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Small-scale reverse osmosis brackish water desalting system combined with greenhouse application for use in remote arid communities

A.K. Hossain*, Philip A. Davies

Sustainable Environment Research Group, School of Engineering and Applied Science, Aston University, Aston Triangle, Birmingham B4 7ET, UK
Tel. +44 121 204 3041; Fax: +44 121 204 3683; email: a.k.hossain@aston.ac.uk

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ABSTRACT

Thermal distillation and reverse osmosis (RO) membrane filtration are the most widely used water desalination technologies in the world. Thermal systems are generally associated with high consumption of energy and only efficient for large scale plants. RO systems are expensive but are widely used due to their high total dissolved solids (TDS) reduction capacity and good recovery rate. Energy consumption in RO systems varies almost linearly with the amount of TDS. In remote arid and semi-arid regions where grid electricity is not available, small diesel generator/battery-operated (constant flow) or solar-powered (variable flow) RO systems for brackish water desalting are attractive options. Safe and economic disposal of salt concentrate from the RO system is a troublesome issue. Solar-powered RO combined with a greenhouse application presents a sustainable environmental system. Evaporative cooling pads are widely used for greenhouse cooling in many parts of the world. Fresh water is used in the cooling pad. In this study, the salt concentrate from the RO module (simulated) is used to cool the greenhouse by passing it through an evaporative pad. The concentrate will then be allowed to evaporate into a solid in a pond to allow easy and safe disposal. Results show that evaporative cooling can be achieved successfully using RO concentrate in place of fresh water. The performance of salt water and fresh water cooling is compared. A pilot experiment shows that the reduction of RO concentrate volume is possible. Degradation of pad material performance, use of different pad materials and assessment of the cooling efficiency degradation with time are future activities to be carried out.

Keywords: Brackish water; Reverse osmosis; Solar PV; Arid zone; Evaporative cooling; Greenhouse

* Corresponding author.

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