

PERFORMANCE ANALYSIS OF SINGLE SLOPE SOLAR STILL DISTILLATION SYSTEM

Ramesh.A¹, Dineshkumar.M², Tamilselvan.N³, Prithiviraj.N⁴, Nithiyanand.P⁵, Sanjay.M⁶

¹PG Scholar, Department of Thermal Engineering, Excel Engineering college, Tamil Nadu, India

²⁻⁵Assistant Professor, Department of Mechanical Engineering, Excel Engineering College, Tamil Nadu, India

⁶Assistant Professor, Department of Aeronautical Engineering, Excel Engineering College, Tamil Nadu, India

Abstract: The everyday usage of the sustainable power requires more. So, to improve the profitability of sun oriented actually utilizing nano-particles. Sun powered refining is a generally basic treatment of saline or sullied water. In this sun powered energy is utilized to dissipate water then this fume is consolidated as unadulterated water. This cycle eliminates salts and different pollutions. Most recent pattern to improve the effectiveness of the sun based actually is utilization of nano-particles like metal oxides. These particles increment surface region of assimilation to sun powered radiation. In this work the Natural graphite nano-particles blended dark paint is utilized to improve the profitability of sun based still. The sun based radiations are communicated through the glass cover and caught by a dark painted inward base surface of the sun based still. Water retains the warmth and is changed over into fume inside the office of the sunlight based still. Single slop sun based actually is utilized from past many years yet in this investigation impact of nano-particles on efficiency of sun based actually is dissected. Trial work is performed for the single slant sun oriented still (SS-SS) under climatic states of natrampalli. The utilization of the nano-particles blended in with dark paint expands the temperature of the sun powered still bowl. The profitability and effectiveness of sun powered still at water profundity 0.01 m with nano-particles are 3.48 liter and 38.65% separately which are greatest qualities contrasted with water profundities 0.02 m and 0.03 m. After effects of the investigation gives 38.1% addition in profitability and 12.18% augmentation in warm productivity when nano-particles of size 40 nm to 90 nm blended dark paint utilized at water profundity 0.01 m. To check the meaning of contrast in efficiency of sun powered still with and without nano-molecule blended dark paint, a matched t-Test is performed which is adjusts that the profitability upgrade due to nano-molecule blended dark paint is critical at 95% certainty stretch.

1. Introduction

In the current situation, the interest of new water is expanding persistently. To satisfy this developing need, ground water has been seriously misused. New water is needed for drinking and other home grown purposes. Sun oriented actually is an easiest desalination gadget which utilizes sunlight based energy for changing over accessible sullied or saline water into refined water. It is not difficult to manufacture and require no upkeep. The profitability of single bowl sun based stills is extremely low, which should be expanded for certain changes.[1-3]

An upset safeguard sun oriented actually is a mix of a basic single incline sun based still and a bended reflector under its bowl which gives extra warmth to bowl in this manner the sun powered actually exploits twofold sided warming of bowl for example from top just as base which builds the temperature of bowl, which brings about expanded efficiency.[4-5]

Most recent patterns to improve the effectiveness of the sun powered actually is, utilization of Nano-particles like metal oxides, coupling of other sunlight based energy gadgets like sun oriented air warmer, sun based lake and so forth, warm capacity tank. Past investigation shows that utilization of Nano-particles exhibit better outcomes

for sun powered gathering gadgets. In home grown structures heaps of warmth is utilized by tenants it tends to be extremely helpful for refining measure. Numerical displaying of sun based actually is finished by heaps of specialists and this can be useful for present investigation. For little or far off networks where there is absence of water yet additionally of electrical lattice the solitary arrangement is the utilization of sustainable power sources, as sunlight based, wind and so forth, in association either to little limit ordinary desalination units however better to utilize sun oriented energy with sun based stills. Regular warm desalination techniques, as Multi-Stage-Flash, Multiple-Effect Diffusion (MED) and minor Thermal and additionally Mechanical Vapour Compression discovered application for enormous limit establishments. Invert Osmosis, a layer working technique what capacities by power, is utilized also in little or enormous limit plants. Every one of these techniques discovered application around the world, yet particularly in spots with an absolute absence of new water and pretty much thick populace. They are worked by customary fuel sources as fills.[6-8]

