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Design Improvement of Solar Still Device Using Separate Condenser

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Abstract: ***The need of human society for medical growth is clean water. It has seen that in rural areas electricity is not available in proper manner so after cleaning device cannot be used in efficient way. So reduce this problem solar still is important device which works on solar thermal energy. In present study, researcher try to develop a solar still which has improved performance than simple single basin solar still. To develop improved solar still, separate condenser is used. The experimental setup is installed at mechanical engineering lab of college building and all experiments are performed for 1st June to 10th June 2017 for to setups of simple solar still and separate condenser. The final conclusion of present study is that separate condenser source performed better than simple solar still for present experimental study.***

Keywords: Solar Thermal Engineering, Solar Still, Separate condenser, Thermal Efficiency

I. INTRODUCTION

Energy and water are two important problems from the environmental purpose of view; each of them play very important role within the improvement of the economy over the whole world. Potable water could be a basic human requirement, and pollutants created by mortals have adversely affected it. Most water exists within the variety of brine, and solely restricted sources of water will be found within the surface of the world or deep within the earth or as natural aqueducts. Most water resources contain salt, bacterium and pollutants. To get recent and potable water, could be a have to be compelled to distill and RO water. These conditions necessitate the applying of purification so as to get pure water from briny or salty water. In several places, the recent and moveable water isn't enough and demand exceeds the provision to supply potable water by using thermal methodology heat is needed the value of utilizing solar power to supply water is affordable and conjointly there's no remained waste from the method. Although, there are many various forms of distillation processes for desalting water systems victimization renewable energy adore solar power has some edges within the remote areas, wherever there's no access to electricity or troublesome to achieve fossil fuels. The objective of present research work is to investigate the performance of external source solar still. The simple solar still based experimental analysis is also performing to compare the external source solar still.

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Proper calibration is also performed for this research work all experiment is proposed at roof of mechanical engineering department of Apex Engineering College.

II. SOLAR STILL THEORY

The term solar Distillation refers to the evaporation and subsequent precipitation of raw water, thus purifying it. Basically, there square measure two principles to be distinguished: direct star distillation, which is characterized by its immediate use of solar power to evaporate raw water; and indirect solar distillation, that makes use of a lot of subtle energy conversion techniques for raw water heating. Frequently, indirect solar distillation to boot separates the evaporation and condensation processes spatially so as to lift the distillation yield. The fundamental distinction between the two principles is illustrated in figure 1, though indirect star distillation in several,

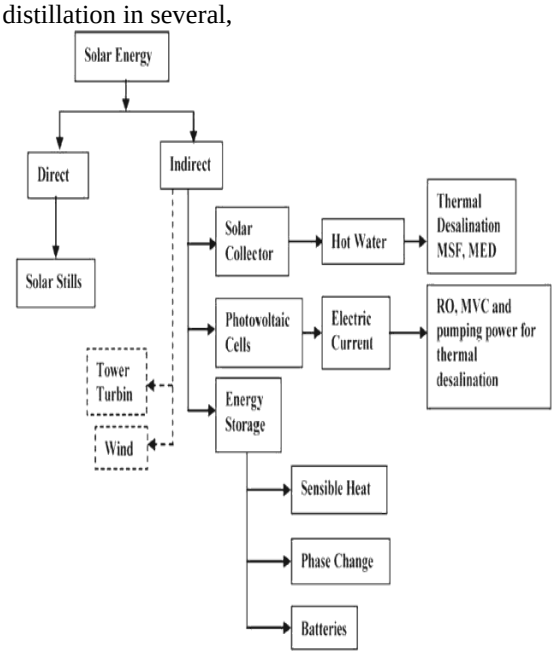

Fig-1

III. EXPERIMENTAL SETUP

In this research two design of solar still are fabricated for experimental work. The first design is simple solar still and second design is separate condenser solar still. Simple structural steel sheet is used to fabricated the set up body.7mm glass plate is used to transmit solar radiation in fabricated setup rubber coating is used to reduce leak of evaporated air from setup. Insulation is also provided at main simple solar still body. Total cost of setup is 10000 for present research work

