Search for a Spanish partner for a
Bilateral R&D Project Egypt-Spain to be submitted to the 6th ESIP CALL

Organization:	
Date of Request:	01/03/2022
Company name:	**Egyptian Petroleum Research Institute (EPRI)**
Contact person and title/ designation:	Prof.Elsayed Gamal Zaki Associate professor of applied physical chemistry **Prof. Hassan Hefni** Associate professor of applied physical chemistry
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SECTION 1: EPRI Profile *(Please give brief / to the point explanations. For more explanation on any point below, you may add a short paragraph as an annexure, with this document.)*	
Business Sector	EPRI provides analytical service, technical consultation, training programs, and technical inspection solutions. Its services include assessments, investigations, field activities, remediation, evaluation, petrology, scanning electron microscopy, gas chromatography, inspection, and training, as well as routine and special core, liquid chromatography and water, routine, and black oil analysis. The institution also offers material and mechanical services. It provides its services for exploration, production, analysis and evaluation, refining, petroleum applications, petrochemicals, and processes design and development departments of the oil sector.
Company mission or core functions	Develop studies & applications within the Petroleum sector, and to find solutions, to both long and short runs technical problems. Providing practical, pioneering solutions to take up the challenges facing society in terms of energy and the industry, promoting the transition towards sustainable mobility and the emergence of a more diversified energy mix, we accomplish this mission through: • Our people: an extraordinary team of scientists. engineers, and support staff who work together across disciplines and, with our state-of-the-art facilities and capabilities, are the foundation of our organization. • Our partnerships: a rich history of trusted, dynamic working relationships with research entities throughout the world, and the clients we serve in industry and energy sector.
Date of establishment	EPRI was established in 1974 under the umbrella of the Ministry of Scientific Research.
Ownership	EPRI is a public institute (governmental organization), under the umbrella of the

	Ministry of Scientific Research and Technology.
Total number of employees	1142
Employees in R&D	250
Key products sold or services provided	EPRI has 14 service units (www.epri.sci.eg/index.php/service-center) 1. Cathodic protection unit: Preserving the economic wealth of petroleum equipment, pipelines and reservoirs from erosion by exposing them to the surrounding environment. 2. Enhanced Oil Recovery by non-traditional ways: Establishment of a Semi-industrial compound for Enhanced Oil Recovery by non-traditional ways. 3. Quality control unit for coal analysis 4. Earth Sounding Unit 5. Core Analysis Lab 6. Fuel Research Unit (FRU) 7. Nanotechnology Center 8. Surfaces Protection center 9. Technical Support & technology center 10. Asphalt & polymers services center 11. Chemical Services and Development Center 12. Central Analytical labs 13. PVT Services Center 14. Tanks Services Center
Company core technical competences	Supplying the petroleum and national industries with scientific studies, cutting edge research, consulting, analytical and technical services, and leadership in energy discoveries in various activities particularly in the oil and natural gas sectors and at the national and environmental levels. The fast development of EPRI researches is related to Egypt rapid economic and technical development. One of the most important objectives our Institute, is to assist in solving the problems related to the petroleum industries. This can be achieved through expanding cutting edge research: to increase the rate of oil recovery from oil fields, produce and develop field-chemicals - to facilitate crude oil production and transportation, gas sweetening or “H2S scavenging” and maximize the utilization of Egyptian natural gas, in the field of petrochemicals industries, and, finally in the oil refining sectors. The institute researches aim at developing alternatives to petroleum products, using nanotechnology, especially in the production of biodiesel and mixing gasoline with alcohol to overcome lack in energy, serving the National industries.
Key R&D programs and activities	R & D Laboratories 1. MWCNT & SWCNT lab. carbon nanotubes (CNTs) are nowadays one of the most extensively studied materials, because of their unique and advanced chemical, physical, magnetic and mechanical properties. 2. Planetary ball mill lab: offers a high degree of operating convenience, safety and versatility through using the high energy input. 3. Electrospinning lab: synthesizes fibers of high specific surface area, small diameters (20-1000 nm) and large porosity that can be used in different applications, such as filtration, catalysis, sensors, Bio-pharmaceutical, and energy applications.

