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Experimental study on the potential of combining TiO_2, ZnO, and Al_2O_3 nanoparticles to improve the performance of a double-slope solar still equipped with saline water preheating

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ABSTRACT

Solar stills are an excellent option for providing freshwater to isolated communities living near the coast of Baja California, Mexico, and facing scarcity. Double-slope solar stills are simple and easy to operate; however, they normally produce low volumes of condensate. To overcome this, changes to the architecture of the still, implementation of mechanical items, or addition of nanoparticles to the water have been proposed. Since coupling the still with a solar water preheater and adding nanomaterials can be done without incurring in costly designs, and provided that using two types of nanoparticles simultaneously has the potential to further enhance the heat transfer capabilities, these options were investigated here. A spiral solar heater, utilized to increase the feedwater temperature, and combinations of TiO_2, ZnO, and Al_2O_3 nanoparticles were implemented to augment the yield of a double-slope solar still. The nanostructures were specifically synthesized for this application and experiments were done at the climate of Ensenada, Baja California. Nanostructures whose shape allowed wide contact with the water and with adequate absorptivity were produced. Peak yields and efficiencies of 5.46 L/m^2 and 59.9% were achieved combining TiO_2 + Al_2O_3, and 4.72 L/m^2 and 50.2% with TiO_2 + ZnO at costs between 0.034 and 0.038 US$/L.

Keywords: Seawater desalination; Solar still; Nanotechnology; Metal oxide nanoparticles; Heat transfer

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