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Title of the Thesis: **"Investigation of Active Solar Still with Evacuated Tube Collector (ETC)"**

Abstract

On the earth, 97% of water is in the oceans and only 3% water is fresh which is stored in forms of ice glares, ground water, rivers and lakes. The world population was about 7.7 billion in the year of 2019 and is expected to increase up to 10 billion in the year of 2025. The requirements of fresh water grow with the population growth. Water is one of the basic needs for human kind. Of about 3% of fresh water, only 0.01% water is available as surface water in lakes, swamps and rivers. Therefore, there is no option other than to extract water from oceans. For the same, the desalination process is an appropriate method. The aim of the research work is to develop novel designs of the active solar still coupled with Evacuated Tube Collector (ETC) with natural and forced circulation of secondary fluid. The novelty of the research work is the circulation of air or tap water through ETC as secondary fluid to eliminate the scale formation on the tube surface of ETC and increase efficiency of the solar still. Three novel designs of active solar still coupled with ETC have been conceived, fabricated and tested under outdoor test field conditions. Thermal models of the active solar stills coupled with ETC are developed considering energy balance for inner glass cover, outer glass cover, saline water, basin of solar still, fluid inside the fluid chamber/serpentine tube/serpentine passage and ETC for natural and forced circulation of the secondary fluids. The main objective of the research work is to experimentally investigate the performance of the active solar stills at different saline water depths with field conditions of Ahmedabad, India (23.0225° N, 72.5714° E). Active solar stills with natural circulation of air and tap water and with forced circulation of air through serpentine tube/passage were fabricated and tested. Day, night and daily yields were measured under different operating conditions. Energy and exergy efficiencies were also calculated on hourly and daily basis. The experiments were performed during the months of April and May of 2016, 2017 and 2018 in the climatic conditions of Ahmedabad.

The highest productivity per day of 7.11 l/m^2 was recorded for active solar still with ETC with forced circulation of air through serpentine passage. The night yield of 1.98 l/m^2 was

maximum for active solar still with ETC with natural circulation of water. The optimum depth of saline water was obtained as 0.02 m and 0.03 m for natural and forced circulation of the fluids respectively. Overall thermal efficiency of 39.79% and exergy efficiency of 8.17% are obtained for active solar still with forced air circulation through serpentine passage, which are highest among all the cases. The productivity of the active solar still with ETC with natural and forced circulation of air was found 170% and 255.5% higher compared to productivity of the passive solar still [7]. The output distilled water was tested and found safe for drinking purpose as per BIS and WHO standards. Maximum annual yield of 2588 l/m^2 is achieved for active solar still with forced circulation of air through serpentine passage, which is 24.15% higher compared of natural air circulation. However, the minimum product cost of distilled water of 1.12 INR/l is calculated for the active solar still with natural circulation of air. The system can also be easily maintained.

This PhD Thesis will help in to produce more drinkable water from saline water by using of solar energy at remote area having low water availability. It would be useful for increase efficiency and output of solar distillation system with effective cost.

List of Publication(s):

1) Jigar Rajput, Prexa Parikh and Bhatt N M, "A Review of Solar Stills Augmented with Thermal Storage Media", GIT-Journal of Engineering and Technology, vol. 9, pp. 132-143, 2016, ISSN 2249 – 6157

2) Prexa Parikh and Bhatt N M, "A Detailed Review on Design and Analysis of Wick to Enhance Performance of Passive Solar Still", IJIRT, vol 7, issue 3, 2020, ISSN 2349 – 6002