2. Experimental setup

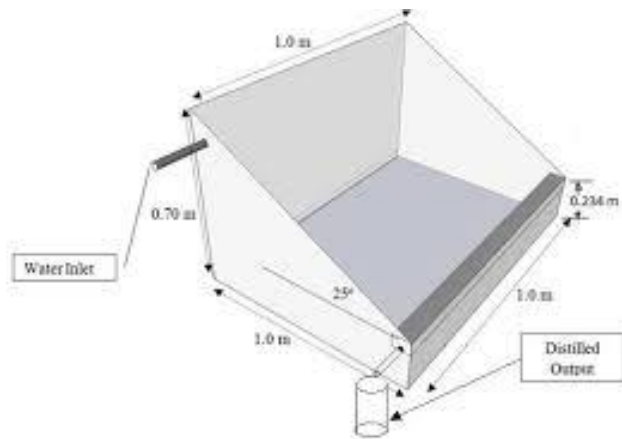


Fig.2.1 Experimental Design



Fig 2.2 Experimental Setup without PCM



Fig 2.3 Experimental Setup with PCM

Output of a Solar Still

An approximate method of estimating the output of a solar still is given by:

$$Q = E \times G \times A$$

$$2.3$$

Where,

Q = daily output of distilled water (litres/day)

E = overall efficiency

G = daily global solar irradiation (MJ/m^2)

A = aperture area of the still i.e., the plan areas for a simple basin still (m^2) Solar distillation

In a regular country the normal, everyday, worldwide sun powered light is ordinarily $18.0 \text{ MJ}/\text{m}^2$ ($5 \text{ KWh}/\text{m}^2$). A straightforward bowl actually works at a general proficiency of about 30%. Subsequently the yield per square meter of zone is

$$\text{Daily output} = 0.30 \times 18.0 \times 1$$

$$2.3$$

$$= 2.3 \text{ litres (per square metre)}$$

The yearly yield of a sun based actually is regularly thusly alluded to as around one cubic meter for each square meter.

The expense of unadulterated water delivered relies upon:

- The expense of making the still
- The expense of the land
- The existence of the still
- Working expenses
- Cost of the feed water
- The rebate rate received
- The measure of water delivered.

3. Result and Discussion

Boundaries which are investigated in this examination are following:

Full Day Yield Production

In this piece of study entire day water refining done by sun based actually is examined which is appeared in Table 1. Loss of warmth from sunlight based actually is likewise thought of, so warm effectiveness of sun powered actually can be improved. Here 0.01 m water profundity will be utilized for investigation since greatest yield creation was seen at 0.01 m profundity.

Impact of Water Mass

Proficiency of sun oriented actually relies upon level of crude water or in alternate manner water mass is a significant boundary for sun powered still effectiveness. In this investigation diverse profundity of water has been taken to discover the adjustment in warm effectiveness. Three unique profundities of water have been recorded which are 0.01 m, 0.02 m and 0.03 m separately.

Effect of Natural Nano-Particles Blended Dark Paint

Utilization of nano-particles blended dark paint can improve warm effectiveness of any warmth move gadget , in light of the fact that zone of warmth retaining surface is expanded. Not many examinations show utilization of nano-particles in sun oriented warm designing, so in this investigation impact of nano-particles blended dark paint has been dissected. Characteristic graphite has been utilized as material for nano-particles. The size of nano-particles utilized is 40nm to 90nm.

4. Cost Analysis

In this work by utilizing nano-particles there is an expansion of Rs. 1400 in the expense of sun oriented still. In any case, builds profitability by 38.1% (0.97 liter each day) so expanded expense recuperated by the sun based still in 105 days since market cost of marked consumable water is Rs. 14 for every liter. $Rs. 0.97 \times 14 = 13.5/-$ each day (expanded expense recuperated by the sun powered still in $1400/13.5 = 105$ days) and less expense show up in upkeep

5. Summary of Results

Exploratory work was performed for the single slant sun oriented still (SS-SS) under desert climatic states of Rajasthan (Jaipur). At the point when the water profundity was expanded from 0.01 m, 0.02m, 0.03 m, it was seen that the efficiency diminished by 6.35%. These outcomes show that the water level intensely affects the profitability of the sunlight based still.

After the utilization of Natural graphite nano-particles it was seen that the sun powered still profitability expanded by 38.1%. The utilization of the nano-molecule blended paint builds the temperature of the sun powered still.

