



Active Member

Dr. Rodrigo González Enríquez



Leader of the Research Group

Dr. Germán Eduardo Dévora



Active Member

Dr. Jesús Álvarez Sánchez

Investigation Group CA-036

Water Treatment and
Alternative Technology

Collaborators



Dra. Reyna Guadalupe Sánchez Duarte



Dra. Yedidia Villegas Peralta



Dra. María del Rosario Martínez Macías



Dra. María Magdalena Armendaríz Ontiveros



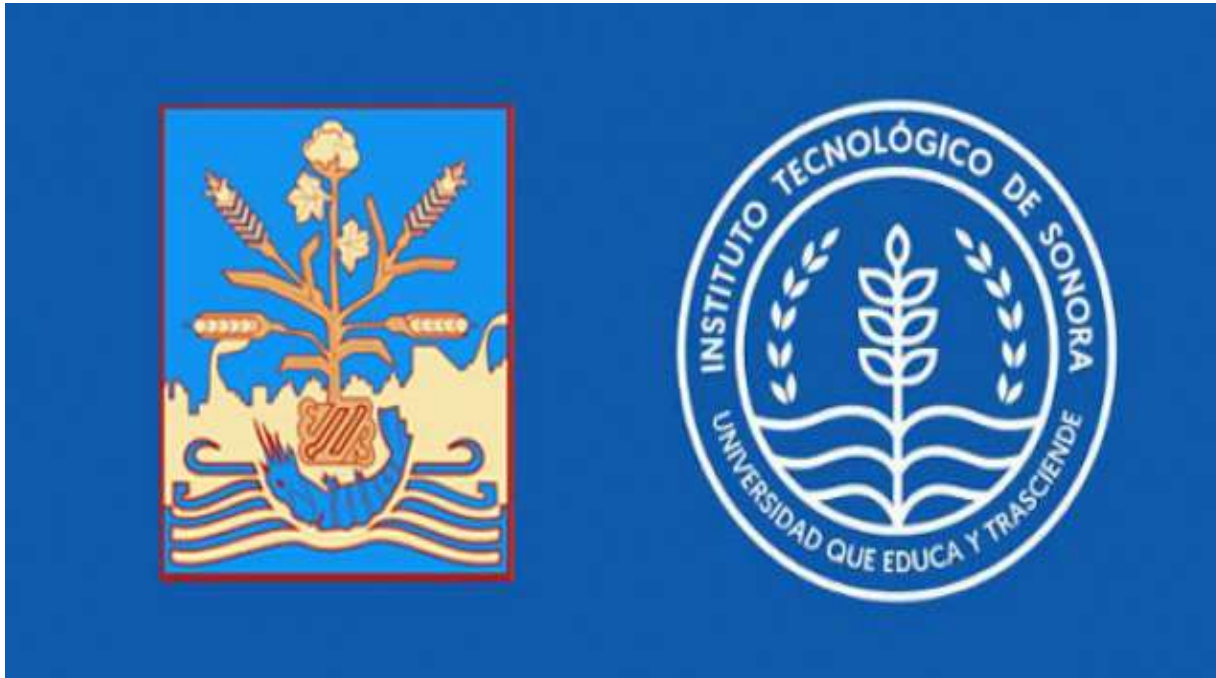
Dra. Ma. Araceli Correa Murrieta

Investigation Group: Water Treatment and Alternative Technology

Researcher	Major Academic Degree	Member of the national system of researchers	Teacher in accredited program of chemical engineer
Germán Eduardo Dévora Isiordia	Dr.	SNI-1	X
Jesús Alvarez Sánchez	Dr.	SNI-1	X
Rodrigo González Enríquez	Dr.	--	X
Reyna Guadalupe Sánchez Duarte	Dra.	SNI-1	X
María del Rosario Martínez Macías	Dra.	SNI-1	X
Ma. Araceli Correa Murrieta	Dra.	SNI-1	X
Yedidia Villegas Peralta	Dra.	SNI-1	X
María Magdalena Armendáriz Ontiveros	Dra.	SNI-C	X
TOTAL	100 %	87.5 %	100 %

Instituto Tecnológico de Sonora

Natural Resources



Department: Water Sciences and Environmental
Educational Program: Chemical Engineer

Research Laboratories

- **Dr. Germán Eduardo Dévora Isiordia**
Desalination of brackish and marine waters with Renewable Energies
- **Dr. Jesús Álvarez Sánchez**
Polymers and materials
- **Dr. Rodrigo González Enríquez**
Hydrogeochemical and Environmental Explorations
- **Dra. Reyna Guadalupe Sánchez Duarte**
Biopolymers
- **Dra. María del Rosario Martínez Macías**
Biopolymers and phytoremediation with microalgae
- **Dra. Ma. Araceli Correa Murrieta**
Bioadsorbents
- **Dra. Maria Magdalena Armendariz Ontiveros**
Dynamic Biosystems and Renewable Energies
- **Dra. Yedidia Villegas Peralta**
Pollutant adsorption and desorption processes

Research Laboratory:

Desalination of brackish and marine waters with
Renewable Energies



Dr. Germán Eduardo Dévora Isiordia

german.devora@itson.edu.mx

+52 (644) 4109000 Ext 1686

<https://www.itson.mx/oferta/iq/Paginas/german-devora.aspx>

AUTHORIZED PROJECTS

CONACYT

“Operation, analysis of the problem and pollution generated in desalination plants located in the Mexican Republic, in order to determine the regulations applicable to this item”

Period:
2007-2010

Amount:
\$197,000 USD



Benefits to ITSON



\$107,000 USD

A reverse osmosis desalination plant 150 m³/d was acquired

Agricultural productive projects are elaborated in Yaqui Valley



Products

Before Desalination plant



Brackish water well



4,000 mg/L Salinity

Yield:

22 Ton/Ha



Tomato

7.5 Ton/Ha



Sorghum

27 Ton/Ha



Mango

4 Ton/Ha



Ricinus Communis

Products

After Desalination plant



Brackish water well 4,000 mg/L

Reverse Osmosis

300 mg/L



Tomato



Sorghum



Mango



Ricin Communis

Before: **Yield:** 22 Ton/Ha

7.5 Ton/Ha

27 Ton/Ha

4.1 Ton/Ha

After: **Yield:** 24 Ton/Ha

9.0 Ton/Ha

29 Ton/Ha

5.3 Ton/Ha

**Foundation
PRODUCE**

Tecnología sobre desalación de agua en pozos con problemas de intrusión salina para reutilización en la agricultura.

**Amount:
\$ 34,359 USD**



Innovation stimulus program (PEI) (CONACYT)

Prototype development of solar desalination plant, for rehabilitation of salitrated wells on the coast of Hermosillo, Sonora, Mexico

Period:
2015-2016

Amount:
\$ 198,000 USD



Delivered Products

Reverse Osmosis Desalination Plant



RO=40 m³/d

RO: Reverse Osmosis

Delivered Products

Solar Park ITSON 120 kWh



3 Generation System

24 Panels in fixed system	~ 30 kWh
36 Panels in 1 axis system	~ 40 kWh
24 Panels in 2 axis system	~ 50 kWh

Future International Research

postdoctoral products

HEAT TRANSFER

- Storage Heat
- Phase Change Materials
- Solar Desalination Tower
- Corrosion

PROCESS HEAT

- Photovoltaic
- Direct Current
- Reverse Osmosis
- Desalination Plant Management



