Development of an Autonomous Low-Temperature Solar Rankine Cycle System for Reverse Osmosis Desalination

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Abstract

The present paper regards the experimental evaluation of the performance under laboratory conditions, of a low temperature solar organic Rankine cycle system for Reverse Osmosis (RO) desalination. The operation principle of the system is given briefly below:
Thermal energy produced by a solar collectors' array evaporates the refrigerant (HFC-134a) in the evaporator surface of Rankine engine. The super-heated vapour is driven to the expander where the generated mechanical work produced from expansion drives the RO unit high pressure pump. The vapour at the expander's outlet is directed to the condenser and condensates. The saturated liquid at the condenser outlet is then pressurised using a pistons-diaphragm pump and the thermodynamic cycle is repeated.

The design of the system has already been done and presented in the paper "Design of an autonomous low-temperature solar Rankine cycle system for reverse osmosis desalination" by Manolakos et al., Desalination 183 (2005) 73–80. For manufacturing the prototype system, the design results have been used.
In this paper the experimental results derived from the laboratory tests are illustrated. The next research step is the evaluation of the system performance on site, under real climatic conditions. The main difference of the above two experimental cases is that in laboratory tests, the thermal energy source used, is an electric heater of 100 kW, capable to operate at partial thermal load, which substitutes and simulates the behaviour of solar collectors.

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