Examples of accomplishments	Protocols & Cooperation Internal Agreements • The Egyptian Petrochemicals Holding Company (Echem) • The Universities; Al-Mansoura, Ain Shams, Suez Canal & Cairo University • Science & Technology Center of Excellence (Ministry of Military Production) • The General Authority of Petroleum in The Following Studies & Projects: - Innovative& Complementary Ways of Enhanced Oil Recovery with Production Companies - Bitumen Modification with Refinery Companies - Alkanolamines Production in Coop-eration with Petrochemicals Companies. • The Egyptian Petrochemicals Holding Company (Echem) for Technical Cooperation • The Engineering for the Petroleum and Process Industries (ENPPI) • IMEC Company for Oil and Gas Services. • Egyptian Universities; Al Mansoura Universit,Fayoum University, Menofeya Utilities Data Center (MUDC), • Menofeya Governate,City of Scientific Research and Technological Applications, Alex.. • Suez Canal Authority , Ministry of Supply &Foreign and Akpa Company in the field of collecting used cooking oil. International Agreements • Al-Thurya Technical Training Institute in Kuwait • IFP ENERGIES NOUVELLES in France • College of Petroleum Engineering and Technology, Sudan University of Science & Technology, SUST-CPENG, Khartoum, Sudan • The African Village, Sudan • New Mexico University in USA • The Central Oil Labs – The Sudanese Establishment for Petroleum (Sudan) • Clausthal University of Technology, Germany. • Asawer Company for Oil and Gas, Ministry of Petroleum, Sudan. • University of Aberdeen, Tesla Lab. • Biofuel National Project, Ministry of Sciences and Communications, Khartoum, The Sudan. • Korea Research Institute of Chemical Technology (KRICT), The Republic of Korea. • Indian Institute of Science (IISc), Bangalore, India. • Centre of Emerging Technologies, Jain Global Campus, Jain University Jakkasandra ,India • A O.U. between SINOPEC Corp. Research Institute of Petroleum Processing. • A M.O.U. between Kuwait Institute for Scientific Research. EPRI Projects EPRI projects come as a fruitful result of researches for on the scientific ground. 1-Oil Quality Control Project to link research, development, and production, which provides the hard currency necessary for importing these chemicals from abroad and preserves the intellectual property of scientists and researchers. 2-Nanocomposite Polymers Project; a project of 10 million Egyptian pounds that seeks to create a multidisciplinary infrastructure to allow the integration of research and applications, in advanced engineering materials.

	3- Non-Conventional Oil Recovery Project to retrieve an amount of the total stored heavy oil from the Egyptian fields or the amounts left after primary and secondary oil recovery. EPRI also has an improved production unit and improved lifting of the oil yield coefficient. It is completed with an investment of 20 million Egyptian pounds to study the extraction of heavy oil, estimated at 3 billion barrels in Egypt alone. 4-Heat Exchangers Cleaning Project, which cleans the water and thermal exchangers using innovative chemical and mechanical methods to solve the problems of all types of salt deposits. 5-The Corrosion Control Project also provides corrosion control programs for various oil companies, monitors corrosion rates using modern technology and advanced equipment to measure corrosion in oil installations and predicts their life span. 6-Cathodic Protection Project aims at linking scientific and applied research in the field of industry, especially in the petroleum sector, due to the problems encountered by the cathodic protection systems such as lines, installations or tanks, and platforms, which may cause disaster and waste of huge sums of money estimated in billions. Innovative projects 7- Paints Development and Production Project, which aims to develop and produce different types of paints, for the establishments according to international standards and specifications using local raw materials. 8- Controlling the Quality of Petroleum Establishments to obtain the highest possible quality of the petroleum facilities required by international standards and specifications –using the latest technologies reached by scientific and applied research. 9- (NDT)Project; This project is designed to examine the safety of oil tankers and their distillates from the outside without stopping the service to identify the weaknesses and strength in the fuel transport tanks to carry out preventive maintenance before the occurrence of transport accidents which cause great losses in money and lives.
Company strategic orientation	EPRI Strategic Plan: 1. Commercializing traditional scientific researches; to twin scientific research with industry. 2. Purifying the scientific climate: a) Providing infrastructure for EPRI labs. b) Supplying the workforce with needed equipment for production. c) Insuring youth minds against intellectual suppression seeking for their creativity. 3. Twinning EPRI with equivalent international institutes i.e. (cooperation with IFP) 4. Modern research trends: a) Establishment of applied geophysics research unit. b) Synthesis of diesel from plastic wastes. c) Production & storage of hydrogen. d) Nano-technology applications in petroleum sector e) Production of Biofuels from algae. f) Production of highly porous materials for catalysis.

