

Global Journal of Advanced Engineering Technologies and Sciences**REVIEW ON PERFORMANCE ANALYSIS OF SOLAR WATER****PURIFICATION SYSTEM****Divyadarshani Dhakre¹, C.S.Koli²**¹M-Tech (Thermal System & Design) Research Scholar, ²Assistant Professor
ShriRam College of Engineering & Management, Banmore (M.P.)**ABSTRACT**

Solar water purification system is new concept in thermal industry .It is vary nearer to the natural purification of water which include vaporization and condensation of water. Solar energy is used to make vapour from stored water .Vapour particles collects on inclined glass and flew down following the condensation process. Condensed water is collected in the container .Number of paper have been reviewed to find out the volume of research and the research gap

Keyword: Solar power, Purification of water, Taguchi method, Glass plate, Temperature

INTRODUCTION

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photo voltaic, solar thermal energy, architecture. It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties. Following are the field in which solar energy can be used

- 1 Thermal energy
- 2 Electric Energy
- 3 Transportation
- 4 Energy Reservoir

LITRATURE REVIEW

Vinod Kumar Verma et al.[1] This paper represent the performance of operating parameter of solar still. In this paper optimizing the four parameter with the help of Taguchi method. This four parameters (glass cover angle, Water temperature, glass cover temperature, Average spacing between water and glass cover) influence on the total distill output. The present paper optimize the Taguchi method to optimize the operating parameter for higher yield for a passive single slope solar distillation system. The main objective of the present study was to apply the Taguchi method to establish the optimal set of parameters for passive slope solar still. The Taguchi method is employed to determine the optimal combination of design parameter.

C. Uma Maheswari et al. [2] This paper deals with the thermal and CFD analysis of single basin double slope solar still. The modelling of still is done in solid works software and CFD analysis in ANSYS. CFD analysis for different months of solar irradiance was carried out. Maximum production rate and temperature distribution in the still was analyzed.

W.M. Alaian et al. [3] This paper presents an experimental investigation on the performance of solar still augmented with pin-finned wick evaporation surface. The experimental system involves two identical solar stills, one of the stills is conventional and the other has an evaporation pin-finned wick surface. The fins are supported vertically on the basin of the still using steel wires. Outdoor experimental tests are conducted to investigate the effect of using pin-finned wick on the still productivity. Tests are carried out at wide range of ambient temperatures and solar radiation. Temperatures at different locations (glass surface, water in the still, wick surface and air–vapor mixture) as well as ambient temperature are recorded with time. Solar radiations as well as collected distillate are recorded during the experiments at different operating days. Experimental measurements indicate that the increase in distillate varies with ambient conditions. Enhancing the still productivity is proved when pin-finned wick is applied in the still. System

efficiency of about 55% is recorded when pin-finned wick is used. An enhancement in the still productivity of more than 23% is recorded during this set of experiments.

Wael M. El-Maghlany et al. [4] This investigation represents the optimum inclination angles of the glass cover of the double slope solar still, and orientation for maximum collected solar energy that could be captured by the solar still glass cover. The results will be displayed for different latitudes to cover Egypt geographically. The double slope solar still has two opposite inclined surface consequently; the total energy is the summation of the collected energy by the two surfaces represents the double slope solar still surface area. The inclination angle (θ) is changed from 10° to 60° on both sides of the glass cover to get independently the optimum inclination angles for each side that not necessary to be the same.

Mr. Yogesh V. Sahane et al. [5] The purpose of this work is to design a water distillation system that can purify water, a system that is relatively cheap, portable, and works on renewable solar energy. Solar Distillation is an attractive alternative because of its simple technology, non-requirement of highly skilled labour for maintenance work and low energy consumption. In this paper solar still basics are discussed along with different designs considerations and layouts of stills. Development of model was done along with testing for different conditions. Experimental results were compared along different conditions. Compare to existing solar still modified still has 53% more efficiency.

