International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 10, Issue 1 (JANUARY-FEBRUARY 2022), PP. 22-33

CONDUCTING EXPERIMENT ON INVERTED SOLAR STILL WITH DIFFERENT WATER DEPTH AND ITS PERFORMANCE EVALUATION

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***Abstract*— Water is the most significant component for continuing life on earth. 71% of the world's surface is water-secured, and the seas hold 96.5 percent of all worlds' water which is salty and can't be utilized straightforwardly. Water additionally exists in waterways, lakes, in icecaps and icy masses which is the crisp water asset on earth and can be made into utilization straightforwardly. The proportion of salty water to fresh water on earth is around 40 to 1. Anyway populace development and industrialization has brought about the incredible request of crisp water for various local, farming and modern uses. Also, the fresh water of the earth is distributed very unevenly. Fresh water lack issue has turned into a noteworthy issue nowadays thus desalination of the ocean water is the main choice left. In this correspondence, a test investigation of modified safeguard sun based still or IASS at various water profundity. Tests are led for the climatic state of Lucknow, Uttar Pradesh, India. It is discovered that the day-by-day profitability of the still is expanded when profundity of water in the bowl is 0.01m. The day-by-day efficiency of the still increment with increment of temperature distinction among water and glass spread. What's more, from the tests it is presumed that, when water profundity decline inside the bowl, heat limit of bowl water abatement and results in higher temperature inside sun oriented still and better dissipation and buildup produces improved distillate yield. The most extreme hourly profitability of the still for various profundities (0.01m, 0.02m, and 0.03m) is observed to be 6.604 kg/m2-day, 5.230 kg/m2-day, 4.736 kg/m2-day. From these outcomes it is affirmed that the 0.01m water profundity is the ideal for greatest efficiency of the sun based still. The hypothetical outcomes acquired from the diagnostic arrangements are in great concurrence with the trial results. Greatest normal day by day distillate yield is observed to be 6.604 kg/m2-day. The ideal water profundity of 0.01m upgraded vanishing and buildup procedure and increment the yield rate, because of the enormous temperature distinction among water and glass spread. It is affirmed that the effectiveness of the still is expanded when profundity of water layer in the bowl is diminished and momentary of warmth extraction. The greatest normal quick proficiency of the sun oriented still with various profundities (0.01m, 0.02m, and 0.03m) is observed to be 39.85%, 31.63% and 28.58%.**

***Index Terms*— Solar still, Inverted absorber, water depth etc.**

I. INTRODUCTION

Clean water is indispensable necessity for healthy environment, which impacts the social and Economic development of the nation. Individuals utilizing polluted water are inclined to water-borne sicknesses and they can't adequately draw in themselves in economic activities. Also, financial implies that could be apportioned to advancement ventures are diverted to sickness causing endeavors. Subsequently, sick wellbeing sponsors to the debasement of monetary development. Being restricted access to helpful water that fulfills satisfactory guideline dimensions of natural, compound and physical constituents, roughly 97% of water accessible on the world's face is salty, and ecological contamination caused overwhelmingly by anthropogenic exercises is likewise added to the debasement of valuable water assets. The WHO report demonstrates that 78% and 96% of the provincial and urban populaces utilize clean helpful water on a worldwide scale individually. In this way, 4 billion instances of loose bowels are accounted for every year, with 88% of them being go along to utilize unclean/dangerous water, and lacking sanitation and cleanliness. Such issue demonstrated the imperative for intermediations that goes for giving sterile water. It is evaluated that more than 2.7 billion individuals will appearance serious water deficiency issue by year 2025 if the verdure continues expending water at the comparable rate per capita and the populace development fits the determined pattern. In India alone, in excess of 200 million individuals don't have any entrance to safe helpful water. The disaster is basically inferable from botch of existing water assets, populace movement, and nonstop climatic changes. And furthermore the majority of the water is in the seas however it

contains a lot of salt and can't be used for helpful and different purposes. The rest of the water on earth which is valuable is frosted up in icy masses and ice tops at north and south shafts. Thus, the main supply of helpful water is for the most part from streams, waterways, lakes, and so forth. It is, subsequently, important that an earnest endeavor ought to be made to confront the undermining water emergency and safeguard contracting water supply joined by the rising interest. The main objective of this experiment is to obtain the performance of inverted absorber solar still with different water depth.