INSTITUTO TECNOLÓGICO DE SONORA
Educar para Trascender



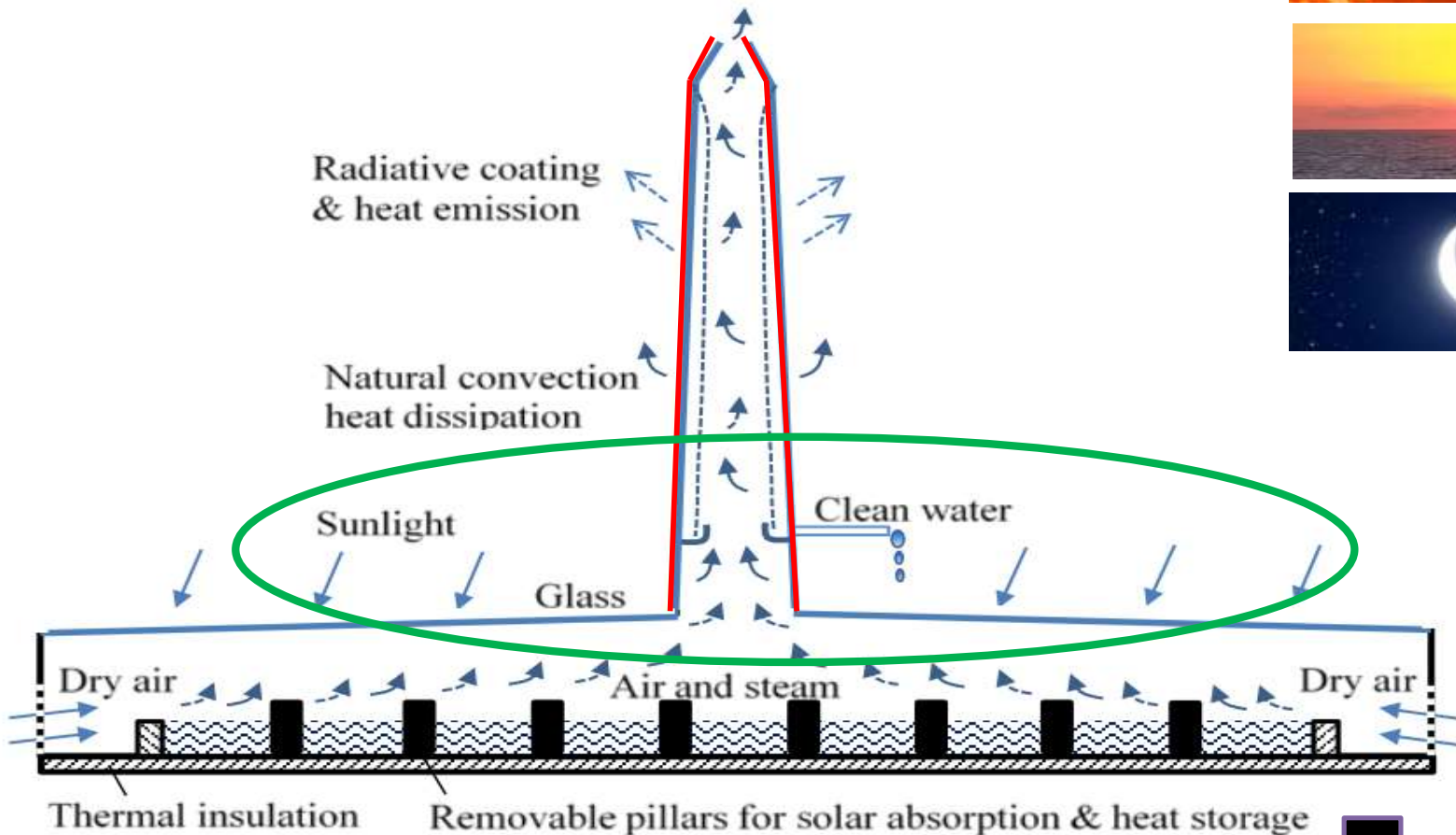
THE UNIVERSITY
OF ARIZONA



HEAT TRANSFER

Solar Desalination Tower + Black Blocks + PCM

Sonora and Arizona

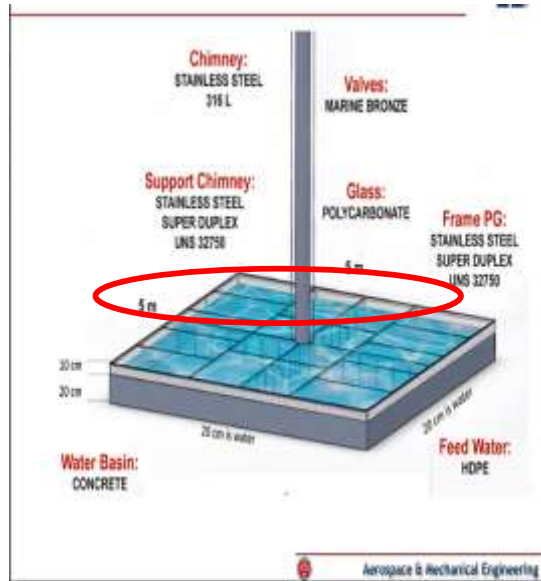


PCM = Phase Change Materials



Corrosion

WATER BASIN COATINGS



Paints and Coatings



Chitosan pearls



Materials

Salt spray chamber

Used for testing the corrosive resistance of products



Fog chamber

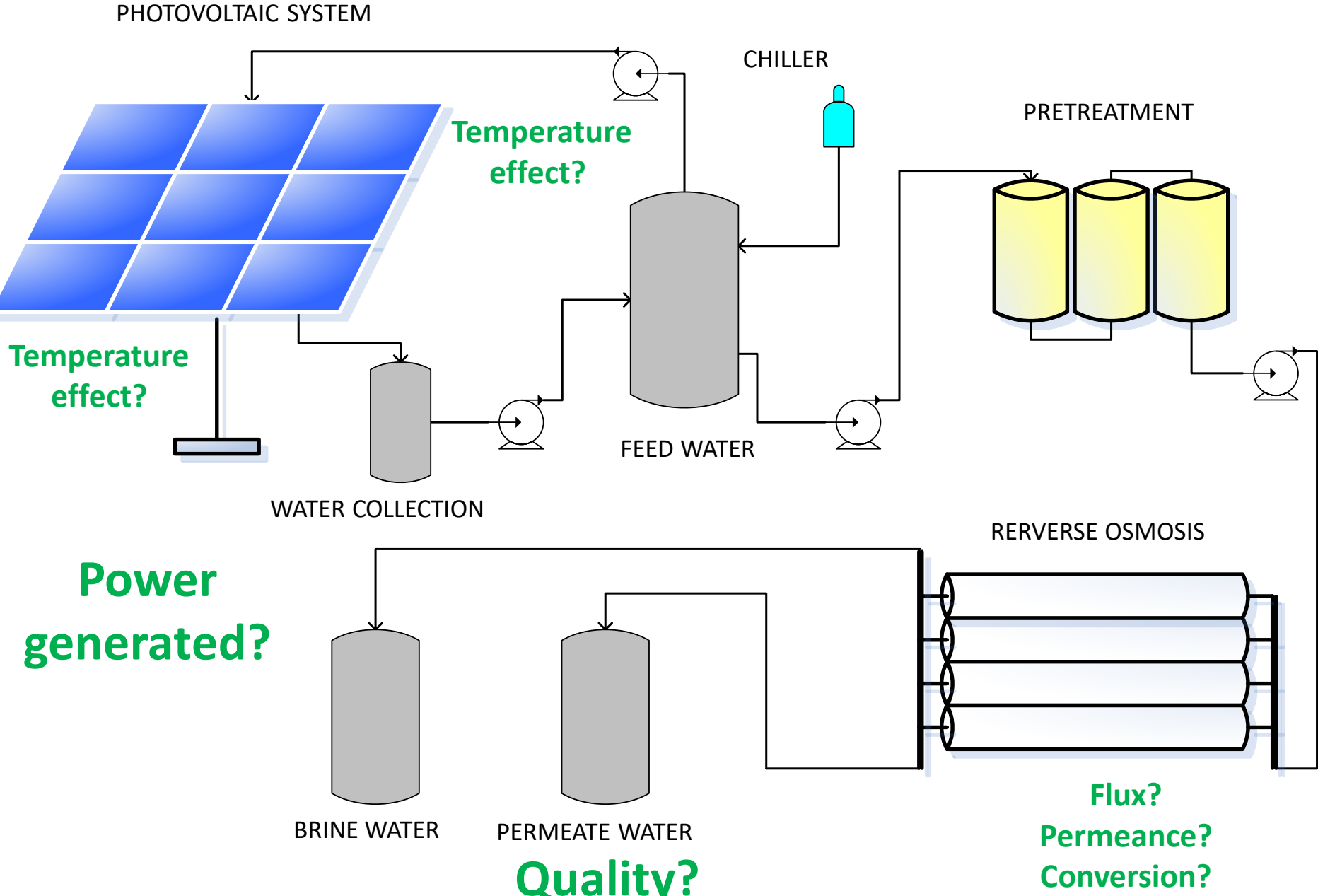


samples

Coating

- Corrosion
- Time
- Cost
- Decision
- Recycle

PROCESS HEAT



Delivered Product

Open access peer-reviewed chapter

Using Desalination to Improve Agricultural Yields: Success Cases in Mexico

By Germán Eduardo Devora-Isiordia, María del Rosario Martínez- Macías, Ma. Araceli Correa-Murrieta, Jesús Álvarez-Sánchez and Gustavo Adolfo Fimbres-Weihs

Submitted: November 16th 2017 | Reviewed: March 18th 2018 | Published: November 9th 2018
DOI: 10.5772/intechopen.76847



Inicio | INICIO | INICIAR SESIÓN | REGISTRARSE

Inicio > Vol. 4, Núm. 3 (2018) > Devora-Isiordia

CONTENIDO DE LA REVISTA

Artículo de la Revista

Título

Resumen

Evaluación de procesos de desalinización y su desarrollo en México

Germán Eduardo Devora-Isiordia, Rodrigo González-Estrada, Selvi Ruiz-Oca

Resumen

Existen diversos procesos de desalinización y se diferencian por costos, impacto ambiental, calidad del producto y energía consumida. Mediante comparación entre procesos térmicos y de membranas se analizaron las diferentes tecnologías existentes para desalar agua de mar. Número de plantas instaladas, tecnología utilizada, fuentes de abastecimiento y uso del agua desalada. La factibilidad técnica y principal objetivo del trabajo consistió en la comparación de los sistemas de desalinización térmica y de membranas respecto a costos de producción.

HERRAMIENTAS DEL ARTÍCULO

- Imprimir este artículo
- Mostrar este artículo
- Facebook
- Correo electrónico
- Enviar este artículo por correo electrónico (Se requiere contraseña)

Evaluation of the effect of the salinity of irrigation water on the yield of castor plant hybrids (*Ricinus communis* L.) in Mexico

Abstract

The study consists of evaluating the response of three hybrids of castor plant (*Ricinus communis* L.): Zoya 856, Olga 804 and Galit K-93, to four irrigation treatments at different salt concentrations (2.3, 3.12, 3.9 and 4.68 dS m⁻¹) simultaneously. The objective was to compare the yield between hybrids for each treatment, as well as to determine the effects caused by excess salt in the stages of germination, flowering and growth of the plant. The research was conducted in Block 1918 of the Yajal Valley, located in the state of Sonora, Mexico. Irrigation water was obtained from a brackish well with 3,900 mg L⁻¹ of total dissolved solids adjacent to the study area and subjected to a desalination process by reverse osmosis using a system with an output of 150m³/d, equipped with 12 membrane modules (model SWCA-MAX) with dimensions of 0.20m x 0.10m. The results showed that the germination and flowering stages were delayed as the concentration of salts increased. In conclusion, the yield of the hybrids increased under irrigation with higher salinity, with the Olga 804 hybrid having the highest production (2.38 ton ha⁻¹ with irrigation of 4.68 dS m⁻¹).

Keywords: castor plant, desalination, reverse osmosis, yield

Volume 2 Issue 3 - 2018

Devora-Isiordia Ge,¹ Valdez-Torres Lc,¹ Granillo-Moreno Ka,² Robles-Lizarraga A,² Martínez-Macias Mr,¹ Álvarez-Sánchez J¹

¹Department of Water Science and Environment, Phisico-Master of Science Program in Natural Resources, Technological Institute of Sonora, Mexico

Correspondence: Devora-Isiordia Ge, Department of Water Science and Environment, Phisico. Email: gei14@tisonora.mx

Received: September 11, 2018 | Published: October 22, 2018

IAPE/UK, Oxford, United Kingdom
2018; 4(3): 62-72

Application of Photovoltaic Solar Energy for rehabilitation of saline wells in Hermosillo, Sonora, Mexico

Ricardo A Rodríguez-Carvajal Chemical Engineering Department, Universidad de Guanajuato Norita Alta s/n, Guanajuato, Guanajuato +52 4737320006 rodriguez_ricardo@ugto.mx	Germán E. Devora-Isiordia Chemical Engineering Department, Instituto Tecnológico de Sonora Antonio Caso 2266, Ciudad Obregón, Sonora +52 6444100900 german.devora@tison.edu.mx	Paula C Isiordia-Lachica Agribusiness Department, Universidad de Guanajuato Hacienda de Copal km 9, Irapuato, Guanajuato +52 462 624 16 89 pc.isiordia@ugto.mx
Martín Picoón-Núñez Chemical Engineering Department, Universidad de Guanajuato Hacienda de Copal km 9, Irapuato, Guanajuato +52 4737320006 picoon@ugto.mx	Victor Jiménez-Arredondo Department of Art and Business, Universidad de Guanajuato Carretera Salamanca - Valle de Santiago km 3.5 + 1.8 Comunidad de Palo Blanco, Salamanca Guanajuato vjimenez@gmail.com	

ABSTRACT

Water scarcity takes place when the demand exceeds the supply for fresh water in the given area. The three main agencies that characterize the scarcity of water are: the physical lack of available water to satisfy the demand; the level of development of infrastructure that controls storage, distribution and access; and the institutional capacity to provide the necessary water services. In solar tracking system to increase the efficiency of the photovoltaic system, this to produce 30 cubic meter/day, giving the water production, the feasibility of using the land in double for raising livestock, obtaining very efficient results.

Keywords: Solar Desalination, Photovoltaic Energy, Wells Rehabilitation.

deswater.com



Desalination Publications
Tel. +39 348.8848406, Fax +1 928 8433066
dwt@deswater.com

Desalination and Water Treatment
2019 SUBSCRIPTION RATES

- Home Page
- Editorial Board
- Papers
- Open Access
- Submissions
- Instructions to authors
- Subscriptions
- Contact Us

DESALINATION AND WATER TREATMENT SCIENCE AND ENGINEERING

ISSN Print 1944-3994, ISSN Online 1944-3986

The journal is dedicated to research and application of desalination technology, environment and energy considerations, integrated water management, water reuse, wastewater and related topics.

CLICK ON BANNERS

Desalination Directory Online

- Indexed Article Published JCR, SCOPUS, WofS
- Participation in congress
- Thesis Master and PhD

Research Laboratory:

Polymers and Materials



Dr. Jesús Álvarez Sánchez

jesus.alvarez@itson.edu.mx

+52 (644) 4109000 Ext 1689

<https://www.itson.mx/oferta/iq/Paginas/jesus-alvarez.aspx>

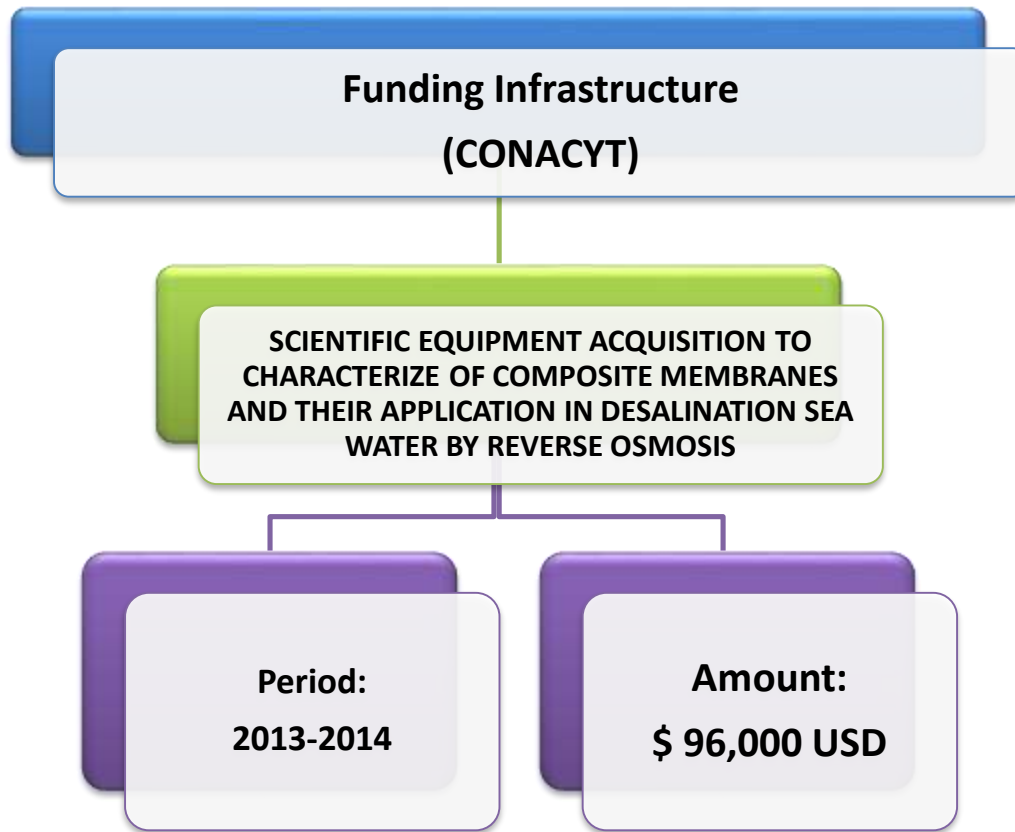
**Teaching Professional Development Program
(PRODEP)**

**PREPARATION AND CHARACTERIZATION
OF NEW COMPOSITE MEMBRANES
CHLORINE RESISTANT AND THEIR
APPLICATION IN REVERSE OSMOSIS**

**Period:
2012-2013**

**Amount:
\$ 25,000 USD**



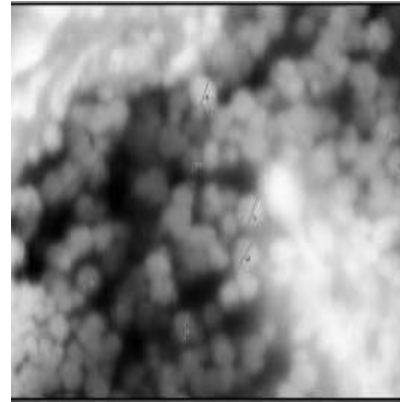


Delivered Products

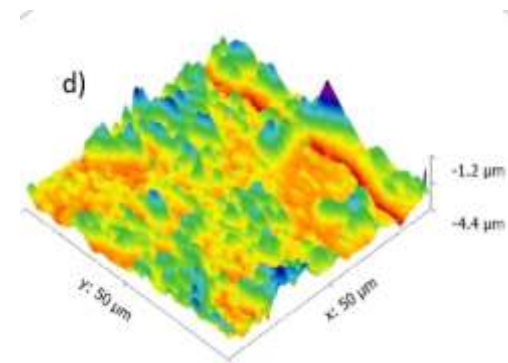
Atomic Force Microscopy (AFM)



