Proposed Partners

Develop an action team of industry, federal, and research experts to help review proposed plans and options developed

Known Prior Research on this Topic

Number of other federal programs that can be used as templates to help accelerate cost and performance assessments for technology developers

ENVIRONMENTAL IMPACTS

Environmental Impacts Project 1

Title

Development of cost-effective enhanced evaporation techniques

Needs the Project Meets

Small/stand-alone communities all around; Increases options of disposal concentrate from reverse osmosis system in inland areas

Benefits of Project and Expected Outcomes

Will increase water supply options for small communities by making membranes systems feasible in inland areas. It will also benefit large volume producers as well (after concentrate have been further concentrated using other techniques.

Research Objectives

Increase evaporation rates cost-effectively in order to reduce land areas required for final concentrate disposal.

Research Approach (numbered by task)

1. Set up WAIV system at BGNDRF
2. Develop/test other system that will increase surface area (continuous loop fabric system, nebulizers, etc.)
3. Investigate using solar energy to drive motors/fans as part of system

Estimated Project Budget and Schedule

$500,000; two years

Proposed Partners

Water utilities (multistage salinity coalition)

Known Prior Research on This Topic

(Israeli research publications)

Environmental Impacts Project 2

Title

Conversion of concentrate stream to food, feed, and biofuel

Needs the Project Meets

Concentrate management

Benefits of Project and Expected Outcomes

This proposal offers a target-rich approach in a two-step process. The first step involves water purification/desalinization, and the second step involves consuming the reject highly saline water for further use. Consequently, the process leaves behind zero reject water, avoiding the costly disposal process that is currently in practice. In short, this proposal offers a system to convert the reject saline water into a highly desirable algae product from which many other benefits can be achieved. These benefits include production of algae biomass that can be converted to biofuels, methane and other by-products such as omega 3, food, feed, fertilizers, vitamins, and other chemicals.

Research Objectives

The goal of this proposed work is to demonstrate a technology which delivers potable water with a minimum reject brine stream by integrating multiple technologies in a unique combination, where waste products from concentrate stream become the raw material for energy production (biofuel and methane).

Research Approach (numbered by task)

1. Evaluation of electrodialysis reversal (EDR) process performance at highest possible removal in order to remove total dissolved solids (TDS) as much as possible. Currently, conventional separation percentage of total dissolved salts in EDR technology is about 40-60% per stage. Depending on the saline/brackish water quality, in most cases EDR systems are designed to desalinate water in multiple stages, which results in higher capital expenditure (CapEx) costs. In general, relatively high CapEx cost of desalination technologies has limited the practical employment of saline and brackish water desalination. Any attempt to reduce CapEx will result in greater utilization of desalination technologies. The objective of this set of experiments is to understand EDR stack limitations under operating conditions that contribute to high current density and high salinity removal for a long period of time. This way, EDR process can be operated at the highest possible removal in order to remove as much TDS as possible.

2. Evaluation of EDR process at highest possible recovery rate in order to minimize the concentrate stream flow. The objective of this task is to maximize the recovery rate of the EDR process to reduce the volume of concentrate steam. Based on the results of Task 1, which investigates the high removal conditions, baseline EDR tests will be performed to find out the highest LSI for calcium carbonate and highest calcium sulfate saturation level for typical brackish groundwater found in the southwest US. Various influent waters with TDS of 500 to 10,000 mg/L will be tested to investigate maximum recovery rate while EDR is operating under highest possible removal rate (Task 1). The experiment will be performed using commercial GE ion-exchange membranes. Influent water will be taken from BGNDRF's groundwater wells, the TDS of which are between 1000-5000 mg/L. The product and blow down flow rate will be set at 7.5 and 2.2 gmp. Voltage and current in the EDR stack have been calculated based on the preliminary tests.

3. Algae strain identification and biofuel production. The objective of this task is to use concentrate obtained from the previous tasks and grow algae for biofuel and other by-products such as fertilizer and animal feed. Different species of algae known to be well grown in saline conditions will be obtained. These species of algae will be cultured on Bold's Basal Medium and f/2 Medium under a fume hood with sterilized conditions. A factorial experiment based on completely randomized design (CRD) with three replications will be designed. Treatments are appropriate media, concentrate, and distilled water as control. 25 ml of

these species grown in media will be added to 250 ml of concentrate, media and distilled water. They will be grown under 16-hour light and 8-hour dark condition. Biomass from algae will be collected after two weeks of growth by centrifuging and removing water. Biomass will be dried and weighed. Analysis of variance (ANOVA) and means will be compared using multiple comparison method. Subsequently, the best species of algae grown with saline concentrate will be selected.

4. Pilot plan of algae biomass production in BGNDRF. The selected algae species will be evaluated in small pond using concentrate in BGNDRF. Depending on outcome of result obtained from lab and small ponds, a pilot plant methane production unit can be installed in next phase of research.

5. Final report.

Estimated Project Budget and Schedule

Budget for the proposed project for three years is estimated to be $450,000

Proposed Partners

[none provided]

Known Prior Research on This Topic

This idea is novel. Little work, if any, has been published in the area of concentrate management using algae. Some preliminary lab work has been done by the researchers at Institute for Energy and the Environment at New Mexico State University. The results indicated there is a possibility of using concentrate as a source of nutrient for growing algae biomass.

Environmental Impacts Project 3

Title

Development of cost-effective renewable energy (RE) powered small brackish water/wastewater treatment systems for stand-alone rural communities

Needs the Project Meets

Small/stand-alone communities all around having no access to water and/or energy.