Near investigation of worldwide sunlight based radiation power and day time creation are appeared in graphical structure show in graphs recorded at 0.01 m water profundity, 0.02 m water profundity, 0.03 m water profundity and 0.01 m water profundity with nano-particles individually has been shown in figures.

Table 5.1 Efficiency Tabulation

S . No .	Study boundary	Complete amount of crude water (kg)	TDS of test water(PPM)	Absolute gathered water (kg)	TDS of gathered water(PPM)	Efficiency
1	Depth = 0.01 m	11	464	2.53	13	26.48 %
2	Depth = 0.02 m	21	495	2.42	15	31.63 %
3	Depth = 0.03 m	31	525	2.35	14	38.17 %
4	Depth = 0.01 m, nano-particles use	11	416	3.47	13	38.66 %

Correlation of Solar Radiation and Day Time Production in Graphical Form

Near investigation of worldwide sunlight based radiation power and day time creation are appeared in graphical structure in show in graphs recorded at 0.01 m water profundity, 0.02 m water profundity, 0.03 m water profundity and 0.01 m water profundity with nano-particles individually has been shown in figures.

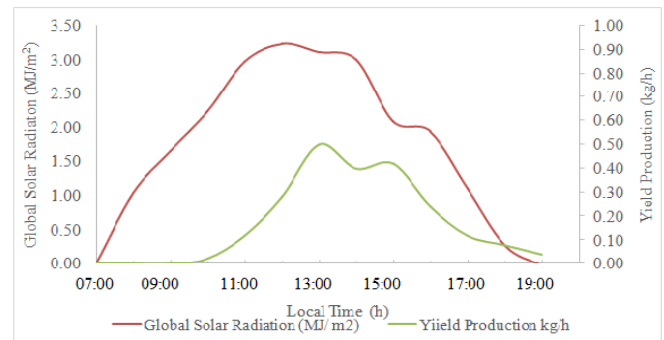


Fig 5.1 Global solar radiation VS local time (0.01m water profundity)

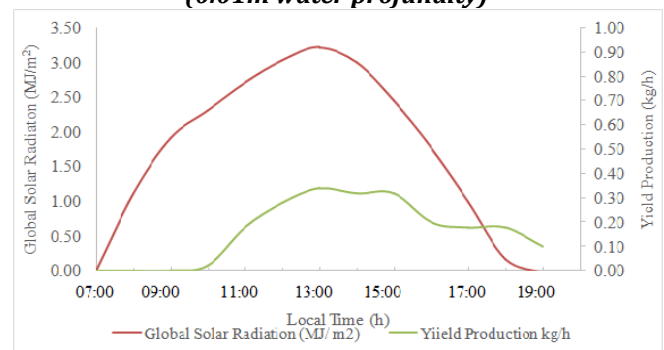


Fig 5.2 Global solar radiation VS local time (0.02m water profundity)

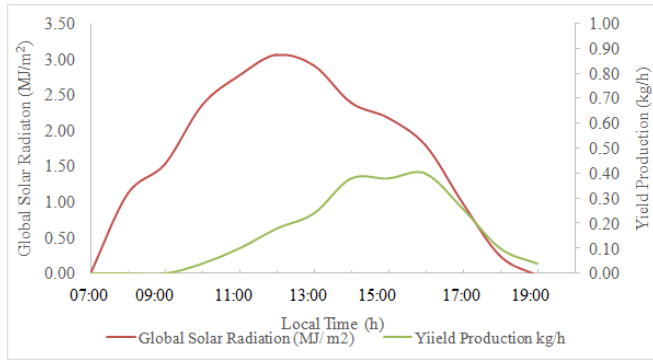


Fig 5.3 Global solar radiation VS local time

(0.03m water profundity)

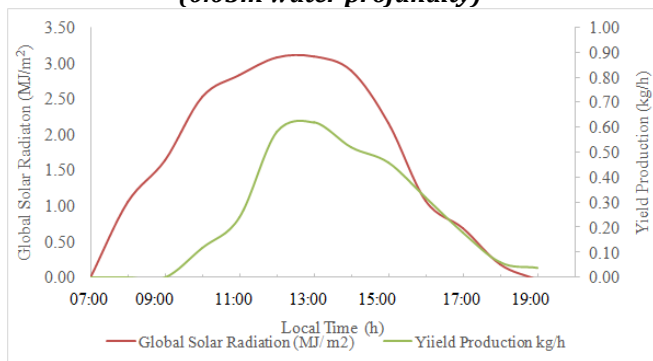


Fig 5.4 Global solar radiation VS local time

(0.01 m water profundity nano particle separetely)