A. WATER AND ITS CONVEYANCE ON EARTH

The circulation of water on earth's surface is particularly uneven, just, 3% of water is in the type of helpful water. Of this valuable water 69% is in the frosty mass, 30% underground and less than 1% is in lakes, streams and so forth. The staying 97% is as seas and is salty and along these lines can't be utilized for any family unit or modern purposes

B. PRINCIPLES OF SOLAR DISTILLATION SYSTEM

There are distinctive sort of parts of vitality equalization and warm vitality misfortune in a ordinary single slant refining unit. It is straightforward and hermetically fixed basin for the most part comprised of electrifies iron and is made protected from all sides by utilizing protection materials. The inner surface of the basin otherwise called basin liner is painted dark in order to capability ingest the sunlight based radiations episode on it. There is additionally an exceptional prearrangement made for the gathering of the pith yield on the sides of the still or on the lower closures of the still. The briny or the saline water is conveyed in the basin for the sanitization procedure.

PRINCIPLE WORKING OF SOLAR STILLS

Sunlight based refining is the procedure which essentially utilizes the warmth of the sun legitimately for acquiring helpful water from the salty saline water. The hardware or the gadget utilized is known as sun based still it comprise of a shallow bowl which is completely darkened from inside in order to retain high measure of episode beams and is secured with a straightforward glass spread. The briny water is filled in the shallow bowl and the sun's beams that are episode on the glass spread enable the water to warm up present in the bowl causing the procedure of vaporization. The warmed water ascends in the structure of vapor and gets consolidated on the inward side of the glass surface these beads rundown into the trough authority and the unadulterated or valuable water gets gathered in the estimating cup through the outlet present in favor of the as yet deserting every one of the pollutions and the salt substance. Approaching radiation from the sun is a standout amongst the most considerable information factors in sun based refining. Sunbeam radiation voyages straightforwardly from the sun to a recipient surface, and its beams can be followed from the sun's position and utilized in deciding the sunlight based elevation and azimuth points. These points influence the amount of pillar outflow transparently going to a given surface.

C. OBJECTIVES

- To study the performance of inverted absorber solar still with different water depth
- To test the nature of distillate yield.

II. LITERATURE REVIEW

Bahadur et al. (2017) utilized vitality stockpiling medium i.e., PCM to help the yield amid off sunbeams hours. In the current work salt hydrate Mg (NO3)2.6H2O was utilized as vitality putting away material in a solitary bowl sun oriented still. Investigational studies were performed in the areas of SHUATS Allahabad, U.P. India and it was seen that the utilization of Magnesium Nitrate hexahydrate as vitality stockpiling medium in the still builds the everyday yield by 22%.

Dube et al. (2017) has examined the exhibition of ventured still for stearic corrosive utilized as a PCM. The methodology of desalination is utilized to expel high briny substance, elements, minerals from water source. The inclusion vitality i.e., sun oriented vitality is utilized for detachment of salt and water in desalination process. Utilization of PCM is a significant procedure for improving the exhibition of still. A Stepped still with pyramidal glass spread and a strategy for improving yield utilizing PCM as stearic corrosive was talked about in this examination paper.

Muftah et al. (2017) has considered a past work of ventured still which is deliberately picked to put on modifications on it and suggest it as another plan. Vitality equalization model was built up to look at the capacity of the ventured still when alteration. The vitality balance results were gotten by settling the vitality balance conditions for a few components as pursues: safeguard plate, saline water and glass front of the still. Hourly sun powered radiation and hourly encompassing temperature of clear sky day conditions were utilized as info information in the vitality parity model. The hourly presentation of the ventured still was analyzed when alteration under the accompanying assessment parameters as pursues temperature contrast between saline water and glass spread, heat exchange coefficients, still yield and still effectiveness. The outcomes demonstrated that the hourly estimations of assessed parameters after change are constantly higher of that before alteration. This augmentation was tried factually to affirm its noteworthiness. Along these lines, the distinctions in the mean estimations of every assessment parameter when adjustment were tried by factual matched t-test. The test outcomes affirmed that there was a noteworthy distinction in the mean estimations of every assessment parameter when change. Besides, the everyday yield of the ventured still after alteration expanded from 6.9 to 8.9 kg/m2; this speaks to 29% improvement contrasted with before change. At long last, in view of the consequences of the