SECTION 2: Partner of Interest *(Please provide a brief summary of the prospective partner company or organization. This summary may address some or all of the points below)*	
Profile of ideal technology partner	- Preparation and characterization of nanofiltration membrane from chitosan complexed with gellan gum and coated on hydrolized PAN for water treatment
Core technological competencies and expertise	Polymer synthesis, and characterization, polymer chemistry, water treatment, Chitsan, chitin, synthesis and characterization of nanofiltration membrane
Other essential qualifications (e.g.: ownership, track records etc.)	Establishment the Reverse Osmosis lab scale unit in polymers lab (EPRI), submitted a patent entitle (Preparation of polyacrylonitrile with different molecular weights and high conversion yield)
If you have a list of companies with whom you are in contact or interested in contacting, please provide contact details	I have no
If you are interested in collaboration: please specify details and other important information you want to share with a potential company	- Fabrication of polyacrylonitrile (PAN) ultrafiltration (UF) membranes as an Integrally Skinned Asymmetric (ISA) by phase inversion method. - Hydrolysis of prepared membranes surfaces by NaOH. - Fabrication the composite nanofiltration membranes by coating of different concentrations of chitosan on PAN and hydrolyzed PAN (HPAN) UF. - Crosslinking the chitosan top layer membranes by different concentration of tannic acid. - Evaluation the selectivity performance of prepared membranes for using 2g/L of different mono and divalent salts solutions. - Measurement the antimicrobial activities for all prepared membranes. - Evaluation the molecular weight cutoff of prepared membranes using 1 g/L of different molecular weight of polyethylene glycol (200, 400, and 600). - Measurement the antifouling and chlorine resistance properties of prepared membranes. - Characterization of prepared membrane properties using FTIR, AFM, thermal analysis, XRD, SEM, Zetasizer, BET analyzer, EDX, and contact angle. - Implementation of the optimized prepared membranes for treatment of industrial and salty oily wastewater
Interested areas of collaboration	- Water treatment by advanced membranes
Specific R&D contribution you are seeking/offering	All companies and research centers who are interested to Improvement the advanced membrane for treatment and desalination of water

Signature
Name: Prof.Elsayed Gamal Zaki
Prof. Hassan Hefni

Preparation and characterization of nanofiltration membrane from chitosan complexed with gellan gum and coated on hydrolized PAN for water treatment

Abstract

Preparation of nanofiltration (NF) membranes via method of coating and crosslinking thin film composite (TFC) membranes, using; chitosan as the active layer material, hydrolyzed polyacrylonitrile (HPAN) ultrafiltration (UF) membranes as the support membranes, and gellan gum as the complexing agent. Study the effects of; chitosan concentrations and concentration of complexing agent (gellan gum) on performance and properties of membranes such as morphology, porosity, hydrophlicity, thermal stability, and antimicrobial activity. Evaluation the molecular weight cut-off of prepared membranes using 1 g/L of polyethylene glycol (200, 400, 600), as well as the assessment the selectivity performance of prepared membranes using 2g/L from different di-and mono-valent salts solutions. In addition, measurement the fouling and chlorine resistance of prepared membrane.