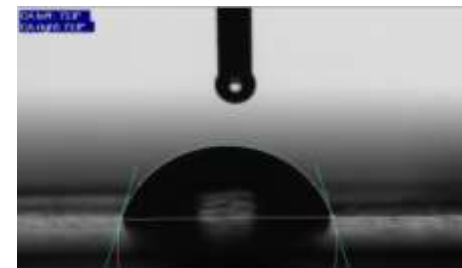
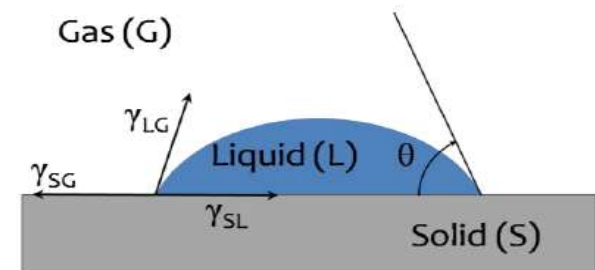
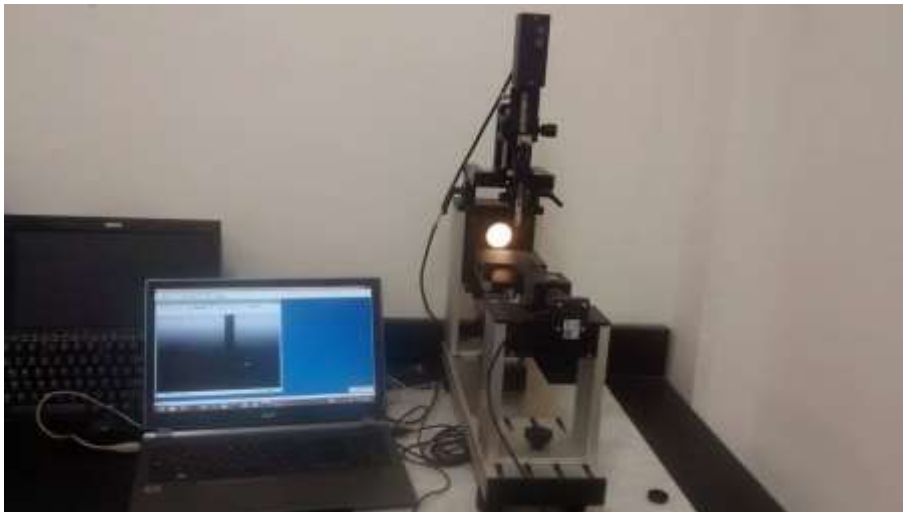
ZnO Nanoparticle



Membrane roughness

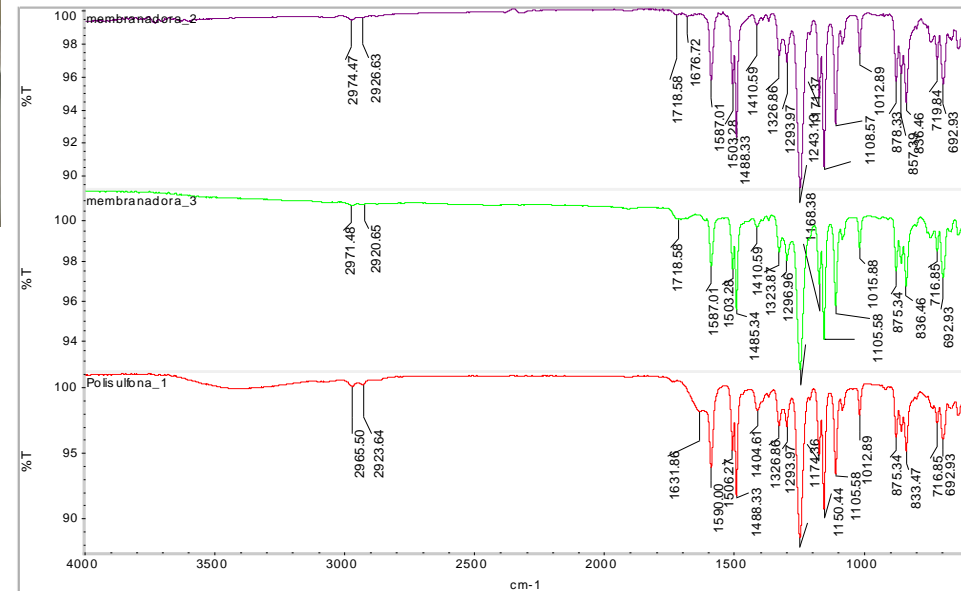


Contact Angle



Delivered Products

Infrared spectrophotometer by ATR
(Attenuate total reflectance)



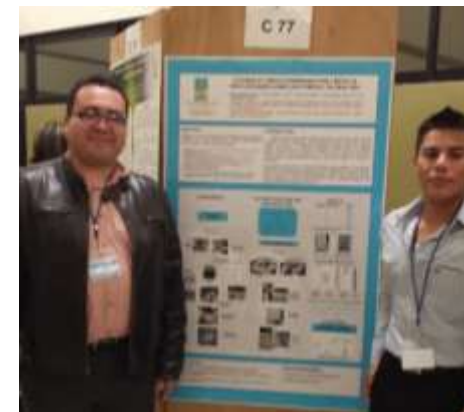
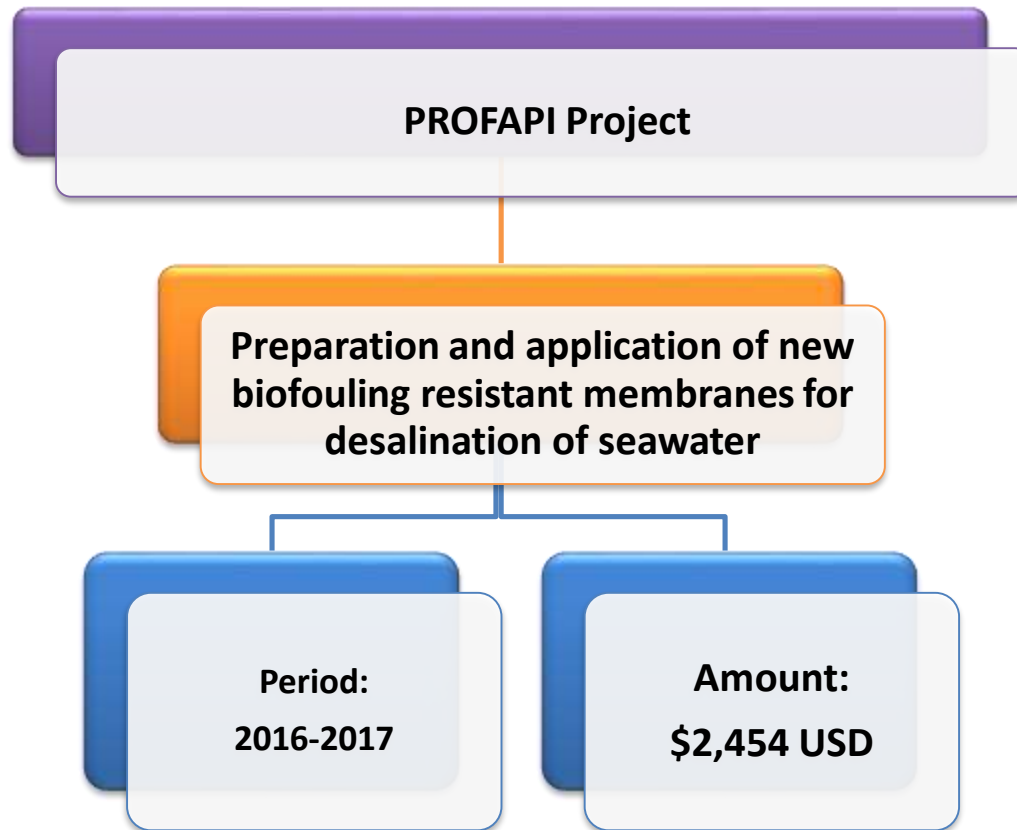
Cathedra project CONACYT (CONACYT)

FOULING MODELING AND DESIGN OPTIMIZATION OF
MEMBRANE MODULES FOR DESALINATION OF MARINE
AND BRACKISH WATER ON THE PACIFIC COAST

Period:
2014-2015

Amount:
\$ 24,542 USD





Delivered Products

Vol. 15, No. 3 (2016) 961-975



Revista Mexicana de Ingeniería Química



MEMBRANAS DE NANOFILTRACIÓN, PREPARADAS VÍA POLIMERIZACIÓN EN INTERFASE, DOPADAS CON NANOPARTÍCULAS DE ZnO: EFECTO EN SU DESEMPEÑO

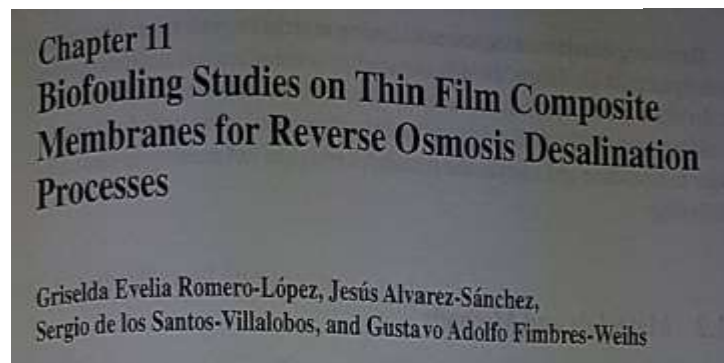
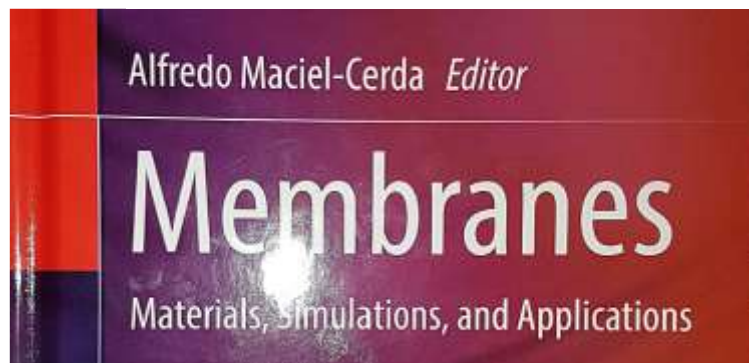
NANOFILTRATION MEMBRANES, PREPARED VIA INTERFACIAL POLYMERIZATION, DOPED WITH ZnO NANOPARTICLES: EFFECT ON PERFORMANCE

S. Pérez-Sicairos^{1*}, S.A. Miranda-Ibarra¹, S.W. Lin-Ho¹, J. Álvarez-Sánchez², J.C. Pérez-Reyes¹, K.A. Corrales-López¹, J.B. Morales-Cuevas¹

Memorias del XXXVII Encuentro Nacional de la AMIDIQ
3 al 6 de Mayo de 2016, Puerto Vallarta, Jalisco, México

OPERACIÓN DE MEMBRANAS COMPUESTAS COMERCIALES EN CELDA DE FLUJO CRUZADO PARA DESALAR AGUA MARINA

Jesús Álvarez Sánchez^{a*}, Patricia Guadalupe Torres Valenzuela^a, Gustavo Adolfo Fimbres Weihs^{a,b}, Germán Eduardo Dévora Isiordia^a, Edna Rosalba Meza Escalante^a, Denisse Serrano Palacios^a



PROFAPI Project

Preparation and application of new biofouling resistant membranes for desalination of seawater

Period:
2019-2020

Amount:
\$ 1,718 USD

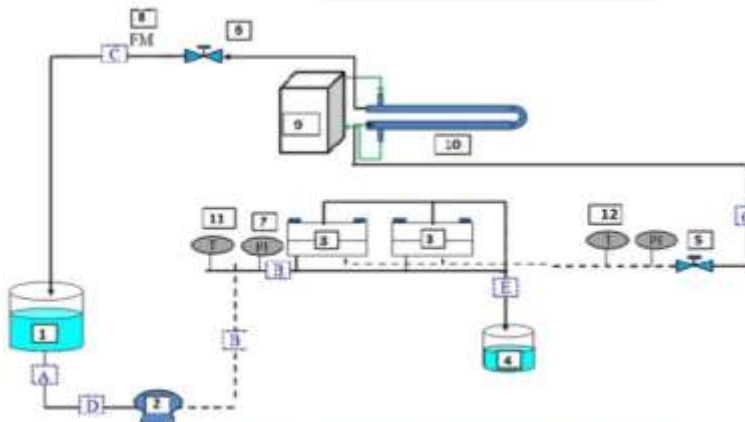


Figura 7. Equipo de flujo cruzado Sterlitech Corporation, modelo CF042.



