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By

D. van Tonder, Department of Geology University of the North West (danel.vantonder@nwu.ac.za)
C.J.S. Fourie. Environmental Water and Earth Sciences, TUT (fouriecjs@tut.ac.za)

ABSTRACT
South Africa is considered a water scarce country and water quality is an additional stress affecting available water supply. In the semi-arid to arid regions of the country significant salt loading in groundwater occurs where anthropogenic influences can be excluded. Treatment of these water sources requires desalination. The conventional desalination process requires large amounts of energy, either in the form of waste heat or grid electricity, which are not available in many rural areas in South Africa. However, many rural communities in South Africa that do not have reliable access to clean drinking water are situated in geographical areas where the annual solar radiation levels are high and where saline groundwater is available. The development and optimization of the solar distillation designs had to conform to the project goals of affordability, durability and performance in supplying sufficient volumes of drinking and cooking water, conforming to national health standards. There is a strong argument to use clean energy generation techniques to power desalination plants. The research adopted was largely exploratory and adapted using the limited number of previous studies available. In order to evaluate the effectiveness of the system a simulation of the entire system, including the solar water heating panels and proposed distillation system, was conducted. Although the proposed design was a solar-assisted distillation system, the distillation process could be viewed as a convective heat and mass transfer problem, as in any other distillation processes. The mechanism involves a temperature rise in the water due to absorbed solar energy and heat transfer; in turn the heated water evaporates at the air-water interface which increases the humidity of the air, the humid air is cooled to condense as clean water. This process depends on the water temperature, vapour pressures, initial air humidity and a variety of moist air properties including specific heat capacity, thermal diffusivity, thermal conductance, density and viscosity. The accuracy depends mainly on two temperatures, namely the evaporation and condensation temperatures of a system. The measured evaporation temperature in the reactor and the condensate temperature of the condensation tank throughout an average winter day.

The results revealed that for rural areas not connected to the electricity grid, it is feasible to invest in solar powered desalination systems instead of diesel powered generators. In conclusion the results have provided preliminary novel evidence of the effectiveness in provision of drinking water quality water through combining renewable energy technologies with low cost desalination technology.

Primary author: Ms VAN TONDER, Danel (University of the North-West)

Co-author: Dr FOURIE, Stoffel (TUT)

Presenter: Ms VAN TONDER, Danel (University of the North-West)

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