Abdulrakib M. Kachwala et al. [6] Solar still is simple device to convert available saline water into drinkable water. In country like India, single slope solar still is used. Their usages are prohibited by their cost. This required study on the modeling and transport parameters determination of basin solar still for an efficient design. Hence a three-dimensional, two-phase model was developed for evaporation and condensation processes in solar still by using computational fluid dynamics (CFD) method to simulate the model. The simulation results were compared with the available experimental data (Research Paper) of basin solar still. The amount of fresh water productivity and water temperature were in good agreement with experimental data. The objective of the study was to determine a best combination of different parameter for good convective and evaporative heat transfer coefficients

Sachin Amte et al. [7] Different designs of solar stills have been investigated throughout world by different researchers. Solar stills of different designs have been investigated by many researchers. A new radiation model has been developed to improve the prediction of the performance of a single-slope solar still. An improved (new) Tubular Solar Still (TSS) was, therefore, designed in this paper to overcome those issues and to provide potable water for a few families or a small society in arid, remote and coastal areas. It can be installed near to a house for the purpose of reducing time and labour involved in carrying drinking water. An old TSS was designed using a vinyl chloride sheet as a cover material which was a little bit heavy, expensive and cannot be formed into a desirable size easily. In order to overcome these drawbacks, the new TSS was fabricated using cheap, durable and locally acquisitioned lightweight materials for practical use. Consequently, the weight and cost of the new TSS were noticeably reduced. These improvements also can help to assemble the new TSS easily in those areas. This paper describes the details of the design, fabrication, cost and water production analysis of the New Tubular Solar Still. The new TSS was made of cheap, durable, lightweight and locally available materials.

Mohammed Tarawneh et al. [8] An attempt is made to improve the performance of single slope solar still for the production of fresh water in this study. The prime aim is to experimentally investigate the influence of control factors namely stone quantity, sea water level and double glazing on the yield of the solar still. Nine experiments were conducted based on Taguchi's orthogonal array. It is noted that double glazing effect makes substantial improvement in the yield of solar still. A non-linear regression model is also developed for the process. The optimum parametric conditions are found through the Taguchi method and genetic algorithm. It is confirmed that the optimum conditions exhibit nearly 57% enhancement in the yield than the yield of conventional solar still without stone bed and double glazing effect.

Considered were open area ratio, Reynolds number, relative roughness height and relative roughness pitch along with Nusselt number and friction. The aim of this analysis is to maximize heat transfer and minimize pressure drop with this configuration. Experimental results are checked with optimal values. The Reynolds number and the relative roughness height for corresponding Nusselt number and friction are found to be the most affecting parameters.

Ravi mishra et al. [9] The present work focuses on the application of Taguchi technique to investigate the effect of bath temperature, water depth and inclination angle of the condensing on the performance of the single slope solar

stills. An indoor simulation model was developed using constant temperature water bath to maintain water temperatures at steady state for the purpose of experiment. The condensing covers inclined at 20°, 30° and 40° were fabricated of commonly used glass sheet to form top inclined cover and GRP sheets to make the side walls of the cover. Orthogonal arrays of Taguchi, the Signal-to-Noise (S/N) ratio, the analysis of variance (ANOVA), and regression analysis have been employed to analyse the effect of the factors on the response. Linear regression equation has been developed with an objective to establish a correlation between the selected parameters and the Productivity. The predicted values of distilled water have been compared with experimental data and are found to be in good agreement. Inclination angle of condensing cover is found to be the most significant factor contributing towards the productivity for Evaporating Heat Transfer Coefficient and Convective Heat Transfer Coefficient.