Research Laboratory:

Hydrogeochemical and Environmental Explorations



Dr. Rodrigo González Enríquez

rglez1@hotmail.com

+52 (644) 4109000 1405



Technological Package of the Agronomic Process of the Higuierilla Crop.

**Period:
2015-2016**

**Amount:
\$ 80,597 USD**



Delivered Products

Give formulation for maximum yield for Higuierilla crop with desalinated water irrigation.



Research Laboratory:

Biopolymers



Dra. Reyna Guadalupe Sánchez Duarte

reyna.sanchez@itson.edu.mx

+52 (644) 4109000 Ext 2116

<https://www.itson.mx/oferta/iq/Paginas/reyna-sanchez.aspx>

Copper bioadsorption of acidic water from mines in a natural polymer (chitosan)

(PROFAPI)

Evaluate the chitosan adsorption capacity as bio adsorbent of Allura red dye through kinetics and isotherm of adsorption

**Period:
2016-2017**

**Amount:
\$ 5,200 USD**



Cáscara de camarón



Quitosano



Delivered Products

- Articles published in international journals and chapter of the book
- Presentations at national and international congresses
- Contributed to the research and development of specific techniques in the application of a natural and environmentally friendly adsorbent.



Abstract
A continuous adsorption study in a fixed-bed column was carried out using a chitosan-glutaraldehyde biosorbent for the removal of the textile dye Direct Blue 71 from an aqueous solution. The biosorbent was prepared from shrimp shells and characterized by scanning electron microscope, X-ray diffraction, and nuclear magnetic resonance spectroscopy. The effects of



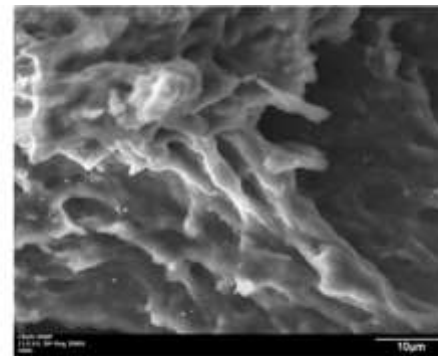
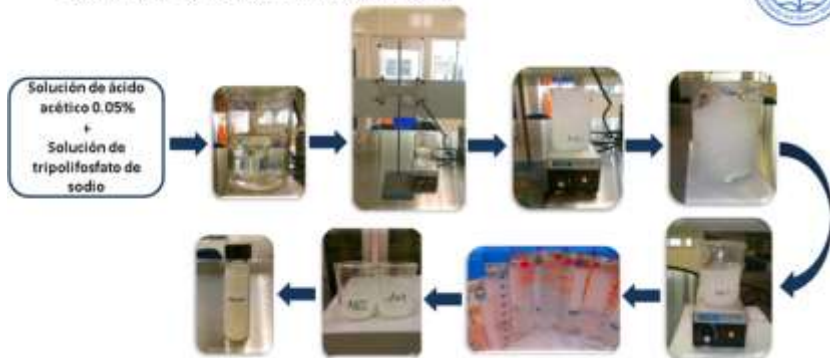
Production and characterization of chitosan nanoparticles to adsorb dyes (PROFAPI)

Synthesis chitosan-tripolyphosphate nanoparticles by using the ionic gelation method for the adsorption of food dyes

Period:
2018-2019

Amount:
\$ 5,200 USD

Obtención de nanopartículas de quitosano



Micrografía electrónica de barrido (SEM) de nanopartículas de plata-quitosano

Delivered Products

- Published articles and book chapters.
- Presentation at congresses, symposiums, graduate students.
- Contributed to the research and development of specific techniques for the production of nanoparticles.

Development, Characterization, and Applications of Capsaicin Composite Nanofiltration Membranes

Jesús Álvarez-Sánchez,
Griselda Evelia Romero-López, Sergio Pérez-Sicaicos,
German Eduardo Devora-Isiordia,
Reyna Guadalupe Sánchez-Duarte and
Gustavo Adolfo Fimbres-Weihs

Additional
<http://dx.doi.org/10.1007/s00289-018-2601-x>



Artículo

Revista de Ciencias Ambientales y Recursos Naturales

Diciembre 2018 Vol.4 No.14 1-9

Preparación, Caracterización y Aplicación de Membranas Compuestas a partir de 2-Metil-*m*-Fenilendiamina y Cloruro de Trimesoilo

Preparation, Characterization and Application of Composite Membranes from 2-Methyl-*m*-Phenylenediamine and Trimesoyl Chloride

ÁLVAREZ-SÁNCHEZ, Jesús†*, MARTINEZ-MACIAS, Maria del Rosario, DÉVORA-ISIORDIA, Germán Eduardo y SÁNCHEZ-DUARTE, Reyna Guadalupe

Polymer Bulletin

<https://doi.org/10.1007/s00289-018-2601-x>

ORIGINAL PAPER



Effect of the preparation method in the size of chitosan nanoparticles for the removal of allura red dye

Yedidia Villegas-Peralta¹ · Ma. A. Correa-Murrieta¹ · Edna R. Meza-Escalante¹ · Eric Flores-Aquino² · Jesús Álvarez-Sánchez¹ · Reyna G. Sánchez-Duarte¹

Received: 17 July 2018 / Revised: 30 October 2018 / Accepted: 8 November 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

Chitosan crosslinked for membrane preparation

Production of chitosan-based membranes with the incorporation of chemical compounds (crosslinkers, plasticizers and/or grafting) in their matrix, for possible use in filtration processes and/or seawater desalination processes.

Period:
2019-2020

Amount:
\$ 2,080 USD

Producción de quitosano

Caracterización de quitosano

Preparación de membranas

Caracterización de membranas

Obtención de membranas a base de quitosano



PRODUCTION AND CHARACTERIZATION OF A BIODEGRADABLE ANTI-CORROSIVE COATING

PREPARE CHITOSAN-BASED BIODEGRADABLE ANTI-CORROSION COATINGS FOR METALS TO EVALUATE METAL CORROSION CONTROL IN SYNTHETIC SEAWATER.

Period:
2021-2022

Amount:
\$ 1,472.94 USD



Research Laboratory:

Biopolymers and phytoremediation with microalgae



Dra. María del Rosario Martínez Macías

maria.martinez@itson.edu.mx

+52 (644) 4109000 Ext 2108

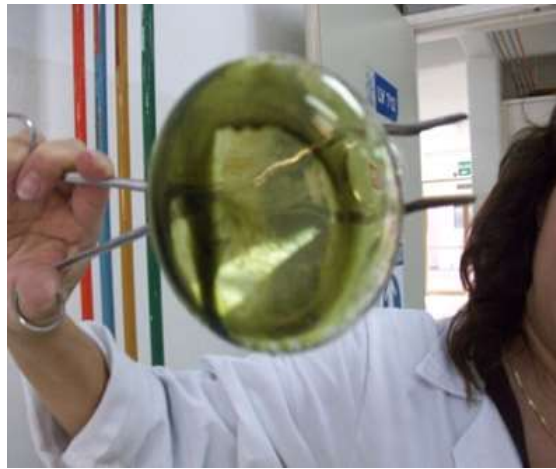
<https://www.itson.mx/oferta/iq/Paginas/maria-martinez.aspx>

Obtaining Biodiesel from Microalgae (PROFAPI 2010)

Integrate the methodology for the development, separation, drying and extraction of the bioenergetic base bioenergy base for the production of biodiesel from microalgae.

Period:
2010-2011

Monto:
\$ 7,924 USD



25 de Enero del 2011.

A quien corresponda:

PRESENTE

Por este medio y a solicitud del interesado ratifico la acción tutorial que realizó: **Maria del Rosario Martínez Macías**, en el periodo **Agosto – Diciembre de 2010**, en modalidad de tutoría individual, atendiendo a los estudiantes de la **Maestría en Ciencias en Recursos Naturales**:

Nombre	ID
Carlos Abraham Díaz Quiroz	07219

Sin otro particular y quedando a sus órdenes para cualquier duda respecto a la información solicitada.

Atentamente



Mtra. Elizabeth Del Hierro Parra
Coordinadora de Desarrollo Académico

The best recovery of *Nannochloropsis oculata* from the culture broth and effect on content of lipids

M. R. Martínez,¹ G. Ulloa,² J. Saldívar,¹ R. Beristain,³
and E. R. Meza-Escalante^{1,4)}

¹Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, Av. 5 de Febrero 818 Sur, Ciudad Obregón, Sonora 85000, Mexico

²Departamento de Biotecnología y Ciencias Alimentarias, Instituto Tecnológico de Sonora, Av. 5 de Febrero 818 Sur, Ciudad Obregón, Sonora 85000, Mexico

³Departamento de Recursos de la Tierra, Universidad Autónoma Metropolitana-Lerma, Av. Hidalgo Pte. 46, Lerma de Villada, Edo. de México 52006, Mexico

(Received 13 September 2013; accepted 2 January 2014; published online 14 January 2014)

Nannochloropsis oculata is an interesting microorganism in the field of marine biotechnology because of its high lipid content. Biodiesel from this microorganism has been demonstrated to be a feasible replacement of petroleum-derived fuels. The effect of pH, flocculant dosage (FeCl_3), and cell density has been studied in order to maximize biomass recovery and lipids. A partial factorial design was used to screen the main factors involved in the maximal biomass recovery from the culture broth, indicating that the best harvesting efficiency of 94.2% was obtained at pH 7, 47.6×10^6 of cell density and flocculant dosage of 13 mg FeCl_3/l . Oleic acid, palmitic acid, and palmitoleic acid (omega-7) were identified inside the microalgae harvested. Omega-7 fatty acid is five times more potent than omega-3 at lowering triglycerides. The lipids identified had lower degree of unsaturation; this makes microalgal lipids a potential replacement for fossil fuel. 0.76% of reduction in eicosapentaenoic unsaturated fatty acid (EPA) was observed probably due to flocculant addition and that is beneficial for providing an increased lipid stability. In summary, this work is devoted to demonstrate that the optimization of the separation of microalgae from culture broth is mostly dependent on the pH, cell density, and flocculants dosage. © 2014 AIP Publishing LLC. [<http://dx.doi.org/10.1063/1.4862209>]

- Indexed Article Published
- Participation in congress
- bachelor's and master's degree graduates, Thesis Master and PhD.



IV Congreso Regional de Ciencias Ambientales

202122
OCTUBRE 2010

ACTUAR POR EL PLANETA;
Cambio de un Medio Ambiente SUSTENTABLE

El Departamento de Ciencias del Agua y Medio Ambiente en conjunto con los programas Educativos de Ingeniería Química e Ingeniería en Ciencias Ambientales del Instituto Tecnológico de Sonora.

Otorga la Presente
Constancia

a:

Maria del Rosario Martínez Macías, Erika R. Meza Escalante, Germán Eduardo Chávez Izquierdo, Iren Miranda Ferrández, Héctor David Falcó, Luis Enrique Figueroa Falcó, Jorge Saldívar Cabrales

"DETERMINACIÓN DE LOS LÍPIDOS EXTRAÍDOS DE LA MICROALGA *Nannochloropsis oculata*"
DE LA TESIS DE GRADUACIÓN DEL TÍTULO DE MAESTRÍA EN CIENCIAS AMBIENTALES

En El IV Congreso Regional de Ciencias Ambientales
"ACTUAR POR EL PLANETA: Garantía de un Medio Ambiente SUSTENTABLE"

Cd Obregón, Sonora, 20, 21 y 22 de Octubre 2010

Dr. Carlos Alberto Espinosa
Director de la UES de Recursos Naturales.

Dr. Luis Carlos López Torres,
Jefe del Departamento de Ciencias del Agua y Medio Ambiente

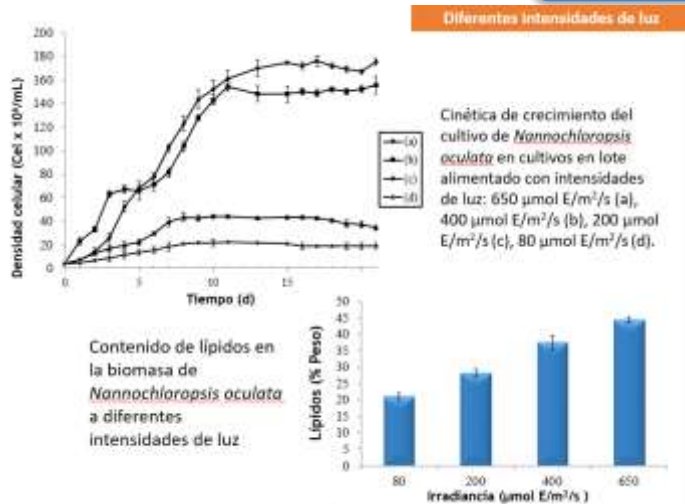
M. Sc. Gerardo Eduardo Chávez Izquierdo
Ingeniero en su programa educativo de Ingeniería Química

Effect of light intensity on kinetic growth rate and lipid content on microalgae *Nannochloropsis oculata*.

Evaluate the effect of different light intensities on lipid content and biomass productivity on *Nannochloropsis oculata*.

