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An Experimental Study on Water Harvesting from a Modified Window Air-Conditioner

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Abstract

An experimental study of the performance of an air conditioning system, using the concept of humidification-dehumidification is presented and investigated. The technique (AWVP) relies on utilizing the moisture present in atmospheric air and to increase its content to certain extent. The water extracted through this technique is of good standard and can be used for drinking and other purposes. The test setup consists of four loops namely fresh water circuit, air circuit, refrigerant circuit and dirty water circuit. Certain operating parameters like volume flow rate of air, air inlet temperature after heating and relative humidity was varied and its effect on the performance of the system was studied and analyzed.

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*Keywords:*Humidification, Dehumidification, AWVP.

1. Introduction

The present age is having a serious problem of rising temperature and there is also an adequate shortage of portable drinking water. Although we have enormous amount of water available in sea and oceans but it cannot be used when and where it is required. There are also lot of diseases which occurs due to drinking of bad quality water. This all can be avoided innear future by simply modifying and utilizing some of our existing technologies. The technique of Atmospheric Water Vapour Processing (AWVP) is very useful in hot and humid climate.Besides AWVP technique, the system also utilizes the vapour compression refrigeration system. The system setup consists of four loops, out of which one is closed one and other three are open loops.

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Nomenclature

T1	Dry Bulb Temperature (DBT) of atmospheric air.
T2	Wet Bulb Temperature (WBT) of atmospheric air.
T3	DBT of air after it is being heated by Heating Coil.
T4	WBT of air after it is being heated by Heating Coil.
T5	DBT of air after water spraying.
T6	WBT of air after water spraying.
T7	DBT of cooled air from A.C. Outlet.
P	Power in Watts.
V	Volume Flow rate in m^3/s.
T	time in minutes.
W	Water collected in millilitre.
R1	Relative humidity of atmospheric air.
R2	Relative humidity of air after water spraying.

Nafey et al. [1, 2] analyzed the humidification and dehumidification desalination process mathematically with accompanied experiments under the effect of solar energy with different environmental and operating conditions. They concluded that the mathematical result was in good agreement with the experimental results. air flow rate, cooling water flow rate and total solar energy influenced the efficiency of the unit. They also concluded that the area of the solar water collector area affected the system's productivity immensely. Amer et al. [3] mathematically and experimentally analyzed the humidification–dehumidification desalination system. They developed a system with water on an open cycle and air stream in closed cycle. They circulated the air with natural or forced circulation. They experimented with varying operating conditions using different packing materials. The heat and mass transfer coefficients were obtained experimentally and then fitted in forms of empirical correlations. They concluded that with increase in the mass flow rate, the productivity of the system increases. The temperature of the water at the condenser increases linearly with the water temperature at the humidifier inlet and decreased as the rate of flow of water decreased. A maximum productivity of 5.8 l/h has been obtained using wooden slate packing and with forced air circulation. Farsad and Behzadmehr [4] developed the balanced equation for the components .and did a thermodynamic analysis for a solar HDH desalination system. They calculated the amount of fresh water production with the developed equation and finished the sensitivity analysis with the main parameters was completed with the design of experimental method.Thus finding out the optimum condition of the desalination process.Parekh et al. [5] did a in depth technical review of solar desalination with multiple effect cycle and concluded that the solar desalination based on the humidification and dehumidification process presents the best method of solar desalination due to overall high efficiency. Younis et al. [6] theoretically designed a procedure to desalinate seawater in which they preheated brackish water using solar collectors and then brought them in contact with the inlet air in an evaporation column followed by a condensation stack for dehumidification.

In the present work an attempt has been made to retrofit a window air conditioner to simultaneously generate cooling effect and drinking water from atmospheric air. Atmospheric air was initially humidified with low and poor quality water and good quality water was harvested from it, which is suitable enough for human consumption.

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