assessment parameters and the measurable test, it very well may be said that the warm presentation of the proposed ventured still was impressively upgraded through the new change.

Dubey et al. (2017) has planned a sun based still with discrete gathering chamber to upgrade the rate of buildup and subsequently the efficiency. Their exhibitions as far as vitality and exergy efficiencies were contrasted and the customary still. The trial was directed in the premises of SHUATS Allahabad, U.P., INDIA. It was seen that the exergy proficiency of still with discrete gathering chamber is 60.8% more than the ordinary sun based still.

Yadav et al. (2017) the greatest measure of sun powered emanation accessible to earth is a chance to selection it however much as could reasonably be expected. The cosmological emanation got on the earth surface on a bright day was around 1kW/m2. This vitality is uninhibitedly possible and most basically it is earth benevolent. In the present research work, the presentation of changed still (MSS) with altered advances and warm stockpiling material has been examined and looked at tentatively. It was gotten that the extraordinary glass temperature of CSS was 56oC at 12:30 pm while the outrageous glass temperature for MSS was recorded to be 68oC at 1:30 pm. The most extreme CSS vapor temperature was recorded to be 63oC though the most astounding temperature acquired by MSS vapor was 65oC. The most extreme hourly yield acquired was 135 ml and 325 ml for CSS and MSS, separately. Consequently, the most extreme hourly yield of MSS was about 2.4 occasions that of CSS. The aggregated yield of CSS and MSS for 8 hour length was acquired to be 517 and 1359, separately, for example MSS has 162.86% higher yield contrasted with CSS.

III. EXPERIMENTAL SETUP

An exploratory setup of the IASS has been introduced in April, 2020 at Sulabh Awas,Gomtinagar Lucknow, (U.P.), India (scope 23° 37′ N, longitude 58° 35′ E). The photo and schematic figure of the IASS have been appeared in Fig. 1(a) and (b). The body of the sunlight based still has been made of galvanized iron (G.I.) sheet of thickness 0.006 m. The basin region and tendency point of the glass of the sunlight based still have been taken 0.25m2 and 32° separately. The stature of the south-bound mass of sun based still has been taken 0.15 m with a trough inside to gather the dense water. A reflector of sweep of shape 0.5 m has been set under the basin. The basin liner has been painted of a flimsy layer of dark paint on both of its surfaces for example top and base surfaces, to expand the absorptivity of the sun powered radiation. Two basic window glass front of thickness 5 mm have been utilized as a gathering spread over the dividers of sun oriented still and to cover the reflector opening.

