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Study of recovery ratio of solar still as basic parameter in prediction of performance

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ABSTRACT

The problem of lack of fresh water can be solved by using these technologies especially desalination, but it face both unlimited amount of nonrenewable energy sources and the global warming of climate change. In addition electrical energy sources using coal, wood, gas and oil generate large amounts of pollution or carbon dioxide emissions, thereby posing health risks. Non-saline water that can be readily abstracted for domestic and industrial use is only available from lakes, rivers and from aquifers. This finite volume of water is increasingly contaminated by human activities. Moreover several regions of the world including Iran are already encountering the problem of freshwater shortage. This work represents a novel mature method for producing sweet water from effluent waste water and generating electricity using renewable energy sources, solar energy specifically.

KEYWORDS

Pollution;
Solar still;
Insolation rate;
Brackish water;
Potable water.

INTRODUCTION

These days, many new technologies such as desalination and water-treatment, which mostly based on fossil fuel consumption, are popular in the market[1, 2]. However the problem of lack of fresh water can be solved by using these technologies especially desalination, but it face both unlimited amount of nonrenewable energy sources and the global warming of climate change. In addition electrical energy sources using coal, wood, gas and oil generate large amounts of pollution or carbon dioxide emissions, thereby posing health risks[3, 4]. Under these circumstances, alternate method for producing sweet water from effluent saline water and generating electricity from renewable energy sources for both using and saving must be explored[5]. The desalination technique which is joined with Photovoltaic cells is the most promising technology which is introduced due to the growing global demand of potable water; on the other hand, environmental pollution from fossil fuels, lack of nonrenewable resources, wastewater and electricity neediness that is every day becoming more expensive and economical benefits

from utilizing renewable energy resources such as solar energy[6, 7]. Investigation and improvement in these issues will be useful and constructive to meet the continuously increasing appeal of freshwater in a cost-effectively sustainable way. It also can be helpful in mitigating global climate change (i.e. reduce carbon dioxide emission). Solar energy is one of the renewable energy sources, which is the most important supplier of energy for the earth and at the same time it is the most environmentally friendly, pollution-free, self-contained, reliable, quiet, long-term, maintenance-free, year-round continuous and unlimited operation at moderate costs form of all energies can be used for desalination[8]. It is really amazing to produce drinking water from effluent saline water and generating electricity from photovoltaic cells without burning any fossil fuels or producing fresh water from effluent wastewater instead of discharging wastewater into the sea, or desert, which is really harmful to the ecosystem, moreover polluting the atmosphere will be prevented seriously.

MATERIALS AND METHODS

All natural pools and lakes convert solar radiation into heat, although most of that energy is misplaced to the atmosphere mainly as a consequence of convection and evaporation. The principle of the salinity gradient solar pond, on the other hand, is to prevent vertical convection and/or evaporation (according to the type of solar pond). Based on the convection behavior of the saline solution in solar ponds, they may be classified into two main categories: non-convective and convective solar ponds. Salinity-gradient solar pond is a vertical saltwater gradient, so that the denser saltier water stays at the bottom of the pond and does not mix with the upper layer of fresher water. Consequently, the lower salty layer gets very hot and this heat can be used to make electricity.

RESULTS AND DISCUSSION

Experiments are held to find the effect of solar cell in solar energy adsorption, rate of water production and amount of energy saving in the proposed solar desalination pond. The vacuum pump pulls out the water vapor slightly from the solar box and improves the vaporization. So, the effect of weather moisture and wind velocity on the vaporization may be minor comparing with the effect of insolation rate. In this work, insolation rate is considered as the most important independent variable which affects the solar performance and is reported in illustrations. Correlation nu.2 shows the amount of insolation rate and the average temperature of wastewater during a year. Three zones can be considered in waste water with different mechanisms of heat transfer. Recovery ratio from waste water is presented as correlation 1.

$$\mathbf{Rec.Ratio_{ave} = 4.5I^3 + 6.4I^2 + 12I + 2.8, R^2 = 0.985} \quad \mathbf{(1)}$$

$$\mathbf{I = 63M^2 + \ln(3.2M^{2.3}), R^2 = 0.97} \quad \mathbf{(2)}$$

Highest and lowest amount of insolation rate is obtained on June and December, respectively with at least 20000 kJ/m2. day differences. The increase in waste water average temperature with the increase in insolation rate is predictable. However, with the same amount of insolation rate on November and March, higher average temperature value is obtained on March and this may related to regular windy days on last month of fall.

$$\mathbf{I = 9.6day^3 + \ln(36.4day^2) + 6.82} \quad \mathbf{(3)}$$

Driving force to vaporize the waste water is difference between average temperature of wastewater and ambient. So, correlation 3 and 4 state data of insolation rate and average temperature of three zones of wastewater, respectively. Daily production is presented in correlation 5.

$$\mathbf{T_{ave-3zones} = 16.5M^{5.3} + \exp(0.328), R^2 = 0.99} \quad \mathbf{(4)}$$

$$\mathbf{Dailyprduction = 0.0006h^5 + 0.00072h^{7.3} + 3.92, R^2 = 0.964} \quad \mathbf{(5)}$$

CONCLUSION

The effect of using solar cell in performance of one solar desalination pond is investigated experimentally in this research. Application of solar energy in fresh water production and also electricity generation from wastewater of desalination unit in one petrochemical industry is considered during a year. Insolation rate, ambient temperature, average

temperature of wastewater, density of wastewater in pond, amount of produced water, electrical energy is produced.

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