

Design of a Wind-Powered Membrane Filtration System

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Motivation

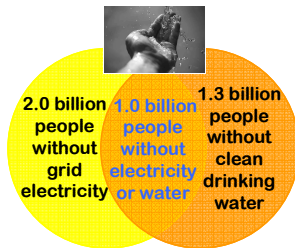


Fig 1. The motivation for stand-alone water purification systems

Introduction

This research focuses on the coupling of a 2-stage membrane filtration system with a wind turbine. The system was originally developed using photovoltaic panels for the Australian Outback [1,2].

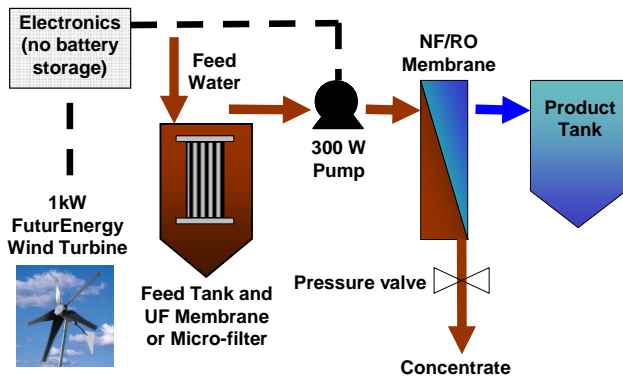
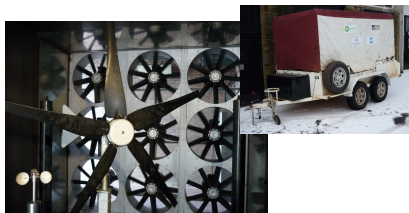


Fig 2. Wind-powered membrane filtration system

Objectives

1. Determine the steady-state operating conditions of the wind-powered membrane system.
2. Examine the effect of high frequency wind speed fluctuations on system performance.



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Progress

- Extensive testing of wind-powered membrane system in the laboratory and in a large wind tunnel.
- Set-up of a wind turbine simulator will allow tests to be carried out using real wind data.
- Design of a portable wind turbine tower which will be set up on HWU campus for data collection.



Results

Operating window under constant wind speeds:

- Limited by start-up wind speed (3.7 m/s).
- Limited by WHO guidelines for higher feed concentrations. Unacceptable water below 4.5 m/s.

The effect of wind speed fluctuations:

- 5.3 m/s needed to purify feed water (2.75 g/L NaCl) due to power switching off at low wind speeds.
- Large fluctuations at average wind speeds of 8.5 m/s or higher have little effect on performance.

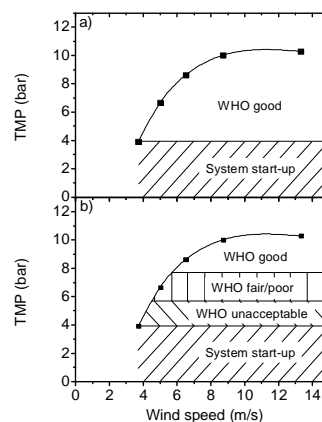


Fig 3. Steady-state operating window for feed concentrations of a) 2.75 g/L and b) 5.5 g/L

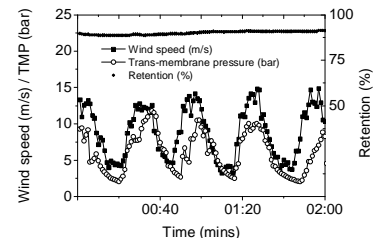


Fig 4. Effect of fluctuations in wind speed on pressure and salt retention

References

1. A.I. Schäfer *et al.* Renewable Energy Powered Membrane Technology. 1. Development and Characterization of a Photovoltaic Hybrid Membrane System. *Environ. Sci. Technol.*, 2007. **41**(3): p. 998-1003
2. B.S. Richards *et al.* Renewable Energy Powered Membrane Technology. 2. The Effect of Energy Fluctuations on Performance of a Photovoltaic Hybrid Membrane System. *Environ. Sci. Technol.*, 2008. **42**(12): p. 4563-4569