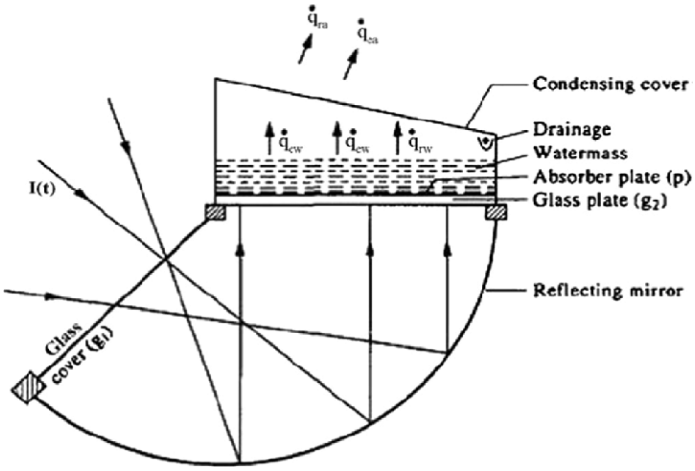

Figure 1: Inverted Solar Still

The glass spread on the reflector opening keeps descending warmth misfortune from the basin to the encompassing. Both the glass covers have been fixed by utilizing air tape, sticky tape and plastic clasps. The air tape gives pad to the glass spread and avoids vapor spillage. The plastic clasps hold the glasses on the dividers of the sun powered still and reflector opening. Every one of the sides of the IASS have been protected by a 0.02 m thick Styrofoam to avoid heat misfortune to the surrounding. The base surface of the basin has been left un-protected to get reflected sunlight based radiation. A plastic cylinder has been associated with the outlet of the trough for gathering the distillate into a container.

Figure 2: Experimental Setup

Figure 3: Experimental Setup

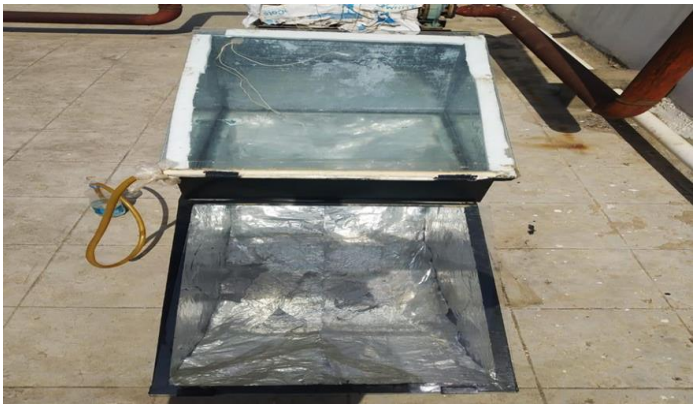

Figure 4: Experimental Setup

IV. OBSERVATIONS

The experimental setup was placed on the top of the home, Sulabh Awas, Gomtinagar Lucknow, Uttar Pradesh, building. The experimental procedure started at 6:00 am. The water level in this unit was constant 0.01m, 0.02m and 0.03m by deliver of brackish water regularly.

The following parameters measured during the experiment:

- Intensities of Solar
- Temperature of Water inside the still
- Still bottom Temperature
- Glass Cover Temperature

Figure 4: Experimental Setup

First day experiment details
Date: 01/04/2021

Inverted Absorber solar still for 0.01 m water depth (with Gomti water)

Temperature variation with time, Table [1]

Time (h)	T_w	Tc
6:00	12	11
7:00	14	13
8:00	30.5	25.3
9:00	38.4	32.4
10:00	48.5	36.7
11:00	58.1	44.3
12:00	68.9	54.3
13:00	71.6	58.2
14:00	73.2	63.5
15:00	72.6	64.7
16:00	68.5	63.1
17:00	65.2	62
18:00	61.4	56.3
19:00	54.8	50.1
20:00	46.1	41.8
21:00	42.5	36.2
22:00	35.6	30
23:00	30.1	28.1
0:00	28.1	24.1
1:00	24.5	22
2:00	22.4	19.3
3:00	19.7	18.2
4:00	17	16
5:00	16.1	15

Second day experiment details
Date: 03/04/2021

Inverted Absorber solar still for 0.02 m water depth (with Gomti water)

Temperature variation with time ,Table [2]

Time (h)	T_w	Tc
6:00	10.7	10.7
7:00	12.7	12.7
8:00	29.2	25
9:00	37.1	34.2
10:00	47.2	39.1
11:00	56.8	48.2
12:00	67.6	58.3
13:00	70.3	61.8
14:00	71.9	63.2
15:00	71.3	64.4
16:00	67.2	62.8
17:00	63.9	61.7
18:00	60.1	56
19:00	53.5	49.8
20:00	44.8	41.5
21:00	41.2	35.9
22:00	34.3	29.7
23:00	28.8	27.8
0:00	26.8	23.8
1:00	23.2	21.7
2:00	21.1	19
3:00	18.4	17.9
4:00	15.7	15.7
5:00	14.8	14.7

Third day experiment details
Date: 07/04/2021

Inverted Absorber solar still for 0.03 m water depth (with Gomti water)

