

Seawater Desalination by Reverse Osmosis Utilizing the Static Pressure due to the Depth of the Sea

Osamu Miyatake, Hidehiko Noda
(Dept. of Chem. Eng., Faculty of Eng., Kyushu Univ.)
Shuichi Takaki and Kotaro Tagawa
(Div. of Eng., Graduate School, Kyushu Univ.)

Summary

Employment of the reverse osmosis technique by utilizing the high static pressure of deep sea has been considered for the development of a desalination device to be used to obtain fresh water from seawater without the use of electrical power. A tube type membrane has been used as the reverse osmosis membrane in the device. The concentrated seawater flows through the tube by natural convection caused by concentration difference. The quantity of fresh water obtainable from seawater can be increased with the increase of the flow rate through the membrane tube. For this purpose, a cylindrical rod was put into the central axis of the membrane tube.

A numerical analysis was conducted to determine the flow profile and the concentration profile in laminar flow in the narrow annular passage between the membrane tube and the rod. A forward-marching, implicit method with iteration was used to solve the nonlinear partial-differential equations.

A theoretical equation is deduced from the results of the numerical calculation to predict the transmitted fresh water flow rate from the width of the annular flow passage, depth of the device from the sea level, permeability of the membrane and the properties of seawater. The transmitted fresh water flow rate increases with the decrease of the width of the annular passage and subsequently becomes maximum at the width of about 1 mm, and then decreases rapidly.

Experimental studies on the desalination of seawater was performed using this device in the Japan Sea. It has been proved that fresh water can be obtained from seawater utilizing the static pressure due to the depth of the sea. And the experimental data shows good agreement with those calculated from the theoretical equation. Utilizing the theoretical equation, it is possible to make optimum design of a desalination device.