FY 2016 DWPR Selected Projects

Laboratory Studies

Arizona

Modeling and Experiments of Advanced Hybrid Pervaporation Membrane Processes to Minimize Concentrate Volume for Inland Brackish Water Desalination

Arizona State University, Federal Funding: $150,000, Non-Federal Funding: $0

Surface and groundwater have increasing concentrations of salts from agriculture and water softening activities, particularly, in the arid southwestern part of the United Sates. An ongoing, critical challenge to inland desalination is management of the concentrated waste streams produced through desalination treatment. This project will use a combination of systems-level simulations and experiments to evaluate the integration of pervaporation and direct-solar enhanced pervaporation into a hybrid system in order to enhance water recovery and minimize the concentrate waste stream. Recent advances in membrane technology suggest that this integrated platform could provide the nest breakthrough in concentrate management.

Colorado

Overcoming the Technical Barriers to Membrane Distillation

Colorado School of Mines, Federal Funding: $143,869, Non-Federal Funding: $63,000

This project will focus on direct contact membrane distillation (MD), which is an emerging approach to desalinating high-concentration brines, brackish waters, produced waters, and seawater. The intent is to address three key technological challenges related to heat and mass transport occurring in the membrane, feed flow, and permeate flow: conductive heat loss, temperature and concentration polarization, and the impact on current technology. MD has emerged as a promising means of concentrating waste streams developed by reverse osmosis technology and this project is going to focus on overcoming technical barriers to further implementation of MD technology.

Characterization of the Microbiome of a State of the Art Water Reuse System to Enhance Treatment Performance

Colorado School of Mines, Federal Funding: $150,000, Non-Federal Funding: $235,000

Due to recent advances in DNA sequencing technologies, identifying full microbial communities in water samples has become feasible. This project proposes to apply next generation sequencing combined with an advanced GENIUS sequencing algorithm from CosmosID to identify microbial community signatures and their transformations through an advanced water treatment system that produces recycled water for IPR. This study seeks to address many uncertainties and lack of understanding of the unique microbial ecology during advanced treatment will enable development of better indicators and surrogates to monitor process performance in wastewater treatment and at reuse facilities.

Updated & Extended Survey of US Municipal Desalination Plants

Mickely & Associates, LLC, Federal Funding: $ 99,941, Non-Federal Funding: $123,379

Since 1990 Mickely & Associates LLC has conducted periodic detailed surveys of the US municipal desalination plants. This proposal is to update and extend the survey, which at present contains data up to 2010 on over 300 municipal facilities. A new aspect of the survey will be to provide cost and energy usage data for the new plants. This work has previously been funded by DWPR in 2001 and 2004 (DWPR Report #69), this project will update and expand on that report.

Emerging Technologies for High Recovery Processing

Mickley & Associates, LLC, Federal Funding: $66,496, Non-Federal Funding: $71,904

An evaluation of brine management approaches and specific technologies from a broad perspective that includes company-related information in addition to technical description, performance, and cost information. This project will complement the work being conducted via the Science & Technology Program on developing a concentrate management toolbox. The work being conducted under this DWPR project would serve as additional information that will be implemented into the concentrate management toolbox and provide a final comprehensive product between Reclamation experts, municipalities, and the private sector.

Iowa

An Integrated Photoelectrochemical Zero Liquid Discharge System for Inland Brackish Water Desalination

University of Iowa, Federal Funding: $150,000, Non-Federal Funding: $7,500

There is a substantial amount of value-added chemical products in concentrated brines that is currently wasted or lost in the treatment process. This project is focusing on capturing a portion of these chemical products would provide a new source of producing fuels and industrial chemicals that would also minimize concentrate volume. The proposed work entails the development of a photoelectrochemical brine management technology and an electrically conductive inorganic membrane to prevent scaling and improve efficiency. This proposal is focusing on innovative technology to reduce cost, improve energy efficiency, and optimize ion-exchange membranes.