Temperature variation with time , Table [3]

Time (h)	T_w	Tc
6:00	9.56	9.56
7:00	11.8	11.8
8:00	27.5	24.6
9:00	36.1	33.4
10:00	45.8	38.9
11:00	55.8	47.1
12:00	66.2	57.3
13:00	69.5	60.5
14:00	70.4	62.5
15:00	69.4	63.5
16:00	66.3	61.6
17:00	62.9	60.5
18:00	58.4	54.4
19:00	52.7	47.4
20:00	43.1	40.2
21:00	39.5	34.6
22:00	32.7	27.5
23:00	27.8	26.3
0:00	24.4	21.8
1:00	21.9	20.6
2:00	20.4	18.4
3:00	16.5	15.7
4:00	13.89	13.11
5:00	13.1	13.2

V. RESULT & DISCUSSION

Hourly yield through solar still (kg/h), when water (Gomti Water) depth in basin is 0.01m Table [4]

Time (h)	mew
6:00	0
7:00	0.0026
8:00	0.05322
9:00	0.095364
10:00	0.3439
11:00	0.6571
12:00	1.1878
13:00	1.2412
14:00	0.9458
15:00	0.72722

16:00	0.37977
17:00	0.2505
18:00	0.1694
19:00	0.1636
20:00	0.1249
21:00	0.09479
22:00	0.07587
23:00	0.03384
0:00	0.01575
1:00	0.01547
2:00	0.01347
3:00	0.00617
4:00	0.00313
5:00	0.00336

