A novel spiral wound module design for harvesting salinity gradient energy using pressure retarded osmosis

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Introduction

Salt gradient processes have great potential for reducing energy consumption in water treatment, especially when dealing with highly saline waters. Salt gradient processes have great potential for reducing energy consumption in water treatment, especially when dealing with highly saline waters. One of the key challenges between theoretical and large-scale applications is the development of commercial-scale membrane modules. This chapter summarizes previous approaches and attempts to develop economically rational and thermodynamically efficient membrane modules. We have focused on flat plate and hollow fiber membranes and their large-scale applications. Flat sheet membranes have distinct advantages in terms of design and optimization of support layer thickness and structure, but the design of spiral wound modules has a serious drawback in that the effective surface area is lost. On the other hand, the applications of hollow fiber membranes, which exhibit excellent utilization of active surface area, are limited by the pressure drop within the fiber. In particular, this paper examines the effectiveness of Pressure Delayed Infiltration (PRO) as a zero CO2 emission method for collecting and converting this energy. PRO technology consists of a semi-permeable membrane that separates streams of water with different salinities, creating a solution that produces electrical energy when depressurized through a turbine. Widespread implementation of PROs has long been hampered by cost and quality issues, but rising energy prices and growing awareness of the potential impacts of climate change have put PROs and salt gradient energy back into the spotlight. Now Salinity gradient technology generates electricity from the chemical pressure difference caused by the difference in ion concentration between freshwater and seawater.

Discussion

Due to its high salinity, sea water has a higher osmotic pressure than fresh water. Two main technologies, Reverse Electro Dialysis (RED) and Pressure Retarded Osmosis (PRO), use semi-permeable membranes to create an osmotic potential that can be used to generate electricity in delta and fjord turbines. Pressure Delayed Penetration (PRO): It converts the osmotic pressure of saline into water pressure and turns a turbine to generate electricity. Similar to reverse electro dialysis technology, PRO technology generates energy from the difference in salinity between seawater and freshwater. Reverse Electro Dialysis (RED): Electricity is generated by the controlled mixing of 2 bodies of water with different salinities. RED technology typically consists of multiple cation and anion exchange membranes assembled to form high-salinity and low-salinity compartments. When salt and fresh water pass through these membranes, the opposite transport of positively and negatively charged ions creates a charged electrode similar to a battery. The major environmental issues associated with salinity gradient technology typically include changes in water quality and impacts on the physical environment. The natural process of freshwater and seawater mixing creates unique brackish water habitats that wash away nutrient-poor water, yielding nutrient and oxygen-rich water, and yielding some of the most productive ecosystems. The regions are used by many organisms and are biologically and physically diverse. Potential impacts may result from the acceleration of mixing processes, changes in freshwater and saltwater balances, or risks to organisms at points of intake or release.

Conclusion

This effect can be mitigated by dumping the resulting brackish water in the centre of the water column and covering the intake pipe with a screen. A major socio-economic problem of salt gradient technology is the diversion of freshwater resources for power generation, which can be negated by avoiding water stress or water stress areas. Due to the limited deployment and information of these technologies, there is a high degree of uncertainty about their environmental impacts and further research is needed to fully understand the potential impacts.

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Conflict of Interest

The author declares there is no conflict of interest in publishing this article.

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