CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1112

Project Title

Blue Energy: A Novel Miniature Osmotic Power System Based on Pressure between Differing Water Salinities

Abstract

Objectives/Goals

In modern times, the demand for more environmentally-friendly and clean energy is booming around the world. Besides wind, solar, and nuclear power, there is a developing source of energy generation that has not been fully explored, namely osmotic power. Osmotic pressure between freshwater and saltwater or brine solution can be harnessed for electricity. The goal of my project was to build a functional osmotic power generation system and test its efficacy in enabling water flux, generating power, and creating electric potential.

Methods/Materials

A novel cylindrical apparatus was brainstormed and designed using a commercial semipermeable membrane made of thin-film composite (TFC) material, affixed with Gorilla glue and tape, and cut off bottoms of water jugs. Equal volume of water was set on both sides of the membrane, with salt dissolved inside the apparatus to facilitate pressure-retarded osmosis (PRO). A multimeter was wired to a micro-hydroelectric generator in order to test efficiency of generating power and voltage.

Results

The efficiency of the membrane apparatus was measured by modifying water salinity. I observed that an increase in concentration of salt was positively correlated with voltage generated and power density. I also found that salt concentration was negatively correlated with time taken to raise the volume of the saltwater solution.

Conclusions/Discussion

In this project, a miniature novel osmotic power system was successfully built. The system's functional efficacy in generating power and electric potential has been demonstrated. Relationships between salt concentration and voltage or power density appear to grow logarithmically. Based on my results, I suggest that ratios established by power density between power production and membrane surface area can be used to model trends of osmotic power productivity scaling with size. Osmotic power could provide a vital emergency power source in case of emergency, e.g. with potential applications in submarines or households, to light LED bulbs and charge mobile devices.

Summary Statement

A miniature osmotic power system based on a thin-film composite membrane apparatus was individually built, and tested for efficiency and power production.

Help Received

This project was conducted independently. All research, experimental design, and tests had been performed by myself.