Massachusetts

System Level Cost and Performance Optimization for Photovoltaic Powered Electrodialysis Reversal Desalination

Massachusetts Institute of Technology, Federal Funding: $149,953, Non-Federal Funding: $0

The goal of this proposal is to investigate and subsequently model cost-optimal system architectures for solar powered electrodialysis reversal (EDR) water desalination systems. This project will build on Prof. Winter's PV-EDR research, which won the 2015 USAID Desal Prize and focus on developing new architectures for PV-EDR systems. The overarching goal is to lower costs and achieve "pipe parity" thresholds ($0.50 spent in total cost, 1kWhr of energy consumed, and less than 1lb of carbon dioxide generated for producing 1 cubic meter of water) for PV-EDR water desalination systems.

New York

Improved Energy Efficiency of Electrodialysis Desalination and Separation: Development of Percolating Network Nanocomposite Ion-Exchange Membranes for High Conductivity

Columbia University, Federal Funding: $149,982, Non-Federal Funding: $0

Electrodialysis (ED) is a membrane-based technology that utilizes an electric current to separate charged ions from a saline stream to produce freshwater. Ion-exchange membranes are the type of membranes that this project will focus on for ED treatment. To advance ion-exchange membranes beyond their current high resistance drawback without sacrificing ion selectivity, innovative membranes that break away from the conductivity permselectivity tradeoff are needed, nanocomposite ion-exchange membranes will be researched as a potential solution. The proposal aims to develop high conductivity and high permselectivity nanocomposite ion-exchange membranes for desalination and nutrient recovery from wastewater.

Texas

Microfiltration System for Indirect Potable Reuse Water Treatment

University of Houston, Federal Funding: $148,126, Non-Federal Funding: $51,033

The goal of this project is to coat commercially available filters and give them the capability of removing heavy metals, nitrates, and inactivating harmful mirco-organisms in water. The coating aims to significantly enhance the performance of existing membrane filtration systems and products. Preliminary results with coated cellulose acetate membranes showed the ability to inactivate microorganisms and remove lead from water. In this project, an in-depth assessment of this filtration technology for indirect potable reuse treatment will be conducted.

Pilot Projects

California

Hybrid NF/RO Sodium Chloride Removal Process

Brown and Caldwell, Federal Funding: $227,480 ($172,881 year 1; $54,599 year 2), Non-Federal Funding: $227,480

The applicants propose a process train that could remove the added salts, which are predominantly sodium chloride, while retaining the ‘good’ ions such as calcium, magnesium and sulfate, would improve the quality of the reclaimed water. This research will demonstrate that this system can work successfully long-term at large pilot-scale and provide four clear benefits: 1) improvement of water quality impaired by widespread water softener usage, 2) improved concentrate management by reducing the mass of salts disposed in the concentrate, 3) lower cost of chemical consumption, 4) significantly lower concentrate treatment and disposal costs.

Brackish Groundwater Desalter Brine Recovery Demonstration

Eastern Municipal Water District, Federal Funding: $400,000 ($200,000 per year). Non-Federal Funding: $1,876,688

This project is the continuation from the previously DWPR funded work of a pilot unit sized at 8 gallons per minute (GPM) and increase the size to a full scale system at 100 gpm AquaSel system. Eastern Municipal Water District carried out a pilot scale evaluation of the AquaSel Technology developed by GE Water & Process Technologies. The test is set to be done in two phases, phase one will operate the 100 gpm system under similar conditions as the previous 8 gpm test, and the second phase would involve operating the 100 gpm system under optimized conditions for a period of up to 6 months.

Building Scale Treatment for Direct Potable Water Reuse & Intelligent Control for Real Time Performance Monitoring

City and County of San Francisco, Federal Funding: $200,000 (one year pilot), Non-Federal Funding: $282,530

Key research needs, the ability to document real time precise and accurate monitoring technologies and the use of advanced analytics to understand the impact of the "unknown unknowns" in wastewater, are the primary objectives of this proposed research project. The proposed project would use the existing constructed wetlands with tertiary treatment that harvests wastewater from the building and treat it to non-potable water reuse standards, and then purify the water to potable standards. The goals of the work are: demonstrate innovative building-scale treatment of wastewater for direct potable reuse, procure purification processes that produce potable water in accordance with health criteria established in national documents, use leading edge online analytical techniques to demonstrate the performance of each treatment process, use advanced analytical monitoring to understand the potential impact of unknown trace level pollutants, clearly document the costs of a potential future DPR system for utilities in California, and educate regulators and community members about the safety of properly engineered potable water reuse treatment systems.