover, these areas represent hot pollution spots over highly preamable recharge zones of the groundwater aquifers. The major wastewater streams in West Bank are represented by Wadi Zumar (Tulkarem-Nablus), Wadi el-Sajour (Nablus), Wadi Beitunia (Ramallah), Wadi Nar (Bethlehem), Wadi As-Samen (Hebron).

Water Pollution

The causes of water pollution may be due to direct and indirect contaminant sources. The former are effluent outputs from refineries, factories, and waste treatment plants. Fluids of differing qualities are emitted to the urban water supplies. In the United States and some other countries, these methods are controlled. However, still pollutants can be found in the water bodies. The latter are the water supply from soils/groundwater systems that have fertilizers, pesticides and industrial wastes. Also those through the atmosphere like bakeries, factories emission and automobile discharge.

Causes of water pollution

The major sources of water pollution are as described below. Discharge of contaminated and/or heated water that has been used for industrial purposes. The surface runoff that contains spilled petroleum products. The surface runoff from farms, construction sites or other impervious surfaces. The improper disposal of solid wastes like littering on a localized scale. Addition of excessive nutrients by runoff containing detergents or fertilizers called as eutrophication. The geology of

aquifers where groundwater is abstracted. Maltreated sewage discharged in a wrong manner. Slash and burn farming practice is a component in shifting cultivation agricultural systems. Radioactive substances from nuclear power plants and industrial, medical and scientific use are also contributive. Uranium and thorium mining and refining are some of the examples. Heat is a leading cause as it results in the death of several aquatic organisms. A discharge of cooling water by factories and power plants lowers the temperature of the water bodies. Oil pollution is very harmful for coastal wildlife. Oil spreads on huge areas to form oil slicks. If there are trials to sink the oil or chemically treat it, the marine and beach ecosystems may be further disrupted.

From the above points summarized our justification to build this lab as the following:

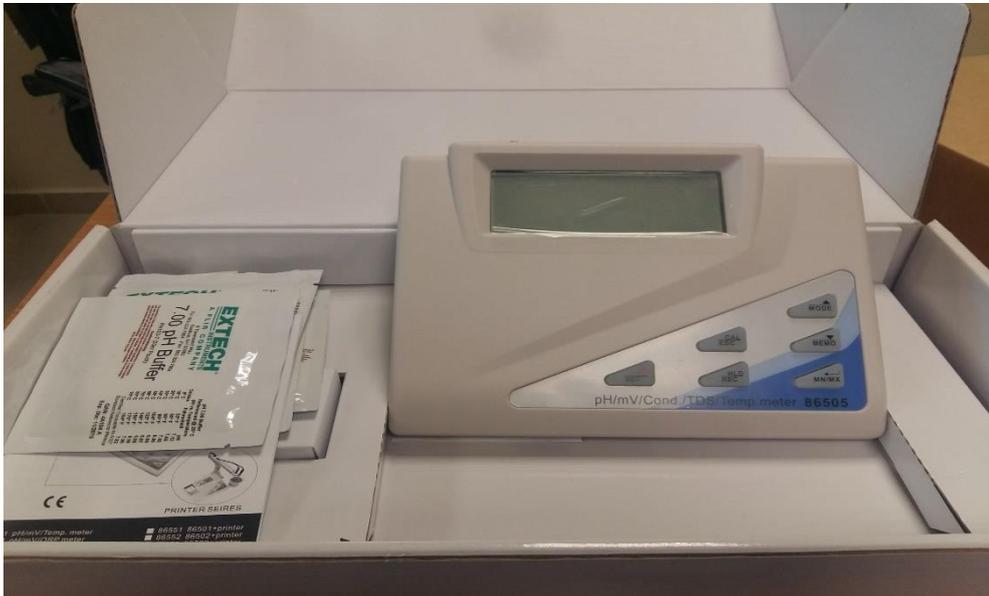
1. The absence of an equipped specialized laboratory to do the work if field for the research that is necessary for the detection of pollution in the region.
2. To increase the field scientific experiments, research and work of appropriate databases in this area.
3. Increase environmental awareness in the region and spread formation of environment-friendly society for saving the environment for future generation.

Project Out puts

1. A specialized laboratory for water research for investigation and detect the pollutants in polluted zone.
2. Forming a group of professional specialists in environmental research and followers of the contemporary changes in the region.
3. Creating a data base serve the scientific research on the areas where there is environmental pollution.
4. Issue a scientific journal for the dissemination of research on the specialized environmental and climate change.
5. Promote environmental awareness among citizens to preserve environmental resources and sustainability for future generations.