Effect of Nano-Particles on Productionat Different Water Levels

Comparison of production of distilled water (kg/hour) in graphical form is shown in Fig 5.5

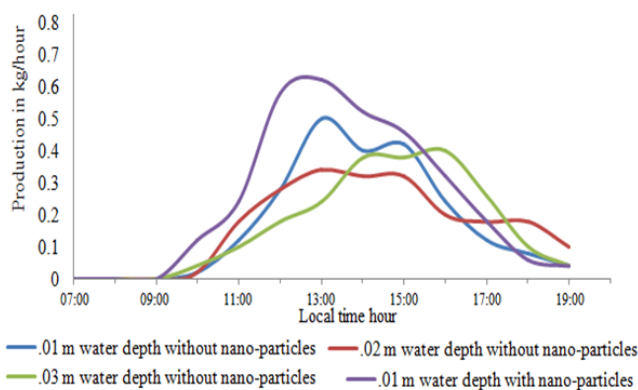


Fig 5.5 Impact of nano-particles on creation

6. Conclusion

From the examination it very well may be presumed that the creation and effectiveness of sun oriented still at water profundity 0.01 m with nano-particles are 3.47 litres and 38.66% separately. 38.1% augmentation underway and 12.18% addition in warm effectiveness

was accomplished when nano-particles blended dark paint is utilized. These outcomes show that the water level and nano-particles blended dark paint intensely affects the distillate yield of the sunlight based still. The PPM of crude water is more than the PPM of refined water given by the sunlight based actually is the proof of nature of refined water.

7. Future Scope

Refined water is extremely valuable for businesses and labs. It be can use for drinking by adding a specific level of ordinary water. Sunlight based model is actually valuable in desert or provincial territories where no association of power is accessible to run current RO (Reverse Osmosis) frameworks. So this work will be valuable for giving this office in the towns which have not power association. Customary individuals can arrangement little sun oriented still on the top of the structure and get refined water consistently. This work will likewise give development of the limited scale enterprises which produce refined water in India. In the arrangement little speculation is required at first and its support is practically nothing. The innovation associated with the manufacture of sun oriented actually is straightforward and can be kept up at the town level itself.

REFERENCES

[1] Boubekria, M., and Chakerb A., (2011) "Yield of an Improved Solar Still: Numerical Approach" Energy Procedia , Vol. 6, pp. 610-617.

[2] Arunkumar, T., Jayaprakash, R., Denkenberger, D., Ahsan, A., Okundamiya, M.S., and Kumar, S., (2011) "An Experimental Study on a Hemispherical Solar Still" Desalination, Vol. 286, pp. 1-7.

[3] Nithiyanand P., Boopathy S., Gobi A., Manikandan S., Suresh kumar M., (2020) "Performance and study of magnesium chloride and Sodium chloride using solar pond" International Research Journal on Advanced Science Hub, 2020, Volume 2, Issue 4, Pages 13-21, DOI: 10.47392/irjash.2020.21.

[4] Dev, R., Wahab, S.A.A., and Tiwari, G. N., (2011) "Performance Study of the Inverted Absorber Solar Still with Water Depth and Total Dissolved Solid." Applied Energy, Vol. 88, pp. 252-264

[5] Koilraj, G.M., Senthil Kumar, P., Rajakumar, S. and Syed Yousuf, M. H., (2011) "Effect of Nano-Fluids in a Vaccum Single Basin Solar Still" International Journal of Advanced Engineering Research and Studies Vol. I, pp. 171-177

[6] Khaoula, H., Slama, R.B. and Gabsi, S., (2010) "Hybrid Solar Still by Heat Pump Compression." Desalination Vol. 250, pp. 444-449.

[7] Kalidasa, M.K. and Srithar, K., (2011) "Performance Study on Basin Type Double Slope Solar Still with

Different Wick Materials and Minimum mass of Water”.
Renewable Energy, Vol. 36, pp. 612-620

[8] Nithiyanand P., Akhil Krishnan A., Bibin Baby., Don Baby., Muhammed Sufaid., “Design of LPG used refrigeration system using Nozzle expansion”

International Research Journal on Advanced Science Hub,
2020, Volume 2, Issue 4, Pages 46-53, DOI:
10.47392/irjash.2020.24