Experimental set up of simple solar still

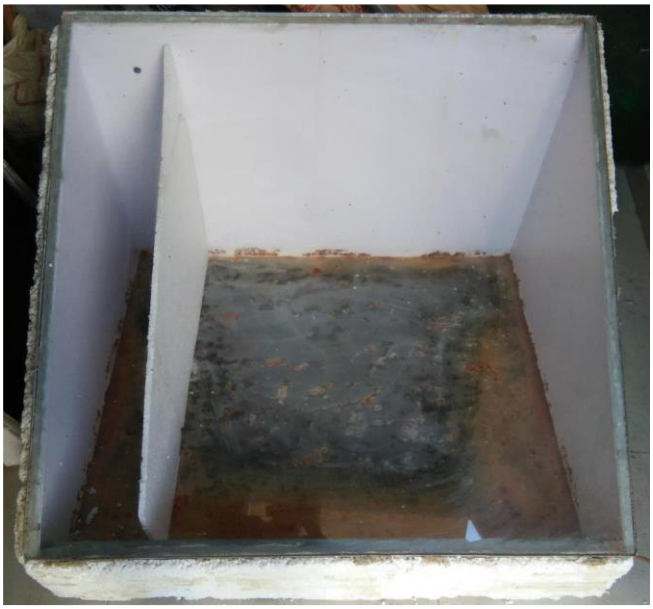

Figure 3 Experimental set up of solar still ith separate condenser

Data Collection

Present research study is done in jaipur for time period 1st june 2017 to 6thjune2017 for both design of solar still which is already present in this work. 10L, 20L and 30L water quantity in first three cases designed for simple solar still .And two design of Separate condenser solar still are also investigated for this research work. Full day reading of all these experiment are present in this section. Data is reduced for present research work for hourly basis .All data was present from table 1 to table 5 for 10L,20L,30L,external source-1 and external source-2.

Table1Hourly data collection (Temperature) for 10 L SS case

Time(h)	Solar Radiation(W/m2)	T1(Glass Upper)	T2 (Glass Lower)	T3 (Ambient Air)	T4(Inside Air Temp)	T5 (Absorber Temp)
7:00	165.00	31	35	32	34	37
8:00	263.00	30	38	36	37	40
9:00	374.00	33	44	38	44	47
10:00	438.00	35	55	40	54	57
11:00	542.00	40	62	41	62	65
12:00	637.00	42	68	42	67	70
13:00	675.00	41	73	39	68	74
14:00	700.00	39	67	39	61	68
15:00	637.00	37	64	37	60	65
16:00	375.00	34	59	35	59	61
17:00	238.00	32	56	33	55	58
18:00	120.00	29	50	31	48	53
19:00	62.00	27	48	30	47	50

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Table2 Hourly data collection (Temperature) for 20 L SS case

Time(h)	Solar Radiation(W/m 2)	T1(Glass Upper)	T2 (Glass Lower)	T3 (Ambient Air)	T4(Inside Air Temp)	T5 (Absorber Temp)
7:00	192.00	32	36	33	34	37
8:00	306.00	31	42	37	39	43
9:00	437.00	34	52	39	48	52
10:00	553.00	37	59	42	56	62
11:00	617.00	42	69	43	65	70
12:00	675.00	43	72	44	68	73
13:00	657.00	43	68	40	64	72
14:00	600.00	41	68	40	65	70
15:00	492.00	38	65	38	63	69
16:00	375.00	36	60	37	56	68
17:00	234.00	33	55	35	51	63
18:00	92.00	31	47	32	45	55
19:00	75.00	30	42	32	39	47

Table3 Hourly data collection (Temperature) for 30 L SS case

7:00	223.00	32	35	30	33	35
8:00	302.00	36	37	35	36	40
9:00	444.00	37	44	36	42	47
10:00	556.00	38	52	37	50	55
11:00	649.00	40	58	39	57	62
12:00	704.00	41	64	40	63	68
13:00	684.00	44	66	42	65	68
14:00	674.00	43	71	41	67	72
15:00	560.00	41	69	40	66	71
16:00	403.00	42	65	41	63	69
17:00	268.00	39	58	37	57	63
18:00	106.00	38	42	37	41	45
19:00	80.00	37	45	35	44	49

Table4 Hourly data collection (Temperature) for10L Separate condenser Solar still

