

Membrane Engineering for Energy Production from Salinity Gradient

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Salinity gradient energy (Blue energy) is an osmotic energy obtained by mixing two solutions of different salinity. It is a completely renewable and sustainable energy with a total global potential of about 1.4–2.6 TW out of which 980 GW is extractable depending on the employed technology. It has been estimated that this amount of energy would be sufficient to fulfill 20% of world's current energy demand. Due to the recent developments and progresses in membrane technology, interesting membrane operations including such as pressure retarded osmosis (PRO) and reverse electrodialysis (RED) have emerged to harness this energy. These operations are capable of generating clean and sustainable electricity from various waste streams including brine and impaired water which otherwise are considered environmental liabilities. PRO and RED require mixing of a high salinity solution (such as seawater or brine and wastewater, respectively) with a low salinity solution to generate electricity. Another less-explored membrane operation-membrane distillation (MD)- has shown the potential to simultaneously generate freshwater and electricity from saline and wastewater. Integration of MD with PRO or RED enhances the performance of these processes and provides a clean and sustainable route to produce freshwater and energy. The current study reviews the recent progresses and developments in emerging membrane operations with proven capability to generate energy from wastewater streams.