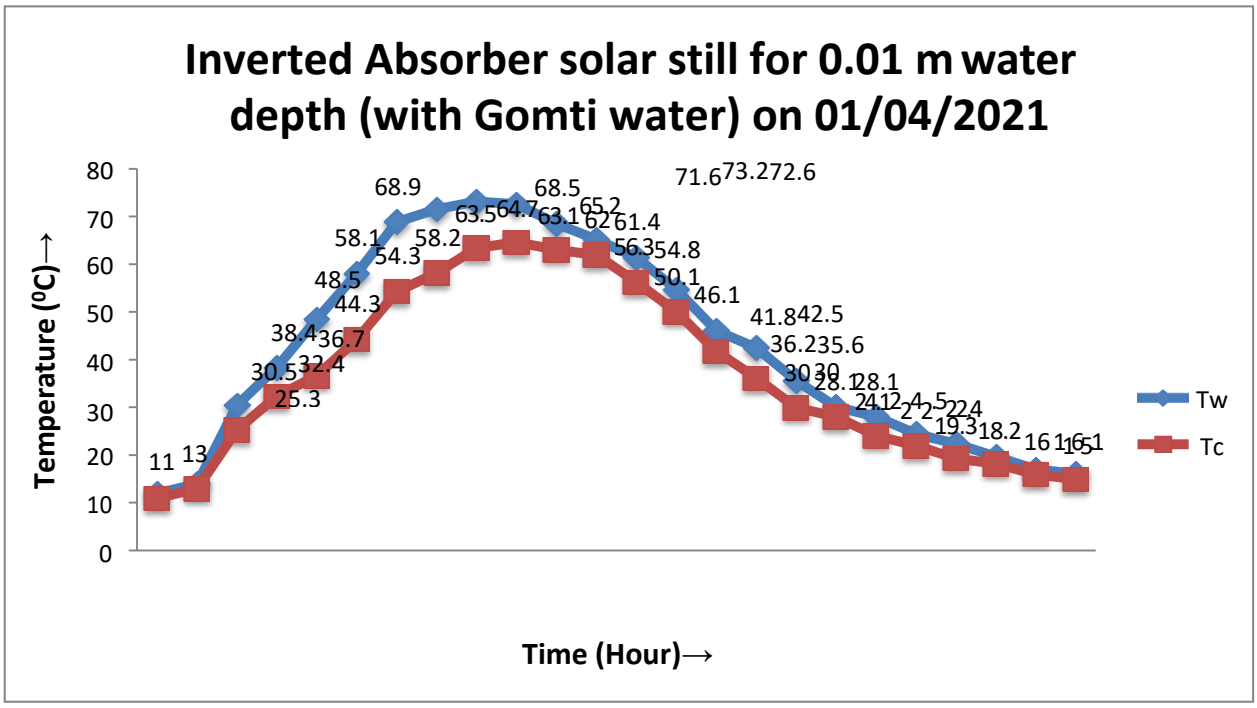

Figure 5

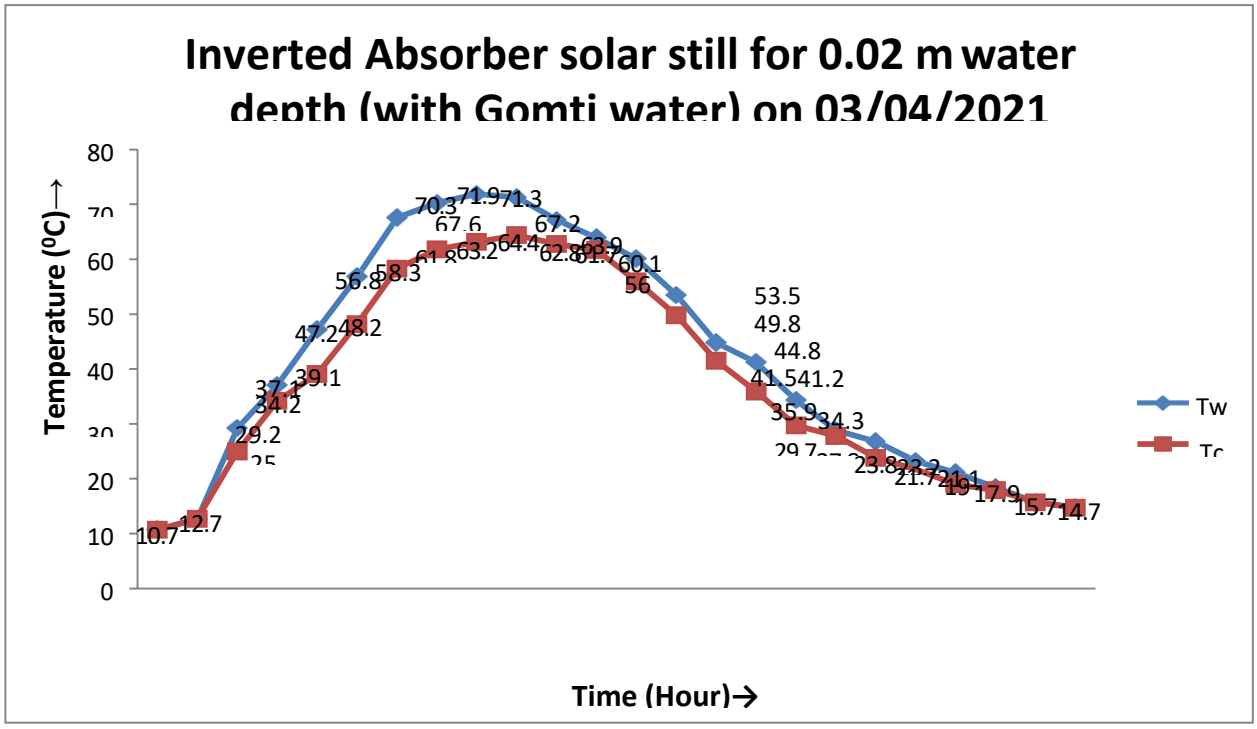

Figure 6

Table [5]

S.No.	Depth of Yamuna water in basin	Max Water Temperature	Max Glass Cover Temperature	hourly yield through solar still (kg/h)
1	0.01m	73.2^{0}C	64.7^{0}C	6.604

Hourly yield through solar still (kg/h), when water (Gomti Water) depth in basin is0.02m Table [6]

Time (h)	mew
6:00	0
7:00	0
8:00	0.04088
9:00	0.083024
10:00	0.14156
11:00	0.55476
12:00	0.98546
13:00	1.03886
14:00	0.84346
15:00	0.62488
16:00	0.27743
17:00	0.14816
18:00	0.10706

