Solar-driven dual-purpose plant with hybrid desalination system for harsh desert farms

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**Abstract**

This work presents the process design and operational performance of a small-scale solar-driven dual-purpose plant to generate electricity and produce desalinated freshwater. The plant consists of a hybrid desalination system of reverse osmosis (RO) and a vacuum multi-effect membrane distillation (V-MEMD), coupled with a solar linear Fresnel collector (LFC) and a turbo-generator system. The integrated system is designed to provide the optimum solution for big desert farms of high groundwater salinity (of 15,000 ppm and more). The RO is designed with 40% recovery and its brine is used to feed V-MEMD units of almost the same recovery of around 40%. The system (base case) is designed with turbo-generator to provide the plant and the farm with electrical power (rating 68 kW) while the hybrid desalination plant is designed with 617 m³/d capacity. Other scale up designs for electricity and water production will also be highlighted. The technical analysis of the dual-purpose system will be presented including the plant specifications, process design and components sizing parameters of hybrid desalination plant and solar LFC.

**Keywords**: Reverse osmosis; Multi-effect vacuum membrane distillation; Solar linear Fresnel collector; Dual-purpose plant; Hybrid desalination system