Devashish Tiwari et al. [10]

In the present work an attempt has been made to investigate the performance of the single slope solar still by adding sensible energy storage medium in still. For this purpose two similar single slope solar still have been designed and fabricated. Al turning is used in the basin of still to store sensible energy during sunshine hours and delivers the same during off sunshine hours. It is observed that the use of Al turning increases the day time productivity as well as night time productivity. Daily productivity increased by increasing mass of the Al turning. 35% daily productivity is increased by adding 5 kg of Al turning in the basin of the still.

R. R. Shah et al.[11] Today demand of fresh water is increasing continuously because of the industrial development, intensified agriculture, improvement of standard of human life style, increase of the world population etc. With increasing Industrialization and population, there is needed to reduce the load of fossil fuels to reduce the environmental pollution. Unlike conventional energy utilization, solar energy is free of cost and has good availability in our country. Water is one of the necessities for all the creatures on earth to live; hence its purification is equally important. Solar distillation is one of the methods in which water purification can be done using solar energy. The present work focuses on fabricating a model of double slope solar still which will distil water using solar energy. In the study, a solar distillation having double slope single basin is studied theoretically and experimentally at A.D. Patel Institute of Technology, New V.V. Nagar (Gujarat). The still was constructed using a 1m x 1m base area with the glass cover of still inclined at 35°. Temperatures of glass cover, water inside the still, ambient air were recorded and the amount of distilled water was measured at the interval of one hour. To obtain more quantity of distilled water, Study on the effect of various heat absorbing materials on the performance of the solar still shows that the output of solar still using black dye as a heat absorbing material is 26.7% higher than that without use of absorbing materials.

A.K. Sethi [12] Potable water is a basic necessity for human being along with food and air. Direct uses of water from sources like rivers, lakes, sea, and underground water reservoirs are not always advisable because of the presence of higher amount of salt and contamination. Solar still is a simple device which can convert available waste or brackish water into potable water using solar energy. Clean water is evaporated from the brackish water and condensed on the glass cover, which is drained out for use. In this paper, thermal efficiency and energy analysis are carried out for evaluating the thermal performance of double slope active solar still under forced circulation mode. The daily thermal efficiency of solar still varies from 13.55 to 31.07% and the energy efficiency varies from 0.26 to 1.34%.

Richa pandey et al. [13] Fresh water is the basic commodity of human life. Using renewable solar energy and Desalination certainly produce an inexhaustible source of drinking water. Development of such systems which can fulfil the world's population of 6 billion to have access of clean drinking water using natural resources is a need of the hour. Solar still is such a simple and affordable device for converting brackish water into potable water. Many more features are attributed to this simple instrument apart from its simplicity, like eco-friendly, economical, low maintenance charges, ease of handling, sustainability, material availability and 99% purity. The present communication elaborates the advancement of solar still till date and also the scope for further research.

Edeoja, Alex Okibe et al. [14] Five solar stills of the same size and configuration but with different glass cover thicknesses were designed, constructed and their performances evaluated. Still 1 had a sheet glass cover, still 2 had two sheets of glass lying on each other, still 3 had two sheets of glass with an airspace between them, still 4 had three glass sheets without airspace between, and still 5 had three glass sheets with an air space between each. A storage medium was designed and constructed to boost the night yield of the stills. The daily insolation, ambient, cover and water temperatures and the output for the five stills were measured. The efficiencies for the daytime operation were computed. The output volumes and efficiencies of the stills were compared. Still 1 had the highest mean water output volume of about 306 cm³ and an efficiency of 24% indicating that for better daytime yield, a window glass solar still

cover in Makurdi location should have a thickness in the region of 4 mm. Still 3 had the better night time yield which implies that the cover configuration could be exploited to boost overall still output.

P. Rajendra Prasad et al. [15] An energy efficient solar still is developed with graphite filled silica gel as adsorbent of incident radiation. The still is maintained with a porous gel which absorbs large extent of incident radiation by internal reflections. The silica gel is made with sodium silicate by acidification. It is modified with graphite powder as a blackening and absorbing agent. Na₂SiO₃ content in the still is varied from 100 to 200 g while graphite was varied from 50 to 100 grams. The water in the still is varied from 6 to 10 litres. Optimal values of parameters were identified. The resulting still yielded a maximum efficiency of 49% against 30-35% in the case with no gel.