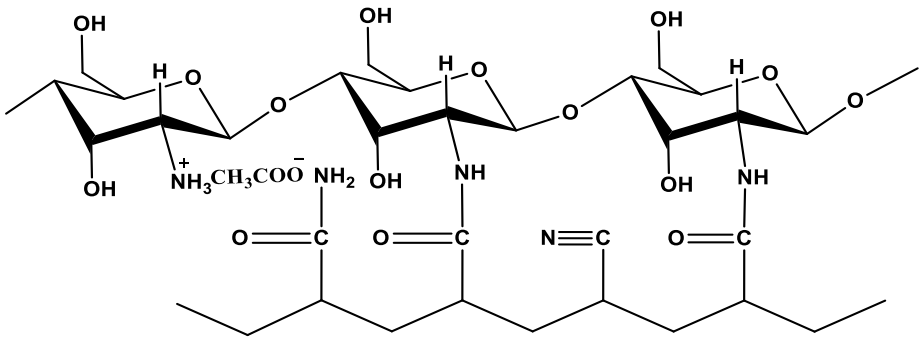
Background

Polyacrylonitrile (PAN) are used in a wide variety of applications ranging from packaging material, textiles, carbon fiber precursors and purification membranes. polyacrylonitrile (PAN) is a good fabricating of porous substrate membrane because, its vigorous acid resistance towards several inorganic acids including nitric acid, sulfuric acid, and hydrochloric acid, additionally, its low price compared to other polymers such as polysulfone [1] and polyimide.

Chitosan is favorable as it exhibits film-forming property, biodegradable, and renewable. The coming together of the Chitosan and membranes is a moment bristling with possibilities and challenges. The tailor-made modification techniques are to overcome the limitations in terms of fouling resistance, pH resistance, solvent resistance, selectivity. Chitosan, the polyaminosaccharide, is a copolymer of N-acetyl D glucosamine and D glucosamine. The critical functionality ($–NH_2$ at the C-2 position of D-glucosamine unit) [2,3] has the unique advantage to modify. The modification approaches of chitosan are crosslinking, blending, complexing, composite, grafting make it more attractive in terms of membranes [4]. The different strategies to improve the membrane performances in terms of countering limitations viz. fouling, pH and, chemical stability, separation are in this ensemble. The coming together of chitosan and membranes is a moment bristling with possibilities.

