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Centrifugal Hyperfiltration

A means to economically recover resources from saltwater and wastewater streams with lower the energy cost of producing freshwater and potable water from marginalized water resources.

Introduction

Reverse Osmosis (RO) is a filtration process for the removal of ionic and organic pollutants from wastewater. Today's technology of utilization of this filtration process is by large array of high-pressure piping and pressure pumps. This process yields low volumes of filtrated output (permeate), utilizes large areas for pipe array and components and the concentration polarization and membrane fouling hinders the wide application of RO filtration process. Utilizing centrifugal forces and cross flow membranes has potential to change the standard (RO) process to one of portable and high volume water purification.

AN AREA OF CRITICAL NATIONAL NEED

Ensuring Future Water Supply: As the Nation's population and economy grow, greater demands are being placed on freshwater resources. At the same time, temporary or permanent drought conditions and water access rights affect regional freshwater availability. Water needs threaten to outstrip available freshwater, now and in the future. Emerging contaminants that must either be removed from distributed water or converted to harmless forms of waste is also pressuring water quality, both in terms of decontamination and disinfection of water supplies. Food contaminations are often traced back to water contaminations, either in the field or in processing. Municipal waste streams and irrigation runoff waste resources that are not recovered.[1]

Over 97 percent of the Earth's water -- seawater and brackish groundwater -- is too salty to use for drinking water or agriculture. Interest in desalination has grown in the U.S. as some regions face water shortages and contention over existing freshwater supplies.

Though desalination still generates less than 0.4 percent of the water used in the U.S., the nation's capacity to desalinate water grew by around 40 percent between 2000 and 2005, and plants now exist in every state. Most use a method called reverse osmosis, which pushes water through a membrane to separate out most of the salts.[2]

TRANSFORMATIONAL RESULT

The transformational result is the use of Centrifugal Hyperfiltration instead of the static array pressure (RO) method that is currently the norm for all new desalination and potable water production.

The static array pressure (RO) are very large, takes large amounts of pretreatment of the water before production and can only run at half efficiency pressure due to concentration polarization or membrane fouling.

Today the standard RO, Ultra filtration, (UF) and Nano Filtration (NF) utilizes a static pressure flow across membranes to induce filtration. This process uses pressure vessel piping, which causes a build up sedimentation against these membranes, which hinders the function of the cross, flow membranes which results in a decrease in filtrate flux. This concentration polarization and membrane fouling limits the volume of permeate production which leads to not utilizing the standard RO process as a viable alternative to disposal.[3]

This leads to larger plants and no portability to areas of need in emergency and remote access. The only solution to this process is to build larger and larger membranes to increase production of clean water.

The Centrifugal Hyperfiltration takes advantage of centrifugal forces to mimic pressures set up in a static pressure vessel by the tangential escape vector through the RO Filter. The centrifugal forces also set up vortices, which induce a spiral flow through the membrane that promotes sediment discharge enhancing the flux improving, permeate volumes and membrane performance. Centrifugation also takes place within the membrane to prevent ionic polarization of the membrane.

The advantage of Centrifugal Hyperfiltration over the standard RO process is the Full utilization of the filter membrane with out polarization limitations, which means no backwashing, less pre filtration and treatment. It also allows higher volumes of permeate per filter than the standard process which will allow for faster processing rates. Having the ability to utilize the maximum pressure rating of the filter, without the polarization, does the higher volumes. This also allows smaller and portable units that can do the work of a plant 4 times its size.

Other processes for treatment such as ion exchange utilize harsh and hazardous chemicals and distillation utilizes vast amounts of energy.

SOCIETAL CHALLANGE

The challenge is to change a standard process with limitations but has a proven means of functioning forces to a new process with out limitation but unproven functionality.

If Centrifugal Hyperfiltration can be proven this would have a paradigm shift in how freshwater is treated and desalination is done.

Although the process of Centrifugal Hyperfiltration can be accomplished with all of the cartridge (RO) membranes on the market, billions have been spent on the infrastructure of utilizing the membranes through static pressure vessels around the world.

The benefit to society with the research on Centrifugal Hyperfiltration can be a portable way of delivering fresh water to area's in need such as natural disasters, environmental emergencies impact zones, or drought areas utilizing polluted or saltwater sources in the area.

1 Federal Register / Vol. 73, No. 242 / Tuesday, December 16, 2008 / Notices

2 DESALINATION CAN BOOST U.S. WATER SUPPLIES, BUT RESEARCH NEEDED TO UNDERSTAND ENVIRONMENTAL IMPACTS, LOWER COSTS April 24, 2008 Copies of DESALINATION: A NATIONAL PERSPECTIVE are available from the National Academies Press; tel. 202-334-3313 or 1-800-624-6242 or on the Internet at HTTP://WWW.NAP.EDU.

3 U.S. Patent No. 7182866 Apparatus and method for separating impurities from a stream