Period:
2011-2012

Amount:
\$ 5,200 USD



- Article published in the International Journal of Environmental Engineering
- Presentation at international congress on Environmental Engineering
- Support for bachelor's and master's degree graduating students.

Rev. Int. Contam. Ambie. 33 (Especial sobre Ingeniería Ambiental. Universidad Estatal de Sonora) 85-91, 2017
DOI: 10.20937/RICA.2017.33.esp02.08

SÍNTESIS DE LÍPIDOS DE LA MICROALGA *Nannochloropsis oculata* PARA SU USO POTENCIAL EN LA PRODUCCIÓN DE BIODIÉSEL

María del Rosario MARTÍNEZ MACIAS*, Reyna Guadalupe SÁNCHEZ DUARTE,
Edna Rosalba MEZA ESCALANTE, Ruth Gabriela ULLOA MERCADO y Jorge SALDÍVAR CABRALES

Instituto Tecnológico de Sonora. Calle 5 de febrero 818 sur, Colonia Centro, Ciudad Obregón, Sonora, México, C. P. 85000
*Autor para correspondencia: maria.martinez@itson.edu.mx

(Recibido junio 2015; aceptado agosto 2016)

Palabras clave: ácidos grasos, productividad, luz, biocombustibles

Instituto Tecnológico de Sonora
Calle Febrero Sur, 818 Sur
Teléfono (644) 416-05-00 (Apdo. 341)
85000 Ciudad Obregón, Sonora, México

Acta de Examen de Grado No. 1432

En _____ Ciudad Obregón, Sonora, México, a las _____ de _____ de _____ del año de _____, celebrada _____ del mes de _____, a las _____ de _____ de _____, se reunió en la Sala de Exámenes del Instituto Tecnológico de Sonora, los miembros del tribunal:

Presidente: Mtra. María del Rosario Martínez Macías
Secretario: Dr. Pablo Luis Méndez
Vocal: Dra. Edna Rosalba Meza Escalante

Para proceder al Examen de Grado de Maestría en Ciencias en Recursos Naturales de Cristín Abraham Díaz Chávez quien desarrolló el tema: "Efectos de la intensidad de la luz en la productividad y composición lipídica de microalgas *Nannochloropsis oculata*"

Para emitir la expedición de los diplomas correspondientes al sustentante y elegidos de ahí en adelante en su abstracción con el resultado de la tesis de la siguiente manera: APROBADO CON CALIFICACIÓN

Acta redactado por Presidente del Tribunal de Examen de Grado, y el secretario en el día de hoy.

Presidente
Mtra. María del Rosario Martínez Macías

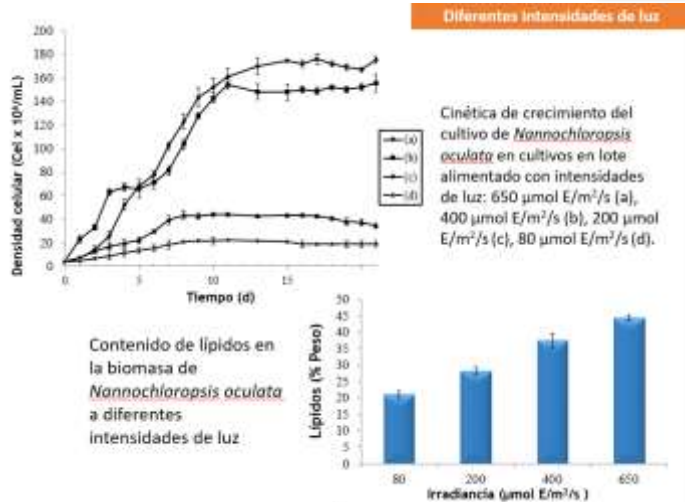


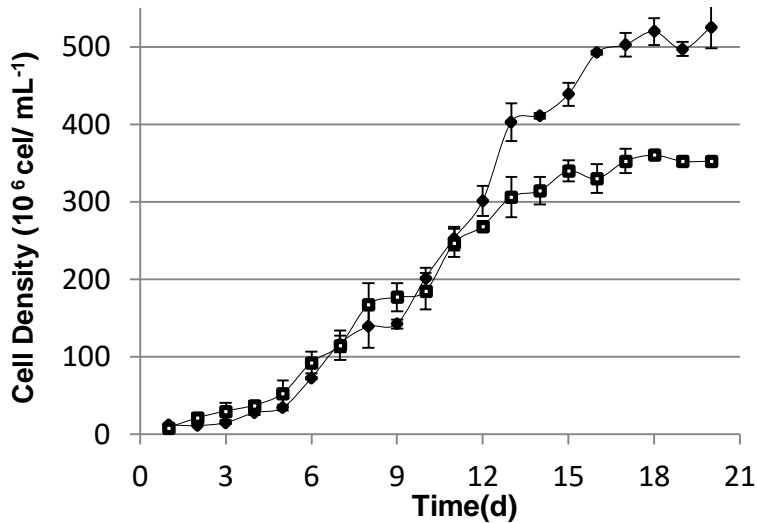
Effect of fed-batch and semicontinuos regimen on *Nannochloropsis oculata* grown in different culture media to high-value products.

Evaluate different grown system and different culture media on microalgae *N. oculata*.

**Period:
2013-2014**

**Amount:
\$ 3,130 USD**





Research Article



Received: 9 February 2017

Revised: 26 July 2017

Accepted article published: 8 August 2017

Published online in Wiley Online Library: 9 October 2017

(wileyonlinelibrary.com) DOI 10.1002/jctb.5405

Effect of fed-batch and semicontinuous regimen on *Nannochloropsis oculata* grown in different culture media to high-value products

Rosario Martínez-Macías,^a Edna Meza-Escalante,^a Denisse Serrano-Palacios,^a Pablo Gortáres-Moroyoqui,^b Patricia Elizabeth Ruiz-Ruiz^b and Gabriela Ulloa-Mercado^{b*}

Abstract

BACKGROUND: High cell density in cultures of microalgae is a key factor to recover biomass and extract metabolites of interest. A fed batch tubular reactor (FBTR) and semi-continuous reactor (SCR) with f/2 Guillard Medium (f/2GM) and algal medium (AM) were evaluated. Both modes were operated under completely defined conditions to assess their effect on cell density, and lipid, protein and carbohydrate productivity of the microalgae *Nannochloropsis oculata*.

RESULTS: Results show that the FBTR promotes the highest cell density for both culture media, achieving $525 \pm 1.84 \times 10^6$ cell mL⁻¹. With AM in the SCR, specific growth rate, productivities of biomass and lipids were the highest, as well as content of protein (48%), lipid (52.1%) and carbohydrates (17%). No significant differences were found in saturated fatty acids composition, whereas unsaturated fatty acids composition was affected by the operating regimen, this being higher in the FBTR.

CONCLUSION: The use of AM in both operating modes, FBTR and SCR, increased the cell density and improved the lipid content of *N. oculata*. A good option would be to combine both culture modes; first, use the FBTR to obtain high cell densities and then apply the SCR mode to increase lipid productivity; finally, an important quantity of high-value products could be recovered.

© 2017 Society of Chemical Industry

Keywords: microalgae; productivity; lipids; biomass; culture-medium; bioreactors



Effect of removal of heavy metals from acid mine water on biomass and lipid productivity to improve biofuels (PROFAPI 2016)

Biosorption of heavy metals from acid mine water by marines microalgae (PROFAPI 2017)

Determine the adsorption capacity of copper in acid mine water, using lyophilized biomass of microalgae as adsorbent.

**Period:
2016-2017**

**Amount:
\$ 2,180 USD**



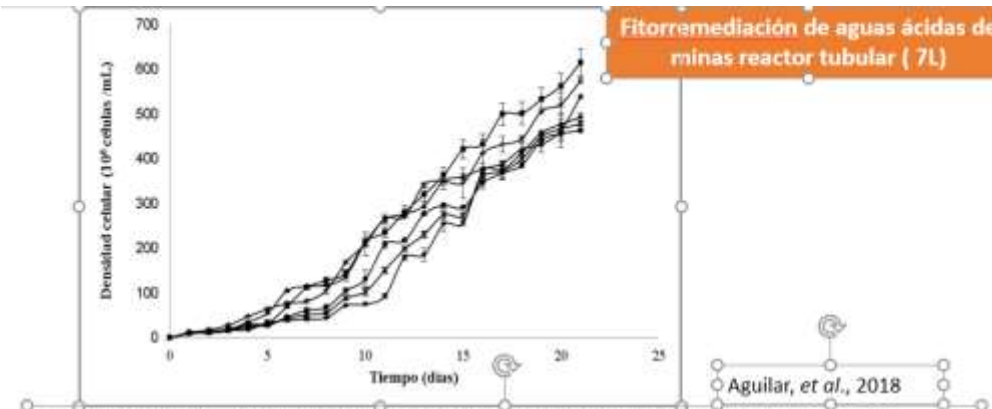


Figura 12. Cinéticas de crecimiento de *N. oculata* a diferentes concentraciones de metales (Cu y Fe); control (cuadrado); con 1.16 mg Cu L⁻¹ (más); 1.74 mg Cu L⁻¹ (triángulo); 2.32 mg Cu L⁻¹ (rombo); 3.48 mg Cu L⁻¹ (asterisco); 4.64 mg Cu L⁻¹ (círculo).

Concentración de metales pesados (mg Cu L ⁻¹)	Densidad celular (x10 ⁶ cel mL ⁻¹)	Velocidad específica de crecimiento (d ⁻¹)	Productividad de biomasa (g L ⁻¹ d ⁻¹)	% Lípidos	Productividad de lípidos (g L ⁻¹ d ⁻¹)
Control	614.25±30.71a	0.331±0.018a	0.261±0.002	33.058±5.398a	0.086±0.001a
1.16	573.96±6.51b	0.312±0.019ab	0.244±0.003b	29.497±2.378a	0.072±0.001a
1.74	538.56±2.48b	0.278±0.020b	0.229±0.001	71.594±1.649b	0.164±0.001b
2.32	492.71±8.87c	0.303±0.012ab	0.210±0.004	75.302±3.933b	0.158±0.003b
3.48	477.81±6.47c	0.260±0.017b	0.115±0.001	68.157±4.287b	0.078±0.001a
4.64	462.92±4.07c	0.308±0.023ab	0.197±0.002f	77.039±2.604b	0.152±0.002b

and Pollution Research
01711334-018-2963-1

SCIE



copper from acid mine drainage by the microalgae *prospis oculata*

io Martínez Macías¹ · Ma. A. Correo-Murrieta¹ · Yedlika Vázquez-Peralta¹ ·
io Dávora-Isidordia¹ · Jesús Álvarez-Sánchez¹ · Jorge Saldivar-Cabrales¹ · Reyna G. Sánchez-Duarte¹

8 / Accepted: 10 December 2019
© Springer Nature 2019

heavy metals from acid mine drainage is a key factor for avoiding damage to the environment. The microalgae *oculata* was cultured in an algal medium with 0.05, 0.1, 0.15, 0.2, and 0.25 mM copper under completely in to assess its removal capacity; the effects of copper on the cell density and lipid productivity of *N. oculata* (ml). The results showed that *N. oculata* was able to remove up to 99.92 ± 0.04% of the copper content in the A total of 89.29 ± 1.92% was eliminated through metabolism, and 10.70 ± 1.92% was removed by adsorption. e favorable because they indicate that a large amount of copper was extracted due to the ability of the microalgae per ions. The cell density, growth rate, and lipid content decreased with increased concentrations of copper in m. A positive effect on the fatty acid profile was found, as the saturated fatty acid (SFA) and monounsaturated A) content improved when the copper concentration was higher than 0.1 mmol L⁻¹, which can potentiate the β-quality biodiesel. *N. oculata* is a good option for the treatment of acid mine drainage due to its ability to until percentage of the copper present. Moreover, combining different culture systems such that heavy metals n-toxic levels in the first stage and high cell densities, which promote lipid production, is obtained in the second a advantageous strategy.

algae - Lipids - Biodiesel - Heavy metals - Acid mine drainage

Martínez et al., 2019.