Time(h)	Solar Radiation(W/m2)	T1(Glass Upper)	T2 (Glass Lower)	T3 (Ambient Air)	T4(Inside Air Temp)	T5 (Absorber Temp)
7:00	148.00	31	37	31	38	40
8:00	305.00	35	37	34	38	45
9:00	443.00	35	49	35	52	55
10:00	557.00	37	57	37	60	64
11:00	634.00	39	63	38	64	72
12:00	702.00	39	65	39	66	74
13:00	670.00	39	57	39	62	73
14:00	216.00	39	55	40	57	70

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15:00	193.00	37	50	35	53	64
16:00	290.00	36	50	36	51	63
17:00	300.00	34	46	34	49	60
18:00	120.00	32	42	32	45	56
19:00	70.00	35	42	42	42	54

Table5 Hourly data collection (Temperature) for 20LSeparate condense roller still with simple

Time(h)	Solar Radiation(W/m 2)	T1(Glass Upper)	T2 (Glass Lower)	T3 (Ambient Air)	T4(Inside Air Temp)	T5 (Absorber Temp)
7:00	124.00	29	39	27	35	38
8:00	340.00	33	38	31	35	42
9:00	204.00	34	50	32	49	52
10:00	232.00	36	58	34	57	61
11:00	704.00	38	65	36	61	69
12:00	770.00	38	67	37	64	71
13:00	639.00	37	58	35	59	71
14:00	640.00	37	56	36	55	68
15:00	561.00	35	51	33	50	61
16:00	488.00	35	51	33	49	61
17:00	300.00	33	48	31	47	57
18:00	187.00	30	44	29	42	54
19:00	102.00	34	43	33	39	51

IV. Result and Discussion

Simple solar still is investigated with design improvement in solar still with separate condenser. Solar radiation data is collected from MNIT Jaipur weather station installed at MNIT JAIPUR. Solar radiation and yield performance for all experiment are present in figure 4 to figure8 for 10L, 20L, 30L and separate condenser solar still. Comparison of all case is present in figure 9 and figure 10. Hourly yield performance and efficiency for all cases are present in table 6 to table 8 for 10L, 20L, 30L and Separate condenser-1 and separate condenser-2 cases**.**

(a) **Yield and Radiation analysis of All selected cases:-**Figure 4 presents yield and radiation for 10L water case at 1st june 2017 for full day field experiments It is seen from the figure that maximum yield to present for 11am to 2 pm for all cases but highest yield is shown for separate condenser solar still.

(b)