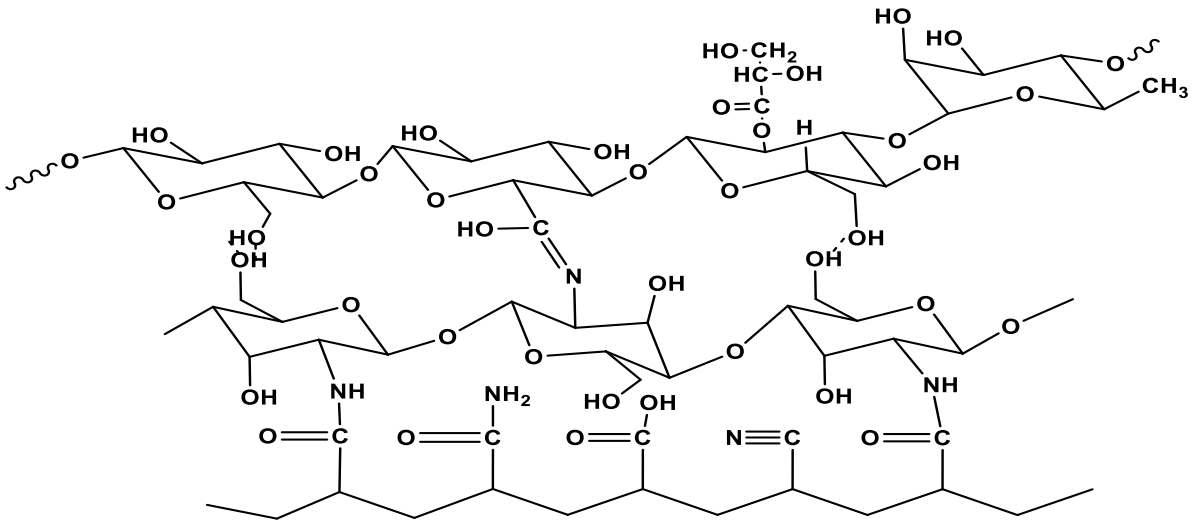
The expected mechanism

- The hydrolysis of PAN aims to increase the hydrophilicity properties, improve the pore structure, and compact the chitosan top layer with membrane surfaces as shown in schemes1.



Scheme 1 The interaction between HPAN and chitosan

- Gellan gum is a natural anionic polysaccharide produced by the aerobic fermentation of sugar with a Gram-negative bacterium (Pseudomonas elodea) [5]. The backbone of gellan gum comprises α-l-rhamnose, β-d-glucose, and β-d-glucuronate in the molar ratio of 1:2:1, as shown in Fig. 1. The main aims to complexation of chitosan with gellan gum is improve the biocompatibility, biodegradability, mechanical properties, antimicrobial activity, hydrophilicity and pores structure of prepared nanofiltration membrane.



Scheme 2 The interaction between HPAN and chitosan complexed with gellan gum

References

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[2]Tao Mu, Yuehua Cong, Wei Wang, Baoyan Zhang, Preparation and characterization of novel chitosan composite nanofiltration membrane containing mesogenic units, Desalination 298 (2012) 67–74
[3]Chien, P.J., Sheu, F., Lin, H.R. (2007). Coating citrus (Murcott tangor) fruit with low molecular weight chitosan increases postharvest quality and shelf life. Food Chemistry, 100, 1160–1164
[4]Park, S.Y., Marsh, K.S., Rhim, J.W. (2002). Characteristics of Different Molecular Weight Chitosan Films Affected by the Type of Organic Solvents. Journal of Food Science, 67(1), 194–197.
[5] Bera, Hriday, Srilatha Mothe, Sabyasachi Maiti, and Sridhar Vanga. "Carboxymethyl fenugreek galactomannan-gellan gum-calcium silicate composite beads for glimepiride delivery." International journal of biological macromolecules 107 (2018): 604-614.

EGYPTIAN RESEARCHER PROFILE:

Dr. Hassan Hefni is an associated professor in Polymer lab, petrochemicals department, Egyptian Petroleum Research Institute (EPRI).

He has a wide experience about advanced membrane technology especially nanofiltration (NF) membrane from chitosan composite on polyacrylonitrile (PAN).

He had got a post-doctoral fellowship in Korean Research Institute of Chemical Technology (2013/2014) about the preparation of high performance NF membrane from chitosan and its crosslinking coated on PAN and modified PAN. He also had got another fellowship in India about preparation of NF membrane from chitosan crosslinked tannic acid coated on PAN at 2019-2020

He has two papers about NF membranes.

1- Hassan H. H. Hefni, Seoung-Joong Kim, Saira Sano,· Kew-Ho -Lee High performance of composite nanofi ltration membrane prepared from chitosan crosslinked with epichlorohydrin and glutaraldehyde coated on PAN and modified PAN, Membrane Society of Korea Spring Meeting, Kyung Hee University. Global Campus, Yongin-si, Gyeonggi Province, South Korea, May 15-16, 2014
2- Hefni, Hassan HH, Mayank Saxena, Romil Mehta, Gopal Bhojani, and A. Bhattacharya. "Chitosan/ polyacrylonitrile composite nanofiltration membranes: towards separation of salts, riboflavin and antibacterial study." Polymer Bulletin (2021): 1-22.