Teléfono (644) 410-09-00 Apdo. 541
85000 Ciudad Obregón, Sonora, México

Acta de Examen de Grado No. 2076

En _____ Ciudad Obregón _____, Sonora, México, siendo las _____ 15:00
horas del día _____ doce _____ del mes de _____ diciembre
de _____ die mil diecinueve _____, se reunieron en la Sala de Exámenes del Instituto
Tecnológico de Sonora, los miembros del síndico:
Presidenta: Dra. María del Rosario Martínez Macías
Secretaría: Dra. Reyna Guadalupe Sánchez Duarte
Focal: Dr. Germán Eduardo Dávora Isidordia

Para proceder al examen de Grado de: Maestría en Ciencias en Recursos Naturales
de: Rocio Janeth Aguilar Ruiz

Synthesis of cellulose and alginates from microalgae as bioadsorbents. (PROFAPI 2018)

Strategies to increase lipid production in microalgae. (PROFAPI 2019)

Copper adsorption isotherms using marine microalgae biomass (PROFAPI 2019)

Synthesizing cellulose polysaccharides and alginates from marine microalgae for use as bioadsorbents in mineral decontamination

Period:
2019-2020

Amount:
\$ 6,972 USD

Author's personal copy

Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-020-10383-4

RESEARCH ARTICLE

Removal of copper improves the lipid content in *Nannochloropsis oculata* culture

Rocio Janeth Aguilar-Ruiz¹ · María del Rosario Martínez-Macias² · Dalila Isabel Sánchez-Machado¹ · Jaime López-Cervantes² · Germán Eduardo Dévora-Isordia² · Omar Nateras-Ramírez¹

Received: 27 January 2020 / Accepted: 27 July 2020
© Springer-Verlag GmbH Germany, part of Springer Nature 2020

Abstract

Mining is an important activity for the economic development of many countries. However, this activity produces toxic residues that pollute water and the environment. The heavy metal removal from effluents of acid mine water is crucial to avoid environmental pollution. The microalgae *Nannochloropsis oculata* was cultured in algal medium, with the addition of 1.16, 1.74, 2.32, 3.48, and 4.64 mg Cu²⁺ L⁻¹, coming from acid mine water to assess its removal capacity and the effect of copper content on the cell density and lipid productivity. The results showed that *N. oculata* removed up to 94.58 ± 0.43% at copper concentration than 1.74 mg Cu²⁺ L⁻¹; additionally, a positive effect on the lipid content was found at copper concentration to be higher, 4.64 mg Cu²⁺ L⁻¹, yielding 77.64 ± 2.89% of lipid content, twice as high as that achieved in the control culture of 11.059 ± 1.188%, thus potentiating the biofuel production. These findings are favorable because they indicate that microalgae can remove copper added in the culture and present in acid mine water and can yield high lipid content at the same time. The cell density and growth rate decreased with increased concentrations of copper in the culture medium.

Keywords Microalgae · Lipids · Heavy metals · Acid mine water · Fatty acid profile · Algal culture



Productos en proceso



Received: 4 February 2021 / Revised: 20 June 2021 / Accepted: 30 July 2021
DOI: 10.1007/s11356-021-10383-4

ORIGINAL ARTICLE

AOCAS WILEY

Influence of different reactor types on *Nannochloropsis oculata* microalgae culture for lipids and fatty acid production

María del Rosario Martínez-Macias¹ · Rocio Janeth Aguilar-Ruiz² · Omar Nateras-Ramírez² · Dalila Isabel Sánchez-Machado¹ · Jaime López-Cervantes² · Germán Eduardo Dévora-Isordia² · Jesús Álvarez-Sánchez¹ · Nidia Josefina Ríos-Vázquez^{1,2}

¹Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, Cd. Obregón, Sonora, México
²Departamento de Biotecnología y Ciencias Alimentarias, Instituto Tecnológico de Sonora, Av. 4 de febrero 218 sur, Cd. Obregón, Sonora 85000, México
Email: nalia.rios@iteson.edu.mx

Correspondence
María del Rosario Martínez-Macias,
Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, Av. 4 de febrero 218 sur, Cd. Obregón, Sonora 85000, México.
Email: maria.macias@iteson.edu.mx

Funding information
Instituto Tecnológico de Sonora, Grant/Award Number: PROFAPI 2018

Abstract

Greenhouse gases emitted into the atmosphere by burning of fossil fuels cause global warming. One option is obtaining biodiesel. *Nannochloropsis oculata* was cultured under different light intensities and reactors at 20°C for 21 days with 1/2 medium to assess their effects on cell density, lipid, and fatty acids (FAs). *N. oculata* improved cell density on fed-batch glass tubular reactor (7 L) at 200 µmol E m⁻² s⁻¹, yielding 3.5 × 10⁸ cells mL⁻¹, followed by fed-batch Erlenmeyer flask (1 L) at 550 µmol E m⁻² s⁻¹ with 1.7 × 10⁸ cells mL⁻¹. The highest total lipid contents (% g lipid × g dry biomass⁻¹) were 44.4 ± 0.8% for the reactor (1 L) at 550 µmol E m⁻² s⁻¹ and 35.2 ± 0.2% for the tubular reactor (7 L) at 200 µmol E m⁻² s⁻¹, until twice as high compared with the control culture (Erlenmeyer flask 1 L, 80 µmol E m⁻² s⁻¹) with 21.2 ± 1%. Comparing the total lipid content at 200 µmol E m⁻² s⁻¹, tubular reactor (7 L) and reactor 1 L achieved 35.2 ± 0.2% and 28.3 ± 1%, respectively, indicating the effect of

“Phytoremediation as an alternative for the removal of heavy metals Cadmium and Lead heavy metals in solution.” (PROFAPI 2020)

Influence of different types of reactors on microalgae culture for lipid and fatty acid production. (PROFAPÍ 2021)

Period:
2020--2021

Amount:
\$ 2,946 USD

Deliverables

1 Cd (II) and Pb (II) bio sorption by inactive biomass of *Nannochloropsis oculata*
2 microalgae.

3 Omar Nateras-Ramirez^a, Jaime López-Cervantes^a, Dalila I. Sánchez-Duarte^a, Rocío I.
4 Aguilar-Ruiz^a, María E. Martínez-Macias^a.

5 ^aDepartamento de Biotecnología y Ciencias Alimentarias, Instituto Tecnológico de Sonora,
6 Cd. Obregón Sonora, 85100, México.

7 *Correspondence to: Departamento de Ciencias del Agua y Medio Ambiente, Instituto
8 Tecnológico de Sonora, Cd. Obregón Sonora, 85100, México. E-mail:
9 maria.martinez@itson.edu.mx.

10 Abstract

11 The development of heavy metal treatment technologies is crucial role in avoiding of
12 contamination water bodies. *Nannochloropsis oculata* was used in Pb²⁺ and Cd²⁺ biosorption.
13 *N. oculata* was cultured in fed-batch reactors at 25 °C, 166 µE m⁻² s⁻¹ light intensity, 82
14 Oscillated medium for 21 days. The biosorption capacity (µg metal × g biomass⁻¹) was
15 determined evaluating the pH effect and biomass amount. The maximum biosorption
16 capacity from Pb²⁺ and Cd²⁺ was 1087.20 ± 9.12 and 934.44 ± 12.84 µg g⁻¹ respectively. The
17 pH of highest biosorption of Pb²⁺ was 5 and 4 for Cd²⁺. Optimal amount of biomass to remove
18 100 ppm of Pb²⁺ was 0.05g and 0.3g for 100 ppm of Cd²⁺, which suggests that microalgae
19 showed high affinity to remove Pb²⁺ than Cd²⁺. FTIR results shown that Pb²⁺ y Cd²⁺ sorption

An overview of microalgae for Cd²⁺ and Pb²⁺ biosorption from wastewater

Omar Nateras-Ramirez^a, M. E. Martínez-Macias^a, D. I. Sánchez-Machado^a, Jaime López-Cervantes^a, R. I.
Aguilar-Ruiz^a.

^a Departamento de Biotecnología y Ciencias Alimentarias, Instituto Tecnológico de Sonora, Cd. Obregón
Sonora, 85100, México.

^a Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, Cd. Obregón Sonora,
85100, México.

*First author to whom all correspondence should be addressed Jaime López Cervantes, e-mail:
jaime.lopez@itson.edu.mx. Telephone: +52(644) 4 10 90 00 ext. 2923.

Abstract

Lead (Pb²⁺) and cadmium (Cd²⁺) are the most toxic and problematic heavy metals that have been discharged
into the environment. Traditional heavy metal removal methods have downsides such as toxic waste
generation. There is interest in the development of new adsorbents capable of removing these heavy metals in
a simple and efficient way. This review focuses on the use of microalgae as an alternative for removing Pb²⁺
and Cd²⁺. The processes and mechanisms that involve the removal of these metals by different species of
microalgae are detailed. In this context, microalgae emerge as an attractive option for heavy metal absorption
due to their low cost, high removal efficiencies, easy waste management and high availability of biomass.
This work provides useful information in this regard, as well as opportunity areas for research on Pb²⁺ and

Efecto de intensidad de luz y medio de cultivo en composición química y
parámetros de crecimiento de *Nannochloropsis oculata* y *Porphyridium*
cruentum

Rocío Janeth Aguilar-Ruiz^a, María del Rosario Martínez-Macias^b, Dalila Isabel Sánchez-
Duarte^a, Jaime López-Cervantes^a, Omar Nateras-Ramirez^a.

^aDepartamento de Biotecnología y Ciencias Alimentarias, Instituto Tecnológico de Sonora, Cd.
Obregón Sonora, 85100, México.

^bDepartamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, Cd.
Obregón Sonora, 85100, México.

Resumen

Las microalgas son consideradas una tecnología prometedora para la extracción de
compuestos de alto valor nutricional. Para definir su potencial uso es de gran importancia
conocer su composición química y la viabilidad en las altas productividades de biomasa. El
objetivo de estudio fue evaluar el efecto de intensidades de luz alta (400 µE m⁻² s⁻¹) y baja
(80 µE m⁻² s⁻¹), así como también el efecto en el medio de cultivo Algal (con alto contenido
de nitrógeno, 4 mmol N: L⁻¹) y medio f2 de Guillard (con bajo contenido de nitrógeno, 0.8
mmol N: L⁻¹) en parámetros de crecimiento como densidad celular, velocidad específica de
crecimiento y productividad de biomasa; así como en la composición química como
humedad, cenizas, lípidos y carbohidratos, en las microalgas *Nannochloropsis oculata* y
Porphyridium cruentum. Como resultados importantes, se encontró para *N. oculata* se
obtuvo su mayor densidad celular, velocidad específica de crecimiento y productividad de
biomasa con 341.64±2.36 cel mL⁻¹, 0.456±0.035 d⁻¹ y 0.145±0.001 g L⁻¹ d⁻¹ respectivamente.
Para *P. cruentum* se registraron los mejores resultados para densidad celular, velocidad
específica de crecimiento y productividad de biomasa de 56.60×10⁶ cel mL⁻¹, 0.053±0.001

Research Laboratory:

Bioadsorbents



Dra. Ma. Araceli Correa Murrieta

maria.correa@itson.edu.mx

+52 (644) 4109000 Ext 1405

<https://www.itson.mx/oferta/iq/Paginas/araceli-correa.aspx>

**Hexavalent chromium removal from wastewater
using aquaculture waste
(PROFAPI: 2015 y 2016)**

Evaluate the adsorption of chromium (VI)
from synthetic water using beads of chitosan
and chitosan modified with glutaraldehyde.

Period:
2015-2016

Amount:
\$ 6,250 USD



Bioadsorbents

- Congress Presentations: International Congress of Environmental Engineering (May, 2015), III National Congress of Biotechnology and Food Sciences (October, 2015), XXXVII Congress of AMIDIQ (May, 2016), and 3rd National Congress of Technologies and Environmental Sciences (October, 2016)
- Congress' memories, book chapter, and journal papers (indexed by JCR).

Modeling of breakthrough curves for aqueous iron (III) adsorption on chitosan-sodium tripolyphosphate

Dalia I. Sánchez-Machado, Jaime López-Cervantes,
Ma. A. Correa-Murrieta and Reyna G. Sánchez-Duarte

Capítulo XVII. Remoción de cromo hexavalente por quitosano entrecruzado

Correa Murrieta M. A. *, Sánchez Duarte R. G., Álvarez Sánchez J., Dévora Isirdia G. E. y Velázquez G. M.
[*macorrea@itson.edu.mx](mailto:macorrea@itson.edu.mx)



Shrimp wastes to remove manganese from aqueous solutions / Treatment of waste from COD analyses using biopolymers.

(PROFAPI: 2017 y 2018)

Evaluate the adsorption of Manganese (II) from synthetic water on chitosan beads modified with sodium tripolyphosphate.

Evaluate the elimination of chromium contained in the residues from the COD analysis by protonated chitosan beads modified with glutaraldehyde.

**Period:
2017-2018**

**Amount:
\$ 5,750 USD**



Delivered Products

- Congress Presentations: XXXVIII National Meeting of AMIDIQ (May, 2017), IV National Congress of Biotechnology and Food Sciences (September, 2017), XXXIX National Meeting of AMIDIQ (May, 2018), and Sixth International Symposium on Environmental Biotechnology and Engineering (November, 2018).
- Congress' memories and book chapter.



ELIMINACIÓN DE MANGANESO (II) POR RESIDUOS DE CAMARÓN
Ma. Araceli Correa-Murrieta^{1*}, Germán Eduardo Dávora Isordia¹, Jesús Álvarez Sánchez¹, Yedidia Villegas Peralta¹
¹Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, 5 De Febrero 818 Sur, Centro, Cd. Obregón, Sonora, 85000, México.
*email: maria.correa@itson.edu.mx
Memorias del XXXVIII Encuentro Nacional de la AMIDIQ
9 al 12 de Mayo de 2017, Ixtapa-Zihuatanejo, Guerrero, México

TRATAMIENTO DE DESECHOS DE DQO POR BIOADSORCIÓN
Ma. Araceli Correa-Murrieta^{1*}, Reyna Guadalupe Sánchez Duarte¹, María del Rosario Martínez Macías¹, Yedidia Villegas Peralta¹, Germán Eduardo Dávora Isordia¹, Jesús Álvarez Sánchez¹
¹Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, 5 de Febrero 818 Sur, Centro, Cd. Obregón, Sonora, 85000, México. *email: maria.correa@itson.edu.mx
Memorias del XXXIX Encuentro Nacional de la AMIDIQ
1 al 4 de mayo 2018, San José del Cabo, BCS.



