

Mechanical Power generation utilizing Pressure Retarded Osmosis (PRO)

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Salinity-gradient energy is now attracting significant attentions as a novel source of clean energy. Fresh water, once made from ocean by solar energy in the natural water cycle, retains higher level of free energy than sea water, and the elevated free energy may be recovered in controlled processes of mixing fresh water with sea water. Pressure retarded osmosis (PRO) method is one of the ways to recover the salinity-gradient energy utilizing water flux and the resulting osmotic pressure. We developed a new PRO configuration with a reciprocating pressure exchanger that is more adequate for generating power from high pressure with low water flux. The mechanical power output and the efficiency were investigated for the new PRO system under conditions that fresh water (0 g NaCl/L) permeated into concentrate sea water (70 g NaCl/L and 105 g NaCl/L) sides through semi-permeable membranes. The experimental results showed that the lab-scale PRO system with a commercial reverse osmosis (RO) membrane module (DOW filmtec, 4"-dia., 40"-long) could recover 0.7 W power at 19% efficiency and 1.3 W at 23% for 70 g NaCl/L and 105 g NaCl/L concentrate feeds, respectively.