19:00	0.09126
20:00	0.08256
21:00	0.07245
22:00	0.06353
23:00	0.0315
0:00	0.01341
1:00	0.01313
2:00	0.01113
3:00	0.00383
4:00	0.00079
5:00	0.00102

Table [7]

S.No.	Depth of Yamuna water in basin	Max Water Temperature	Max Glass Cover Temperature	hourly yield through solar still (kg/h)
1	0.02m	71.9^{0}C	64.4^{0}C	5.203

Hourly yield through solar still (kg/h), when water (Gomti Water) depth in basin is0.03m Table [8]

Time (h)	mew
6:00	0
7:00	0
8:00	0.03088
9:00	0.073024
10:00	0.12156
11:00	0.45476
12:00	0.78546
13:00	0.83886
14:00	0.74346
15:00	0.52488
16:00	0.17743
17:00	0.54816
18:00	0.09706
19:00	0.08126
20:00	0.07256
21:00	0.06245
22:00	0.06353
23:00	0.0215
0:00	0.01341

1:00	0.01213
2:00	0.01013
3:00	0.00283
4:00	0.00079
5:00	0.00002

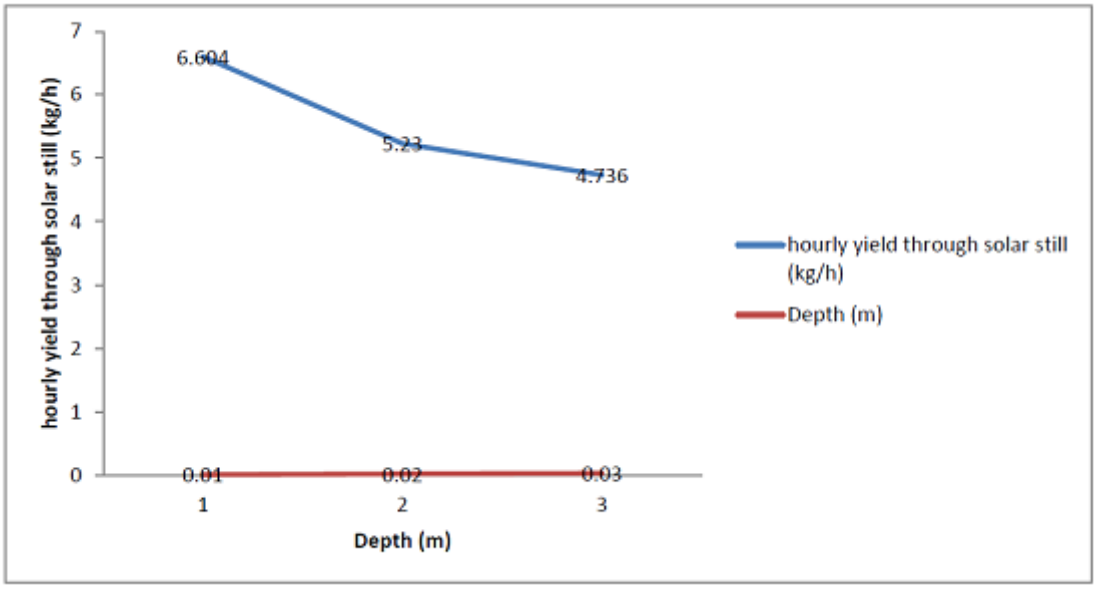

Figure 7: Variation Of Yield with Water Depth

VI. CONCLUSION

There are following conclusions have been drawn:

- There is a critical increment in the water temperature of an IASS because of decreased base warmth adversity and higher absorptivity of the inverted absorber plate.
- The yield of a sunlight based still is expanded by inverted absorber.
- The radiative and convective warmth exchange coefficients of the inverted absorber sun based still don't differ much with change in water profundity. In any case, the evaporative warmth exchange coefficient altogether relies upon water profundity because of the expansion in water temperature as the profundity diminishes.
- The everyday yield diminishes with water profundity true to form..

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