Chapter 4.2 Chitosan

Dalia I. Sánchez-Machado^{*}, Jaime López-Cervantes^{*}, Ma. A. Correa-Murrieta^{*}, Reyna G. Sánchez-Duarte^{*}, Paola Cruz-Flores^{*} and Gabriela Servín de la Mora-López^{**}
^{*}Instituto Tecnológico de Sonora, Ciudad Obregón, Sonora, Mexico, ^{**}Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, Mexico

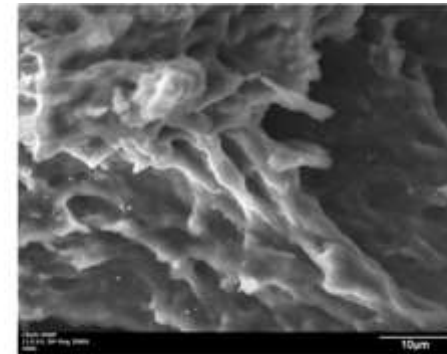
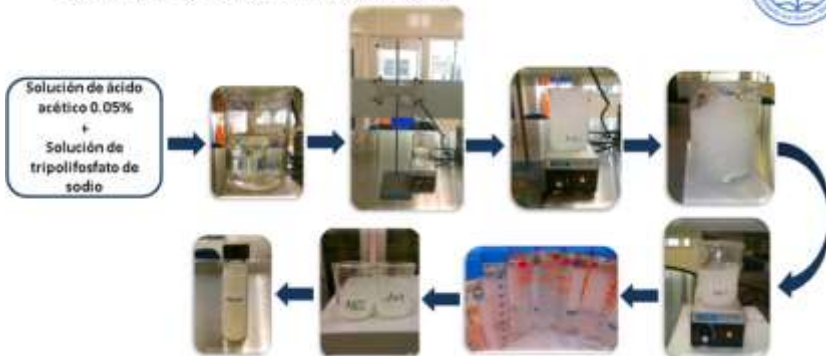
PRODUCTION AND CHARACTERIZATION OF CHITOSAN NANOPARTICLES FOR ADSORBING DYES (PROFAPI)

SYNTHESIZING CHITOSAN-TRIPOLYPHOSPHATE NANOPARTICLES BY IONIC GELATION METHOD FOR THE ADSORPTION OF FOOD COLORANT

Period:
2018-2019

Amount:
\$ 4,910 USD

Obtención de nanopartículas de quitosano



Micrografía electrónica de barrido (SEM) de nanopartículas de plata-quitosano

Delivered products

- Published articles and book chapters
- Presentation at congresses, symposiums, graduate students
- Contributed to the research and development of specific techniques for the production of nanoparticles.

Development, Characterization, and Applications of Capsaicin Composite Nanofiltration Membranes

Jesús Álvarez-Sánchez,
Griselda Evelia Romero-López, Sergio Pérez-Sicaicos,
German Eduardo Devora-Isiordia,
Reyna Guadalupe Sánchez-Duarte and
Gustavo Adolfo Fimbres-Weihs

Additional

<http://dx.doi.org/10.1007/s00289-018-2601-x>

Ab

Bio

in

Cap

a th

(NI

pre



Artículo

Revista de Ciencias Ambientales y Recursos Naturales

Diciembre 2018 Vol.4 No.14 1-9

Preparación, Caracterización y Aplicación de Membranas Compuestas a partir de 2-Metil-*m*-Fenilendiamina y Cloruro de Trimesoilo

Preparation, Characterization and Application of Composite Membranes from 2-Methyl-*m*-Phenylenediamine and Trimesoyl Chloride

ÁLVAREZ-SÁNCHEZ, Jesús†*, MARTINEZ-MACIAS, Maria del Rosario, DÉVORA-ISIORDIA, Germán Eduardo y SÁNCHEZ-DUARTE, Reyna Guadalupe

Polymer Bulletin

<https://doi.org/10.1007/s00289-018-2601-x>

ORIGINAL PAPER



Effect of the preparation method in the size of chitosan nanoparticles for the removal of allura red dye

Yedidia Villegas-Peralta¹ · Ma. A. Correa-Murrieta¹ · Edna R. Meza-Escalante¹ · Eric Flores-Aquino² · Jesús Álvarez-Sánchez¹ · Reyna G. Sánchez-Duarte¹

Received: 17 July 2018 / Revised: 30 October 2018 / Accepted: 8 November 2018

© Springer-Verlag GmbH Germany, part of Springer Nature 2018

**Adsorption capacity of activated carbon obtained from wheat sheaves
Encapsulation of wheat sheaf activated carbon in chitosan for removal of
aqueous contaminants
(PROFAPI: 2019 & 2020)**

Determine the adsorption capacity of activated carbon obtained from wheat sheaf through adsorption tests in aqueous methylene blue - Determine the optimal conditions for adsorption of aqueous methylene blue on activated carbon encapsulated in chitosan.

**Period:
2019-2020**

**Amount:
\$ 3,437 USD**



Delivered products

Presentation of papers at: V National Congress of Technology and Environmental Sciences in Virtual Modality (October 20-23, 2020 in ITSON, cd Obregon Sonora); XLI National Meeting of the Mexican Academy of Research and Teaching in Chemical Engineering A.C. in Virtual Modality (October 22-24, 2020).
Extended Proceedings and Book Chapter



CAPÍTULO IV QUITOSANO COMO ALTERNATIVA PARA ELIMINAR CONTAMINANTES ACUOSOS

Ms. Araceli Correa Morales¹, Reyna Guadalupe Sánchez Quarta²
y Genoveva Fabiana Devora Ibarra³

Resumen:

El agua es un recurso indispensable para todas las formas de vida. Actualmente se tiene el problema de su escasez y su contaminación por diversas fuentes. En este capítulo se hace referencia a la contaminación por metales pesados y otros contaminantes recalcitrantes, como los colorantes azoicos que representan una problemática en los estados de Sonora y Chihuahua, México. Para dar solución al problema de la contaminación se dispone de diversas tecnologías, en este caso se profundiza en el uso del proceso de adsorción. Finalmente, se describe y se propone el quitosano como una alternativa de remediación atractiva para la eliminación de contaminantes presentes en los cuerpos de agua.

Palabras clave: Quitosano, recursos hídricos, metales pesados, colorantes.

¹ Instituto Tecnológico de Sonora ITSON-6

Research Laboratory:

Dynamic Biosystems and Renewable Energies



Dra. María Magdalena Armendáriz Ontiveros

Maria.armendariz@itson.edu.mx

+52 (644) 4109000 Ext 1403

<https://www.itson.mx/oferta/iq/Paginas/maria-armendariz.aspx>

AUTHORIZED PROJECT

CONACYT

“Optimization of synergies between photovoltaic solar cells and reverse osmosis membranes for the desalination of marine and brackish waters”.

Period:
2016-2019

Amount:
\$ 78,000 USD



Delivered Products

- Article published
- Participation in congress



Desalination

Volume 451, 1 February 2019, Pages 45-58



Biofouling performance of RO membranes coated with Iron NPs on graphene oxide

M.M. Armendáriz-Ontiveros ^a, A. García García ^b, S. de los Santos Villalobos ^c, G.A. Fimbres Weihs ^c 

 Show more




<https://doi.org/10.1016/j.desal.2018.07.005>

[Get rights and content](#)



Article

Biofouling of FeNP-Coated SWRO Membranes with Bacteria Isolated after Pre-Treatment in the Sea of Cortez

Maria Magdalena Armendáriz-Ontiveros ¹, Gustavo A. Fimbres Weihs ^{2,*} , Sergio de los Santos Villalobos ^{2,*}  and Sergio G. Salinas-Rodríguez ³ 

¹ Instituto Tecnológico de Sonora. 5 de Febrero 818 Sur, Cd. Obregón, Sonora, C.P. 85000, Mexico

² CONACYT-Instituto Tecnológico de Sonora, 5 de Febrero 818 Sur, Cd. Obregón, Sonora, C.P. 85000, Mexico

³ IHE Delft Institute for Water Education, Environmental Engineering and Water Technology Department, Westvest 7, 2611 AX Delft, The Netherlands

* Correspondence: gustavo.fimbres@itson.edu.mx (G.A.F.W.); sergio.delossantos@itson.edu.mx (S.d.l.S.V.)

Received: 14 June 2019; Accepted: 19 July 2019; Published: 23 July 2019



Abstract: Commercial seawater reverse osmosis (SWRO) membranes were coated with iron nanoparticles (FeNPs) and biofouled with a bacterium strain isolated from the Sea of Cortez, Mexico. This strain was selected and characterized, as it was the only cultivable strain in pre-treated



AUTHORIZED PROJECTS

CONACYT

“Optimum concentration of FeNPs in the coating of reverse osmosis membranes for the reduction of bio-fouling”.

Period:
2019

Amount:
\$ 1,460 USD



Delivered Products

- Article published
- Participation in congress



Article

Anti-Biofouling and Desalination Properties of Thin Film Composite Reverse Osmosis Membranes Modified with Copper and Iron Nanoparticles

M. Armendariz Ontiveros ¹, Y. Quintero ², A. Llanquilef ², M. Morel ³,
L. Argente Martínez ^{1,4}, A. García García ⁵ and A. García ^{2,*}

¹ Instituto Tecnológico de Sonora. 5 de Febrero 818 Sur, Sonora 85000, Mexico

² Advanced Mining Technology Center (AMTC), Universidad de Chile, Santiago 8370451, Chile

³ Facultad de Ciencias Naturales, Departamento de Química y Biología, Universidad de Atacama, Copiapó 1531772, Chile

⁴ Instituto Tecnológico del Valle del Yaqui, C. 600, Block 611, Sonora 85275, Mexico

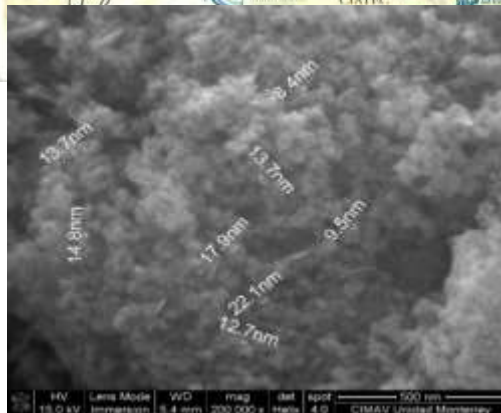
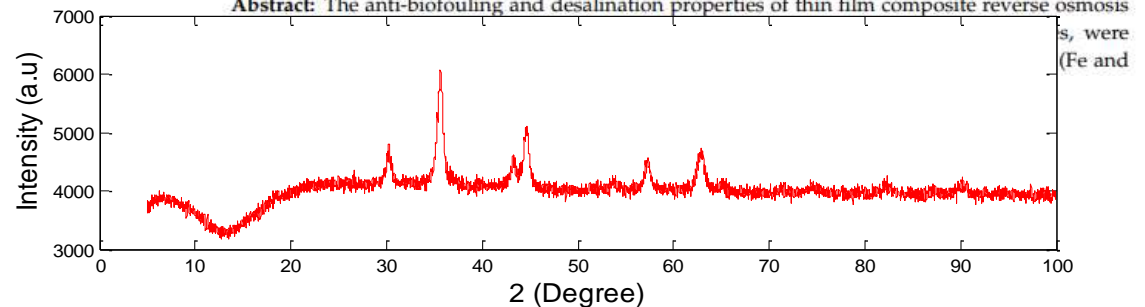
⁵ Laboratorio de Síntesis y Modificación de Nanoestructuras y Materiales Bidimensionales, Centro de Investigación en Materiales Avanzados S.C. Parque PIIT, Apodaca Nuevo León 66628, Mexico

* Correspondence: andreina.garcia@amt.c; Tel.: +56-2-29771015

Received: 4 June 2019; Accepted: 26 June 2019; Published: 28 June 2019



Abstract: The anti-biofouling and desalination properties of thin film composite reverse osmosis



FeNPs

XRD de FeNPs

International Collaborative Research

AUTHORIZED PROJECTS

CONICYT-Chile

New applications of copper nanoparticles from mining products on emerging technologies for desalination process and energy production

Period:
2018-2021

Amount:
\$ 22,089 USD



INSTITUTO TECNOLÓGICO DE SONORA
Educar para Trascender



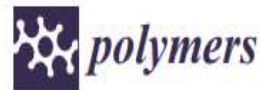
fcfm

FACULTAD DE CIENCIAS
FÍSICAS Y MATEMÁTICAS
UNIVERSIDAD DE CHILE

amtc
ADVANCED MINING TECHNOLOGY CENTER

Delivered Products

- Article published
- Participation in congress



Article

Influence of Multidimensional Graphene Oxide (GO) Sheets on Anti-Biofouling and Desalination Performance of Thin-Film Composite Membranes: Effects of GO Lateral Sizes and Oxidation Degree

Bárbara E. Rodríguez¹, María Magdalena Armendariz-Ontiveros², Rodrigo Quezada¹, Esther A. Huitrón-Segovia³, Humberto Estay¹, Alejandra García García^{3,*}

Effect of seawater variability on endemic bacterial biofouling of a reverse osmosis membrane coated with iron nanoparticles (FeNPs)

M.M. Armendáriz-Ontiveros², J. Álvarez-Sánchez², G.E. G.A. Fimbres Weihs^{3,*}

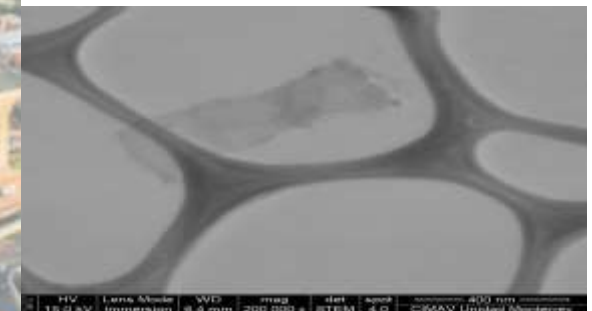
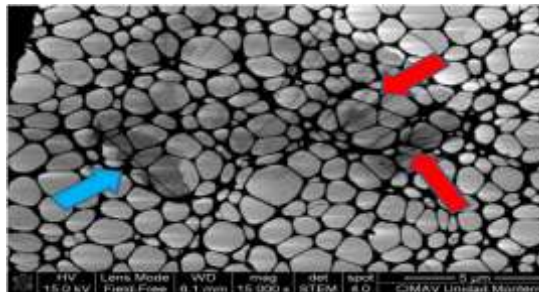
¹Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, S. de

²Advanced Mining Technology Center (AMTC), Universidad de Chile, Av. Tupper 2007, 83704

³CONACYT-Instituto Tecnológico de Sonora, 5 de Febrero 818 Sur, Cd. Obregón, Sonora C.P.