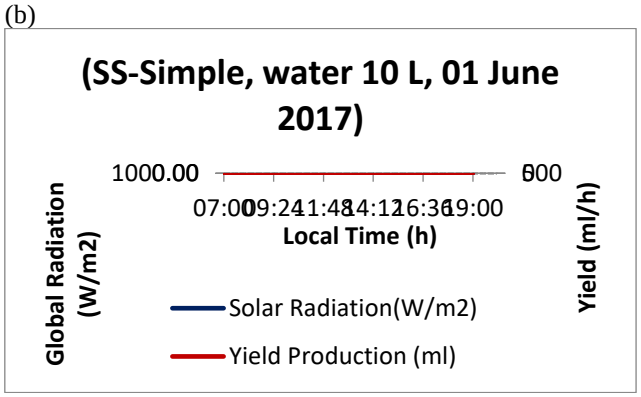

Figure.4.Simple solar still 10L water 01 June 2017

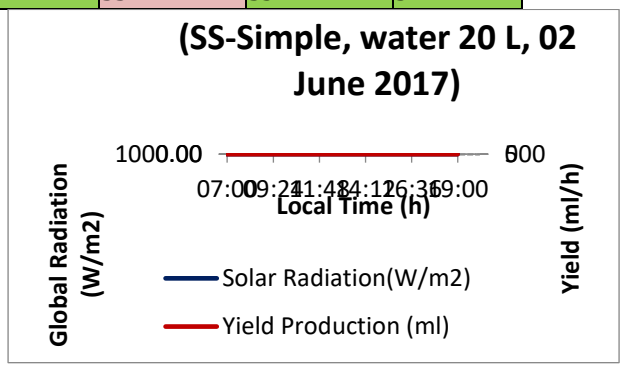

Figure.5 Simple solar still 20L water

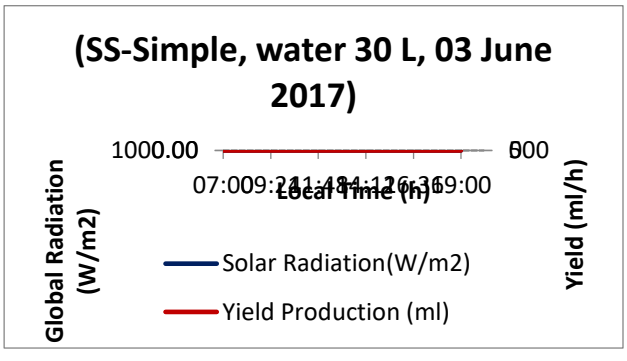

Figure.6. Simple solar still 30L water

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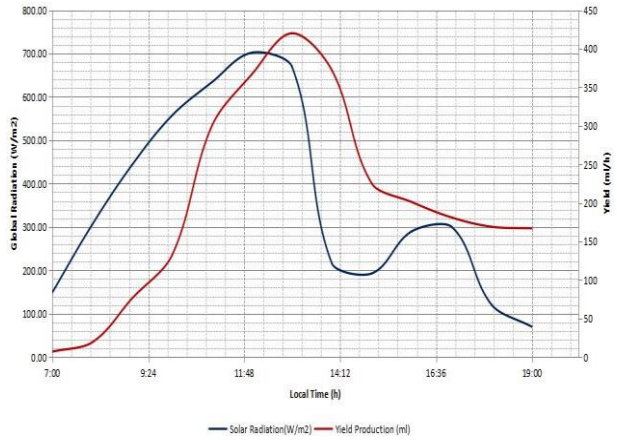

Figure.7.Simple solar still with separate condenser

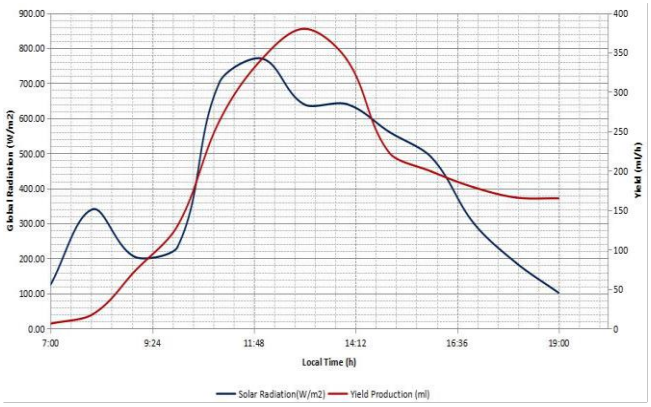

Figure.8.Simple solar still with Separate condenser-2

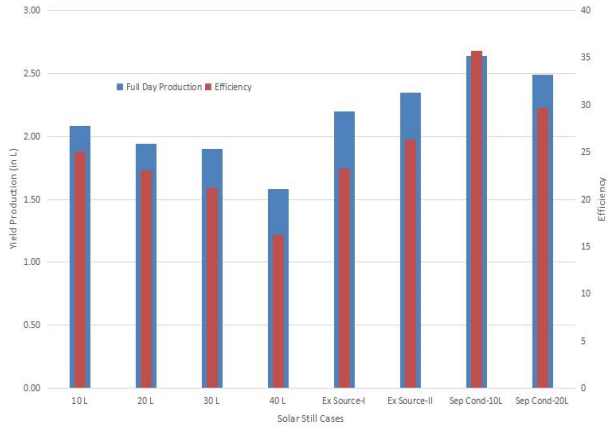

Figure 9.Comparison of different boundary conditions of solar still

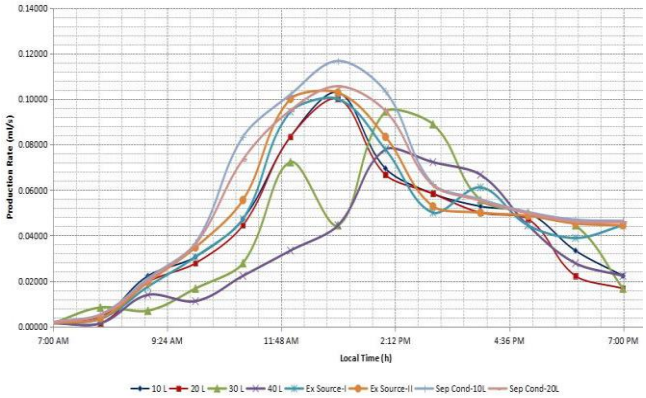

Figure 10.Variation of Production rate for different conditions of solar still

(c)

(b) Yield Performance Comparison: - separate condenser highest yield performance and efficiency for all case which is present in figure 9. The same result is present for figure 10 for comparison of cases.

