J. Ind. Geophys. Union, 29(3) (2025), 132-138
https://doi.org/10.71122/JIGU.29(3)2025.0014

Membrane desalination as one of the sustainable option for water needs of coastal India

Puyam Sobhindro Singh
CSIR Central Salt & Marine Chemicals Research Institute,
Ministry of S & T, Govt. of India; G.B. Marg, Bhavnagar 364002 (Gujarat), India
Corresponding author: puyam@csmcri.res.in

ABSTRACT

India would move to water-starved country by 2030 (per capita availability ~ 1,000 m^3/year) from water surplus (~6000 m^3/year) in 1947. To make potable water available, desalination by membrane processes will play a major role. The desalination membrane research has been carried out since 1969 at CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar (Gujarat) with an aim to develop technology to meet the demand for clean water. The institute has given research priority on this membrane-based water desalination over the years, and now it has the capability on providing solutions as per the locational requirements. However, worldwide, a core environmental concern of desalination plants is the reject stream discharge from the plant. Zero-liquid-discharge process by rightful management of reject stream, is key towards achieving sustainable desalination.

Keywords: Membrane process, Desalination, Reject stream discharge, Environment, Sea water, Potable water

INTRODUCTION

India would move to water-starved country by 2030 as average annual per capita water availability in India is predicted to be at around 1000 m^3 only. Desalination can increase availability of potable water by converting seawater/ brackish water into potable water. Desalination by membrane processes can play a major role for providing potable water, as the process is more viable than the other processes. Besides, the membrane processes can reduce the pollution by removing undesired dissolved salts, a wide range of components ranging from suspended solids to pathogens, toxic metals, small organic compounds and other harmful ions. At CSIR-Central Salt and Marine Chemicals Research Institute (CSMCRI), (Bhavnagar, Gujarat), membrane research program was initiated in the year 1969 with an aim to develop technology to meet the demand for clean water through desalination. In the initial period during 1970-1985, RO membranes for brackish water desalination were developed. Cellulose Acetate (CA) membranes are the first generation commercial RO desalination membranes. CA membrane type is a semi-permeable membrane that allows the water containing low amount of dissolved salt to permeate through, but it retains water containing high amount of dissolved salt when operated under external pressure in excess of the osmotic pressure of the saline feed water. In this way, it is the 'reverse osmosis' process of forcing potable water from brackish or seawater through the membrane by applying a pressure in excess of the osmotic pressure. This is reverse to the natural process of osmosis in which solvent from dilute solution moves towards the concentrated solution across the membrane. A better membrane separation technology that allows the usage of less material, low energy consumption and permit recovery and reuse of process streams, is certainly desirable. It can be low-pressure desalination of seawater at high recovery using combinatorial approaches of advanced material preparation and integrated systems.

POTABLE WATER AVAILABILITY IN INDIA

There is acute water shortage in various regions of the world and one major aspect that a number of towns and/or cities located in such regions have in common is the lack of adequate treatment processes for producing sufficient quantities of portable drinking water. Hence, there is a significant requirement for the development of efficient and economical water treatment technologies for production of safe and portable drinking water, water for re-use for industrial, agricultural or domestic purposes or for treatment of industrial effluents to ensure safe disposal. Most water sources in India are contaminated by mixing with various industrial and sewage effluents. Although, access to drinking water has improved, significant amount of communicable diseases in India are from contaminated water. Providing safe drinking water at affordable cost is the top priority for the country as every year, millions of people suffer from water-borne disease (disease caused by microbes and pathogens). Safe water for drinking and cooking uses is an essential component of effective policy for health protection. To counter the water problems, various water treatment technologies have emerged which include physical, chemical and biological processes.

The water problem in India has been serious and it is towards water-starved country by 2030 as mentioned above as average annual per capita water availability in India is predicted as 1000 m^3 only (Figure 1). According to press release by Ministry of Jal Shakti, Government of India dated 25 MAR 2021 PIB Delhi, the average per capita per annual water availability in India is 1486 cu m which is in decrement by more than four folds from 6000 cu m of the average per capita per annual water availability in 1947 (https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1707522). The Department of Drinking Water and Sanitation, Government of India, has already taken significant steps to meet this challenge. It has made some