ABSTRACT

The Optimization of the Efficiency of Cascade Type Solar Distillation Systems

Monica K. Boodhan

Solar Distillation is a solar energy powered water purification technique analogous to the naturally occurring hydrological cycle. This distillation method is currently utilized in the purification of saline, brackish and any other type of contaminated water. The product water is of a very high state of purity, free of dissolved salts, minerals, pathogens, bacteria and the vast majority of other contaminants found in impure water.

This research sought improvements to the centuries old technique with the use of cascade design solar distillation units under climatic conditions of St. Augustine, Trinidad. Various parameters, inclusive of glazing thickness and still orientation, were investigated in the first part of the experimental work. Secondly, the effect on the rate of distillation due to the addition of heat storage materials was investigated.

The results clearly show that the still having the highest productivity was the one fitted with the glass cover of thickness (4.76×10^{-3}) m. Additionally, stills oriented facing south produced more distillate than those facing north. Moreover, the solar still enhanced with slag displayed superior productivity in comparison to those enhance with charcoal as the heat storage material. The still with the large slag particles produced an average 73 % more distillate than the reference still

whereas the ones enhanced with small slag, small charcoal and large charcoal produced an average 47 %, 59 % and 52 % more distillate respectively.

In conclusion, the literature shows geometrical parameters, such as orientation of the solar still, thickness of the glazing and the use of heat storage materials are seen to have significant impacts on the performance of cascade design solar stills. Furthermore, the investigative work has validated a correlation between meteorological parameters such as solar radiation, ambient temperature and the productivity of solar stills.

Keywords: Monica K. Boodhan; Solar distillation; Water purification; Cascade design Solar Stills; Solar Stills; Solar Energy; Charcoal; Slag; Glazing Thickness; Orientation of Still; Desalination; Heat Storage Materials.