

## Development of an integrated reverse osmosis-greenhouse system driven by solar photovoltaic generators

P.A. Davies\*, A.K. Hossain

*Sustainable Environment Research Group, School of Engineering and Applied Science, Aston University, Birmingham B4 7ET, UK  
Tel. +44 121 204 3724; email: p.a.davies@aston.ac.uk*

Received 30 November 2009; Accepted 26 April 2010

---

### ABSTRACT

The development of a system that integrates reverse osmosis (RO) with a horticultural greenhouse has been advanced through laboratory experiments. In this concept, intended for the inland desalination of brackish groundwater in dry areas, the RO concentrate will be reduced in volume by passing it through the evaporative cooling pads of the greenhouse. The system will be powered by solar photovoltaics (PV). Using a solar array simulator, we have verified that the RO can operate with varying power input and recovery rates to meet the water demands for irrigation and cooling of a greenhouse in north-west India. Cooling requires ventilation by a fan which has also been built, tested and optimised with a PV module outdoors. Results from the experiments with these two subsystems (RO and fan) are compared to theoretical predictions to reach conclusions about energy usage, sizing and cost. For example, the optimal sizing for the RO system is 0.12–1.3 m<sup>2</sup> of PV module per m<sup>2</sup> of membrane, depending on feed salinity. For the fan, the PV module area equals that of the fan aperture. The fan consumes <30 J of electrical energy per m<sup>3</sup> of air moved which is 3 times less than that of standard fans. The specific energy consumption of the RO, at 1–2.3 kWh m<sup>-3</sup>, is comparable to that reported by others. Now that the subsystems have been verified, the next step will be to integrate and test the whole system in the field.

*Keywords:* Reverse osmosis; Concentrate disposal; Solar PV; Greenhouse; Brackish water

---

\* Corresponding author.