MEDRC - PWA instruments for the university and municipalities at West Bank

1. pH/mV/Temp/Cond/TDS/Salt Meter Complete ki:



2. Conductivity meter:



3. A) pH meter laboratory:



4. Turbidity meter laboratory:



5. Dissolve Oxygen meter



MEDRC-PWA Forums



THE FIRST MEDRC PALESTINIAN WATER RESEARCH ALUMNI FORUM "Water and Sustainable Development"

Tuesday, 11/12/2018
An-Najah National University
Nablu - Palestine

8:30 – 9:00	Arrival and Check-in
9:00 - 09:45	Opening Session at The Korean Palestinian IT Institute of Excellence's, Conference Room
	<ul style="list-style-type: none"> Phrases of Holy Quran Palestinian National Anthem. Welcome Message: Dr. Maen Ishtaiwi, Chairman of First MPWR - NNU. Speech of Prof. Maher Natsheh, Acting President of An –Najah National University. Speech of Dr. Nidal Zatar, Head of Chemistry Department –NNU. Speech of Eng. Hazem Kittani, General Director of Technical Affairs at PWA. Speech of Mr. Brendan Smith, Development cooperation manager of MEDRC. Film Honoring Session
9:45 – 10:00	Incubator Session
	Dr. Radwan Qasrawi , Al-Quds University
10:00–10:15	Coffee break
	Session (1): Smart Management and Water efficiency. Chair: Eng. Hazem Kittani
10:15 – 10:25	Smart Irrigation and Pollution Monitoring System Areen Naji , An-Najah National University, Nablu, Palestine

10:25 – 10:35	An IoT Based Monitoring and Controlling System for Water Chlorination Treatment. Nae’l Zidan , Arab American University Palestine
10:35 – 10:45	Prediction of Pipes Break in Water Distribution System Using Data Mining Tools “Case Study Nablus Municipality” May Saleh , Arab American University, Jenin, Palestine
10:45 – 10:55	Cloud Application for Smart Agricultural Irrigation Management system Mostafa Younes , Al-Quds Open University
10:55 – 11:05	Clay-supported sensitized nano-ZnO in photocatalytic degradation of aqueous halophenols using direct solar light . Sarah Asaad , An-Najah National University, Nablus, Palestine
11:05 – 11:15	The use of magnetic multiwalled carbon nanotubes functionalized with chitosan for nitrate removal from wastewater Inas Bsharat , An-Najah National University, Nablus, Palestine
11:15 – 11:35	Panel Discussion (1)
11:35 – 12:15	Coffee break & Poster Session
Session (2): (Water Pollution and Water Management)	
Chair: Prof. Shehdeh Jodeh	
12:15 – 12:25	PGPRs and Phytoremediation introduce new NEXUS Approach Rinad Hamed , An-Najah National University, Nablus, Palestine
12:25 – 12:35	Photo-mineralization of aqueous gram positive and gram negative bacteria together with their organic components using sensitized ZnO nano-particles Sawsan Jaber , An-Najah National University, Nablus, Palestine
12:35 – 12:45	The Impact of Water Price on the Financial Sustainability of the Palestinian Water Service Providers Abdullah Murrar , Arab American University, Jenin, Palestine
12:45 – 12:55	Optimization of Energy Consumption in Jericho Wastewater Treatment Plant Amani Jabari , Birzeit University, Birzeit, Palestine
12:55 – 1:05	The Assessment of Private Sector Participation through different Contracting Models on the Sustainability of Desalination Plants Ayaa Hisham , An-Najah National University, Nablus, Palestine
1:05 – 1:15	The Effect of Bacillus megaterium on Barley Tolerance to Salinity Hana Jardaneh , An-Najah National University, Nablus, Palestine
1:15 – 1:30	Panel Discussion (2)
1:30 – 1:40	Outcomes, Recommendations (Ms.Bayan Khalaf)
1:40 – 2:00	Certifications, Awards
2:00	Lunch break



THE SECOND MEDRC PALESTINIAN WATER RESEARCH ALUMNI FORUM "From Research to Application "

Monday, 16/12/2019
An-Najah National University
Nablus - Palestine

9:00 – 9:30	Arrival and Check-in
9:30 – 10:30	Opening Session at the Auditorium of Faculty of Law – New Campus
	<ul style="list-style-type: none"> • Phrases of Holy Quran • Palestinian National Anthem. • Welcome Message: Dr. Nidal Zatar, Head of Chemistry Department –NNU. • Speech of Prof. Maher Natsheh, President of An–Najah National University. • Speech of Eng. Ciarán Ó Cuinn, Center Director at MEDRC Water Research • Speech of Eng. Mazen Ghuneim, Minister and Head of Palestinian Water Authority. • Film • Honoring Session
10:30–10:45	Coffee Break
Session (1): Entrepreneurship Session Chair: Eng. Hazim Kittani	
10:45-11:00	Universities Research Commercialization, Challenges and Potential Dr. Radwan Qasrawi , Al-Quds Business Center for Innovation Technology and Entrepreneurship - Al-Quds University
11:00-11:15	Entrepreneurship in Palestine Technical University – Kadoorie (PTUK) Innovation and Educational Technology Center (IETC) Mr. Amjad Almasri , Director of Innovation and Education Technology Centre in PTUK

