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Energy Recovery from a Continuous Process of Low-Pressure Membrane Filtration: An Analytical Study †

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Abstract: Many industries are dependent upon membrane-based desalination for the fulfillment of their water requirements. It is necessary to optimize this desalination process for energy consumption for economic and environmental benefits. The seawater reverse osmosis plants operate at higher pressures; consequently, with higher energy consumption. Hence, a significant amount of energy recovery is possible from the reject stream by using expensive devices, and hence, these devices are economically viable. However, this is not the case for low-pressure reverse osmosis (brackish water reverse osmosis) or nanofiltration plants, and hence, the use of expensive devices for energy recovery is economically impracticable. A system with partial recirculation of the reject stream is proposed to address this issue. The fundamental advantage of this system is to utilize the pressure in the reject stream and reduce the energy loss by reducing the flow across the pressure control valve. An analytical study of a domestic system of this kind is presented in this paper, which indicates that at any operating pressure, the theoretical specific energy consumption attains a minimum at a certain water recovery. However, the quality of permeate deteriorates at higher water recovery. Hence, the operating parameters should be optimized based on requirements and priorities. Moreover, the proposed system generally appears to be much more energy-efficient than the conventional system.

Keywords: desalination; energy recovery; mathematical modeling; membrane filtration.

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Conflicts of Interest

The authors declare no conflict of interest.