Benefits of Project and Expected Outcomes

Replicable systems; good quality water; safe wastewater disposal; clean surroundings; health benefits; economic growth

Research Objectives

Development of technology/system that is cost effective robust/smart, easy to use/operate/maintain, and sustainable.

Research Approach (numbered by task)

1. Standardizing water pumping practices based on available renewable energy sources with small scale wind / PV / CPV / CSP, etc.

2. Feasibility of using established low tech water (filtration, coagulation, disinfection)/wastewater (septic tanks, oxidation ponds, trickling filters etc.) treatment processes/combination of processes with a wide range of source brackish water/wastewater quality

3. Coupling RE source with the water systems
4. Optimizing system performance over broad range of water quality
5. Evaluating potential of selling/hauling water to nearby communities
6. Developing operations and management manual & providing/capacity building for the operators/end users
7. Follow up to debug/improve system performance

Estimated Project Budget and Schedule

$150,000 - $200,000

Proposed Partners

Reclamation, universities, water/wastewater research organizations, small communities, Indian Tribes

Known Prior Research on This Topic

Suggested water/wastewater treatment systems and renewable energy technologies are already established/ proven.

Environmental Impacts Project 4

Title

Pilot project at schools to demonstrate renewable energy, water, wastewater systems

Needs the Project Meets

Education of rural communities on benefits and mechanics for using renewable energy/water/wastewater treatment systems. Demonstrate safety of using recycled water for playground/garden/agricultural purposes. Rural communities can get exposure to systems without individual investment first.

Benefits of Project and Expected Outcomes

Test the economic and social feasibility of treating brackish water using renewable energy.

- Promote water conservation through reuse
- School and children will educate parents on the benefits
- Demonstrates practical benefits and encourages careers in science (environment, engineering, chemistry, and biology

Research Objectives

Social to:

- Determine operations and management needs/limitations of a system in a rural community.
- Understand acceptance/demand for such systems in rural communities.
- Maximize sustainability of systems

Research Approach (numbered by task)

1. Identify a system that can serve a school of 300 students. Renewable energy+wastewater treatment and reuse. Also recovery of sludge and concentrate.
2. Identify a school with commitment to participate in the project, including qualified staff
3. Survey parents' attitudes toward this type of system
4. Develop the school's capacity to maintain the system
5. Identify uses for recycled water, sludge, and concentrate including sports fields, garden, trees for reuse; compost sludge – available for community; concentrate – building materials/playgrounds
6. Work with school to integrate into the curriculum
7. Determine parents/community interests in procuring more systems
8. Local banks to finance possibly

Estimated Project Budget and Schedule

$200,000

Proposed Partners

System producer; Reclamation, Texas office; Water Reuse Research Foundation;university rural sociology department; agriculture extension service (for growing grass and determining crops)

Known Prior Research on This Topic

Couldn't find any

Environmental Impacts Project 5 (project summary submitted but not described at plenary session)

Title

Combining concentrate with wastewater to produce algae biofuels

Cities that have brackish groundwater or produce a concentrate from brackish water treatment can use this water as a resource with municipal wastewater to produce biofuel. The nutrients and organic matter present in the wastewater and the salts present in the concentrate will produce an excellent environment for algae to grow at a very low cost.

Benefits of Project and Expected Outcomes

Replicable systems/good quality water supply, safe wastewater disposal, clean surroundings, health benefits, economic growth. The benefit of this project is to convert a waste-product into a resource to produce water and/or energy.

Research Objectives

The objective of this project is to determine the feasibility of mixing reverse osmosis concentrate and wastewater to produce algae that could be used for biofuel production.

Research Approach (numbered by task)

1. Determination of candidate types of algae (literature review)
2. Different combinations of concentrate/wastewater to improve growth
3. Comparison with different methods of algae growing

Estimated Project Budget and Schedule

$200,000 for the first year

Proposed Partners

Jalal Rastegary, PhD

Known Prior Research on This Topic

[not provided]

Environmental Impacts Project 6 (project summary submitted but not described at plenary session)

Title

Guidance document for selection and operations and management of small sustainable water/wastewater systems

Needs the Project Meets

Reducing cost of small system and keeping them functional

Benefits of Project and Expected Outcomes

Improving cost-effectiveness of small systems

Research Objectives

Produce document than contains information about conditions/circumstances when "off the shelf" systems can be used without extensive engineering/pilot testing

Research Approach (numbered by task)

1. Identify water qualities suitable for standard reverse osmosis systems
2. Identify situations where "off the shelf" systems will not be suitable (i.e., silica, arsenite)
3. List expected capital and operating cost versus system capacity

Estimated Project Budget and Schedule

$250,000; one year

Proposed Partners

Texas Water Development Board

Known Prior Research on This Topic

Texas Water Development Board RFP

NOTE: similar document/project should be executed for wastewater treatment systems

GEOTHERMAL

Geothermal Project 1

Title

A survey of existing geothermal power plants and direct use facilities to determine near-term feasibility to cascade geothermal and heat energy water for desalination

Needs the Project Meets

Provide information from current geothermal facilities to apply in categorizing geothermal fluids and in order to match potential desalination applications.

Benefits of Project and Expected Outcomes

Project will provide a better understanding of the economic and technical potential for pairing existing geothermal facilities with desalination applications, including economic recovery of minerals.

Determine pretreatment requirements and provide preliminary information on most promising desalination technologies to use.

Research Objectives

Identify opportunities for geothermal and desalination applications. Identify regulatory, marketing and business challenges to implementing geothermal-desalination projects.

Research Approach (numbered by task)

1. Identify existing facilities
2. Literature search
3. Solicit stakeholder input for survey
4. Develop and apply survey tool
5. Interpret results
6. Prepare report

Estimated Project Budget and Schedule

$150,000; 12 months