11:15-11:30	Building a Culture of Entrepreneurship & Innovation: Placing students at the heart of the ecosystem to develop 21st century graduates Eng. George Yerosous , Birzeit University
11:30-11:45	Entrepreneurial Opportunities in Desalination - Case of Palestine Abdel Fattah Al Mallah , An-Najah National University.
11:45-12:00	Safe Recycling Of Hazardous Liquid Waste as a Tool To Avoid Water Contamination. Amer EL-Hamouz , An-Najah National University.
12:00-12:30	Discussion
12:30-12:45	Coffee Break
Session (2): Water Treatments Session	
Chair: Prof. Shehdeh Jodeh	
12:45 – 1:00	Efficiency Assessment of Water Providers Based on the Installation Scenarios of Prepaid Meters Using DEA Approach. Abdullah Murrar , Arab American University, Jenin, Palestine
1:00 – 1:15	Water purification from nitrate ions by electrochemical reduction on modified nanocomposite electrode catalysts. Heba Nassar , An-Najah National University, Nablus, Palestine
1:15 - 1:30	Assessment and removal of heavy trace metals by magnetic multiwall carbon nanotube decorated by novel functionality from ground water in Jericho, Palestine. Ghadir Hanbali , An-Najah National University, Nablus, Palestine
1:30 -1:45	Metals content, occurrence and Distribution in soil of Al-Qilt catchment. Hanan Harb , An-Najah National University, Nablus, Palestine
1:45 - 2:00	Photocatalytic degradation of imidacloprid insecticides by Al-doped ZnO under solar light radiation. Doaa Seder , An-Najah National University, Nablus, Palestine
2:00 - 2:15	Synthesize and Characterization of Cellulose Derivataized with an Aromatic Amine and Application in Waste Water Purification Bahia Abu Leil , An-Najah National University, Nablus, Palestine
2:15 – 2:45	Coffee break & Poster Session
2:45 - 3:00	Outcomes, Recommendations, Certifications and Awards
3:00	Lunch break



THE THIRD MEDRC PALESTINIAN WATER RESEARCH ALUMNI FORUM “Entrepreneur of Innovative Water Solutions for Next Generation”

Monday, 7/12/2020
An-Najah National University
Nablus - Palestine

10:00 - 10:50	Opening Session
	<ul style="list-style-type: none"> • Speech of Minister Eng. Mazen Ghuneim, Head of Palestinian Water Authority. • Speech of Prof. Maher Natsheh, President of An–Najah National University. • Speech of Eng. Ciarán Ó Cuinn, Center Director at MEDRC Water Research
10:50 - 11:00	Break
Session (1): Private and Non-governmental sector speech	
11:00 – 11:15	Business to Business and research implantation Cooperation between the public and privet sector. Eng. Basim Dudeen , Palestinian National Economic Empowerment Institution (Tamkeen)
11:15 - 11:30	Agriculture challenge and solution suggestion for seed and tree plantation in relation to water , Eng. Baseem Aljunadi , Al-Junadi Nursery
11:30 - 11:45	Limitation for Date Palme tree using the brackish water for irrigation Dr. Khader Zawahra , Al Rawwad - Palm Tree company
11:45 - 12:00	Water challenge, limitation for Date Palme industry at Palestine and proposed future solution Dr. Derar Smadi , Date Palme Tree Company.
12:00 - 12:15	Pharmaceutical industry “water requested and pollution impact at the local environment” Dr Ziad Abu Al-Rub , Pharmaceutical residual - Jerusalem Pharmaceuticals Co. Ltd.
12:15 - 12:25	Coffee Break

Session (2): PhD. Speakers and Researcher	
12:25 – 12:35	Ghadir Hanbali , An-Najah National University, Nablus, Palestine.
12:35 – 12:45	Bayan Khalaf , An-Najah National University, Nablus, Palestine.
12:45 - 12:55	Abdullah Murrar , Arab American University, Jenin, Palestine.
12:55 -1:05	Heba Nassar , An-Najah National University, Nablus, Palestine.
1:05 - 1:15	Dr. Ghassan Barghothi , Birzeit University, Ramallah, Palestine.
1:15 - 1:25	Dr. Fuad Al-Rammal , Palestinian Water Authority, Ramallah, Palestine.
1:25 – 1:40	Discussion
1:40 - 2:30	Launch