⁴The University of Sydney, School of Chemical and Biomolecular Engineering, NSW 2006, Au

(R.Q.), Universidad de Chile, Av. Tupper 2007, @amtc.uchile.cl (B.E.R.); rodrigo.quezada.m@ing.uchile.cl (R.Q.);



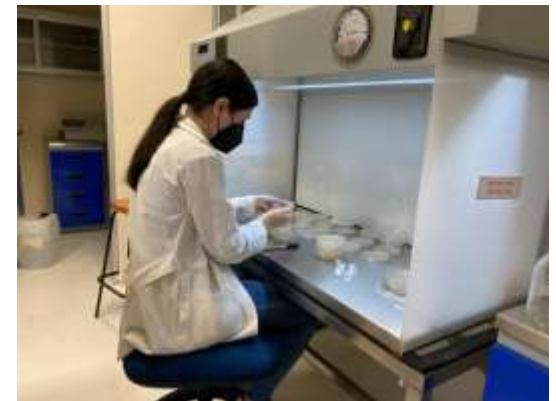
AUTHORIZED PROJECTS

PROFAPI

Anti-biofouling performance of a novel FeNPS-decorated graphene oxide coating on reverse osmosis desalination membranes.

**Period:
2020**

**Amount:
\$ 1,473 USD**



Delivered Products

- Article published
- Participation in congress



Article

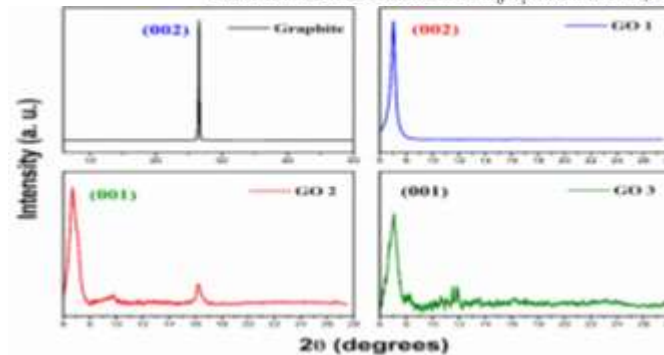
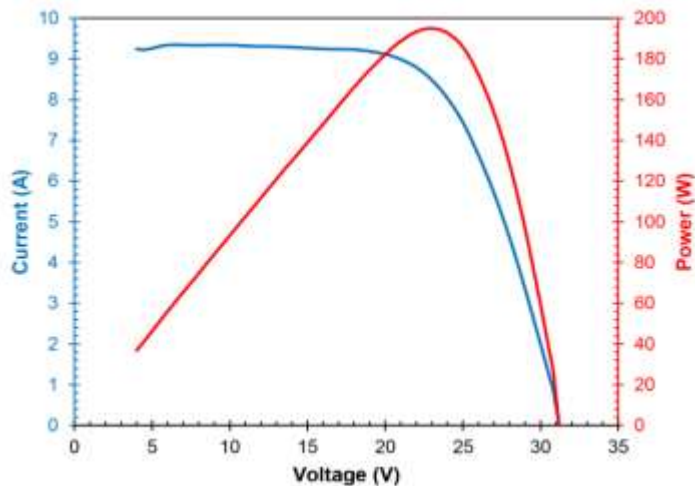
Improving Thermal Distribution in Water-Cooled PV Modules and Its Effect on RO Permeate Recovery

Mario E. Suzuki Valenzuela¹, Fernando Sánchez Soto², María Magdalena Armendáriz-Ontiveros², Ian M. Sosa-Tinoco^{1,3} and Gustavo A. Fimbres Weihs^{3,*}

- ¹ Departamento de Ingeniería Eléctrica y Electrónica, Instituto Tecnológico de Sonora, 5 de Febrero 818 Sur, Cd. Obregón, Sonora C.P. 85000, Mexico; mario.suzuki99094@potos.itson.edu.mx (M.E.S.V.); ian.sosaitson.edu.mx (I.M.S.-T.)
- ² Departamento de Ciencias del Agua y Medio Ambiente, Instituto Tecnológico de Sonora, 5 de Febrero 818 Sur, Cd. Obregón, Sonora C.P. 85000, Mexico; fernsanchezq@gmail.com (F.S.S.); maria.armendariz@itson.edu.mx (M.M.A.-O.)
- ³ School of Chemical and Biomolecular Engineering, The University of Sydney, Sydney, NSW 2006, Australia
- * Correspondence: gustavo.fimbresweihs@sydney.edu.au; Tel.: +61-2-9351-5284

Abstract: Among the most notable emerging hybrid technologies for water treatment are those that combine reverse osmosis (RO) membrane systems with alternative energy sources such as solar photovoltaic (PV). Solar PV modules can enable systems disconnected from the electricity grid, and in some locations can also be used for water heating as photovoltaic-thermal (PVT) units, a process in

efficiency. When
the incoming



AUTHORIZED PROJECTS

PROFAPI

Anti-biofouling performance of a novel FeNPs decorated graphene oxide coating on reverse osmosis membranes.

**Period:
2021**

**Amount:
\$ 1,423 USD**



Delivered Products

- Article published
- Participation in congress



Electrolysis
<https://doi.org/10.1007/s12678-021-00689-0>

ORIGINAL RESEARCH

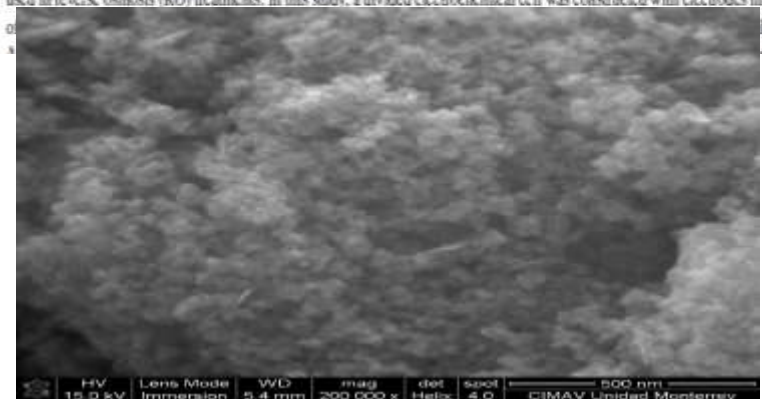
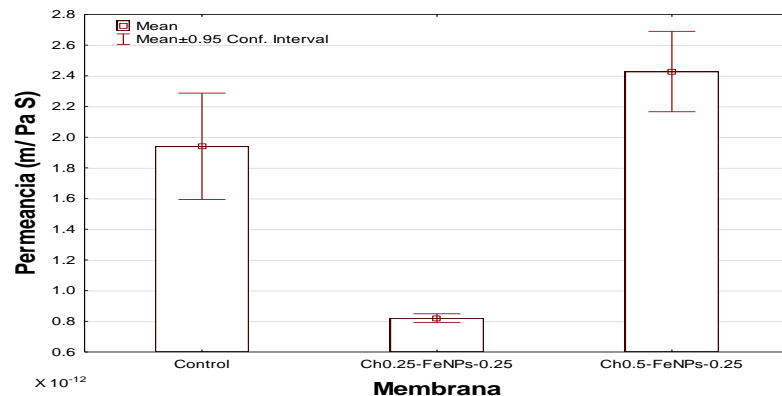
Technical–Economic Analysis of Hydrogen Peroxide Activation by a Sacrificial Anode: Comparison of Two Exchange Membranes

Jhonatan J. Hermosillo-Nevárez¹ · Yaneth A. Bustos-Torres² · Jesús G. Rangel-Peraza¹ · Maria M. Armendáriz-Ontiveros³ · Leonel E. Amabilis-Sosa² · Susana Silva-Martinez⁴ · Blenda Ramirez-Pereda³

Accepted: 14 September 2021
 © The Author(s), under exclusive licence to Springer Science+Business Media, LLC part of Springer Nature 2021

Abstract

Divided electrochemical reactors allow the design of strategies to take advantage of the two reactions of the redox pair involved for wastewater treatment. Nafion membranes are the most used separators in these cells. These membranes have demonstrated high efficiency, but their high costs make the process more expensive. The present work focuses on the evaluation of the technical and economic feasibility of replacing the Nafion 117® membrane with a commercial polymeric membrane used in reverse osmosis (RO) treatments. In this study, a divided electrochemical cell was constructed with electrodes made



Research Laboratory:

Pollutant adsorption and desorption processes



Dra. Yedidia Villegas Peralta

Yedidia.villegas@itson.edu.mx

+52 (644) 4109000 Ext 2116

<https://www.itson.mx/oferta/iq/Paginas/yedidia-villegas.aspx>

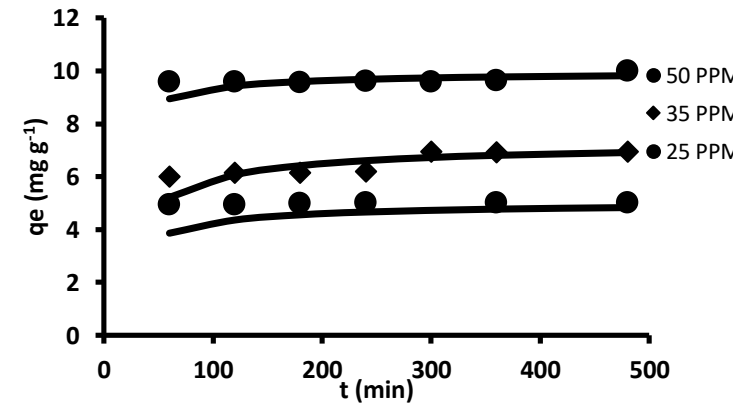
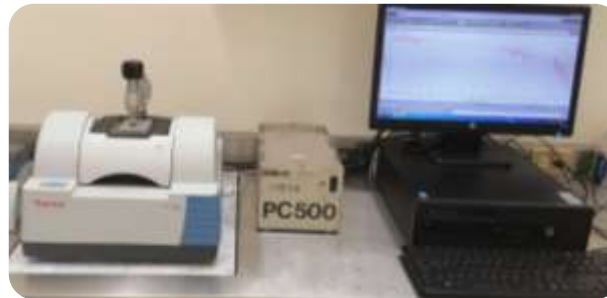
AUTHORIZED PROJECTS

PROFAPI

“Determination of optimal conditions for aniline adsorption on chitosan nanoparticles.”

Period:
2021-2022

Amount:
\$ 1,423 USD



Delivered Products

- Article in publication.
- Presentation at congresses, students advised for degree programs.
- Contributed to the research and development of parameters for adsorption of Allura red and aniline on chitosan nanoparticles.

Research Article

Behavior of the adsorption of Allura red dye by chitosan beads and nanoparticles

[†]Departamento de Ciencias del Agua y Medio Ambiente. Instituto Tecnológico de Sonora. 5 de febrero 818 Sur, 85000. Ciudad Obregón, Sonora, México.

[‡]Departamento Biotecnología y Ciencias Alimentarias. Instituto Tecnológico de Sonora. 5 de febrero 818 Sur, 85000. Ciudad Obregón, Sonora, México.

*To whom correspondence should be addressed. Phone: +52-644-4100900

Fax: +52-644-4109001, E-mail: Yedida.villegas@gmail.com

Abstract

In this study, the adsorption capacity of Allura red (AR) dye by chitosan cross-linked triphosphate beads (BCS) and nanoparticles (CSNPS) was compared. The evaluation of adsorption parameters was carried out in a batch processing system and under acidic conditions, using kinetics and adsorption isotherms models. Pseudo-





INSTITUTO TECNOLÓGICO DE SONORA
Educar para Trascender

Thank you!