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Energy

Design of a Wind-Powered Membrane Filtration System

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Introduction

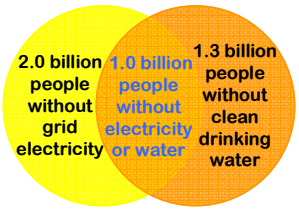

Figure 1: The need for stand-alone water purification systems.

This research focuses on the coupling of a two-stage membrane filtration system with a wind turbine. The system has previously been tested with photovoltaic panels in the Australian Outback [1].

- Main power requirement is a 300 W progressive cavity pump. It sucks feedwater through UF membranes (~0.5 bar pressure drop) and forces it through NF/RO membrane (up to 12 bar).
- Produces up to 1000 litres/day (with average wind speed of 4 m/s).

Figure 2: PV powered membrane system and 1 kW FuturEnergy WT.

Areas of Research

• Testing of wind turbine in a wind tunnel (TUVNEL, East Kilbride) to determine accurate power curve. Also initial experiments on the effect of wind speed fluctuations on the quality of water from the membrane filtration system.

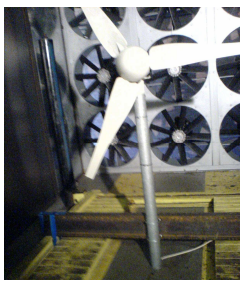

Figure 3: Wind tunnel at TUVNEL.

• Construction of a wind turbine simulator in order to test small wind turbines (up to ~3 kW) in the laboratory.

• Develop a model for predicting the wind speed based on site characteristics (turbulence intensity and turbulence length scale). By combining the Van der Hoven model for medium and long-term fluctuations and the Von Karman model to account for the short-term turbulence effects, an accurate model can be obtained [2].

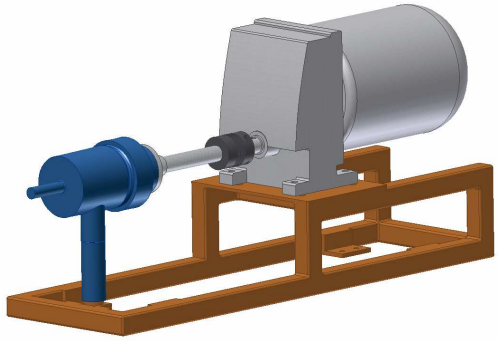

Figure 4: Wind turbine simulator.

• Use of supercapacitors to absorb short term turbulence fluctuations in the wind speed. Initial calculations show that a bank of six 15 V modules would provide between one and three minutes of storage depending on the power consumption of the membrane filtration system *(Figure 5).*

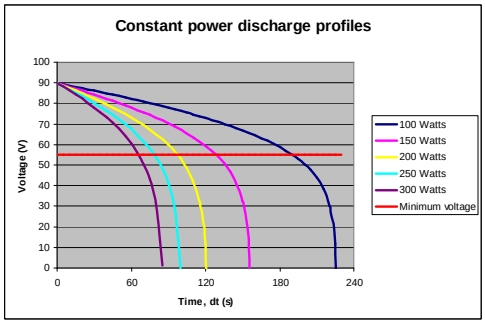

Figure 5: Supercapacitor bank discharge profiles (6×15V modules in series).

References

1. Al Schafer 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. C Nichita et al. Large band simulation of the wind speed for real time wind turbine simulators. in Power Engineering Society General Meeting, 2003, IEEE. 2003.

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