Hourly Yield Performance Comparison

Table.6 Hourly Efficiency variation for 10L and 20L water depth

Time(h)	Total Solar Radiation(W/m2) (10 L)	Yield Production (ml) (10 L)	Efficiency (10 L)	Total Solar Radiation(W/m2) (20 L)	Yield Production (ml) (20 L)	Efficiency (20 L)
7:00	165.00	5	1.91	192.00	5.00	1.64
8:00	263.00	15	3.60	306.00	5.00	1.03
9:00	374.00	80	13.49	437.00	70.00	10.10
10:00	438.00	110	15.84	553.00	100.00	11.40
11:00	542.00	170	19.78	617.00	160.00	16.35
12:00	637.00	300	29.70	675.00	300.00	28.02
13:00	675.00	370	34.56	657.00	360.00	34.55
14:00	700.00	250	22.52	600.00	240.00	25.22
15:00	637.00	210	20.79	492.00	210.00	26.91
16:00	375.00	190	31.95	375.00	180.00	30.27
17:00	238.00	180	47.69	234.00	170.00	45.81
18:00	120.00	120	63.06	92.00	80.00	54.83

Table 7 Hourly efficiency variation for 30L water depth

Time(h)	Total Solar Radiation(W/m2) (30 L)	Yield Production (ml) (30 L)	Efficiency (30 L)
7:00	223.00	5.00	1.41
8:00	302.00	30.00	6.26
9:00	444.00	25.00	3.55
10:00	556.00	60.00	6.80
11:00	649.00	100.00	9.72
12:00	704.00	260.00	23.29
13:00	684.00	160.00	14.75
14:00	674.00	340.00	31.81
15:00	560.00	320.00	36.03
16:00	403.00	200.00	31.29
17:00	268.00	180.00	42.35
18:00	106.00	160.00	95.18

Table 7 Hourly efficiency variation for Separate condenser 1and 2

Time(h)	Total Solar Radiation(W/m2) (ES-I)	Yield Production (ml) (ES-I)	Efficiency (ES-I)	Total Solar Radiation(W/m2) (ES-II)	Yield Production (ml) (ES-II)	Efficiency (ES-II)
7:00	148.00	7.00	2.98	124.00	6.00	3.05
8:00	305.00	19.00	3.93	340.00	18.00	3.34
9:00	443.00	76.00	10.82	204.00	73.00	22.56
10:00	557.00	132.00	14.94	232.00	130.00	35.33
11:00	634.00	300.00	29.84	704.00	264.00	23.65
12:00	702.00	367.00	32.96	770.00	342.00	28.01
13:00	670.00	420.00	39.53	639.00	380.00	37.50
14:00	573.00	372.00	40.94	640.00	341.00	33.60
15:00	193.00	225.00	73.51	561.00	223.00	25.06
16:00	290.00	201.00	43.70	488.00	199.00	25.71

V. Conclusion

The present research work is presented for efficiency improvement of water desalination device run on solar thermal energy. The present research work is focused on comparison of solar still having separate condenser with simple solar still. All experimental work are completed at Jaipur from 1stjune 2017 to 6thjune 2017.The main conclusion of thesis research work is following.

(A) Different water quantity like 10L, 20L and 30L is invested for different days on simple solar still and it is concluded that as the quantity of water is increased the productivity is decreased because of latent heat of vaporization increase due to water quantity.

(B) When separate condenser results are compared with simple solar still results it is concluded the separate condenser perform much better than simple solar still experimental result.

(C) Hourly efficiency of both cases are also present in this research work and quite differences are show for all experiments and reason behind is environmental real time uncertainty present during field experiment performance time.

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