A. A. F. Al-Hamadani et al. [16] An experimental investigation on a solar still with lauric acid as phase change material (PCM) is carried out to examine the effect of both the mass of PCM and basin water on the daily distillate productivity and efficiency of the system under outdoor condition. Basic energy balance equations are written to predict the water and glass temperatures, daily distillate productivity and instantaneous efficiency of the single slope solar distillation system with PCM. It is found that the higher mass of PCM with lower mass of water in solar still basin significantly increases the daily productivity and the efficiency. Therefore, the distillate productivity at night and on day for solar still with PCM increased by 127% and 30-35% respectively than without PCM one. Shukla et al. approach of the use of inner glass cover temperature for productivity prediction which has also been investigated, and the prediction shows relatively better agreement with the experimental data than outer glass cover temperature.

Mohd Zaheen Khan et al. [17] Although, more than two thirds of the earth is covered with water and remaining is land, all over the world, access to potable water by the people is narrowing and decreasing day by day. Most of the human diseases are due to polluted or non-purified water. Nowadays, each and every country is facing a problem of huge water scarcity because of pollution created by manmade activities. Adequate quality and reliability of drinking water supply is the fundamental need of all people on this earth. Fresh water, which was obtained from rivers, lakes and ponds, is becoming scarce because of industrialization and population explosion. Water purification using solar energy has become more popular because it is eco-friendly and cost effective. A solar still is commonly used device for water purification and it doesn't require any electricity for distillation of water. Solar distillation is a technology for producing potable water from brackish water or underground water of low quality at low cost. This method can reduce water scarcity problems in the world. In a solar still, water is evaporated using solar energy, which is a form of renewable energy and collected as distillate water after condensation of the vapour.

This method can produce distilled water after removal of impurities. Since last three decades, more research work is going on to improve the system performance and efficiency of the solar still and provide sustainable water purification. A variety of solar distillation devices have been developed with different materials and in different shapes in different locations to improve the efficiency of solar distillation. There is a strong need to improve the single slope solar still performance and increase the production of water distillation. The various factors affecting the productivity of solar still are: Climatic Parameters, Operational Parameters and Design Parameters. Among all these three parameters, main focus on the Operational Parameters; which are: Salinity, Mode of Operation, Amount of Dyes and Water Depth. From my literature survey, many researchers, engineers and scientists experimentally studied solar water distillation using Phase Change Materials. There is no more work. So, this present paper is focused on performance of solar water distillation using Phase Change Materials.

TAGUCHI METHODOLOGY

Taguchi is a methodology which gives the optimum combination of independent parameter which has a significant role to change the value of dependent parameter. The prime objective of the method is to design best quality product at least cost of manufacturer. This method was generated by Dr. Genichi Taguchi of Japan. This method has designed to investigate how various parameters significantly affect the mean and variance of parameter pertaining to main characteristic and quality of process. The orthogonal arrays is the prime tool which arrays to organize the parameters affecting the process and the levels at which they should be varies. Taguchi method tests pairs of combinations in place of all possible combinations. This provide the necessary data to identify the significance of factors affecting product quality with a minimum recourses and time. The arrays are selected on the basis of degree of freedom of parameter which depends on the no of parameter and their level. The data from the arrays can be analyzed by visual analysis.

OUTCOMES FROM LITERATURE

A lot of work have been done for abetting the use of solar energy for in the field of thermal, refrigeration and air condition, transportation, and as a reservoir of energy but few works has done in optimization of parameter in purification of water

CONCLUSION

Finding the research gap in purification of water using solar energy by double inclined glass plate system we have decided to work in this field and try to optimize the parameter using Taguchi optimization technique.

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