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A Review on Single & Double Slope Stepped Basin Water Collector

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ABSTRACT: The aim of the work is to utilize the heat energy from sun to evaporate water, so that it may cooled and collected there by purifying it. Producing fresh water by the help of solar energy by using double slope stepped basin, we also recover the heat energy removed in condenser which uses the water as cooling element, that's also taken into the process of desalination using solar still.

KEYWORDS: solar radiations, purified water, solar stills, still productivity.

I. OBJECTIVE

A Solar still distills water with substances dissolved in it by using the heat of the sun to evaporate water so that it may be cooled and collected thereby purifying it. They are used in areas where drinking water is unavailable, so that clean water is obtained from dirty water of from plants by exposing them to sunlight. In a solar still, impure water is contained outside the collector, where it is evaporated by sunlight shining through clear plastic or glass. The pure water vapour condenses on the cool inside surface and drips down, where it is collected and removed.

II. PROBLEM IDENTIFICATION

1. Algae formation on the inner surface
2. Dust on transparent cover.

III. APPLICATION

This double slope stepped basin water collector is used in cases where rain, piped, or waste flow water ,such as in remote homes or during power outages .In subtropical hurricane target areas that can lose power for days, solar distillation can provide an alternative source of clean water.

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IV. CLASSIFICATION

It is basically classified into two main categories, they are

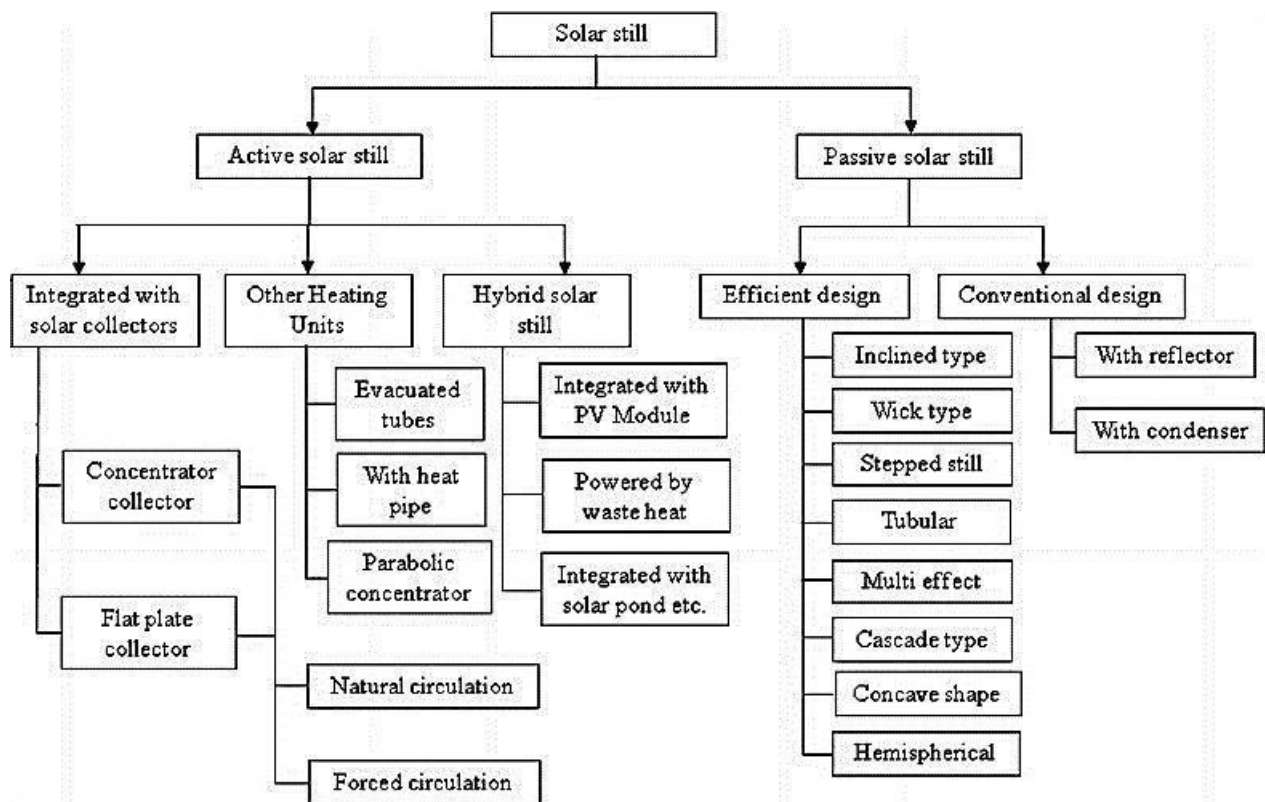


Fig.1 SKETCH OF SOLAR STILL

In this type we were going to analysis on the Passive Solar still. Whereas the passive distillation is divided into four, they are

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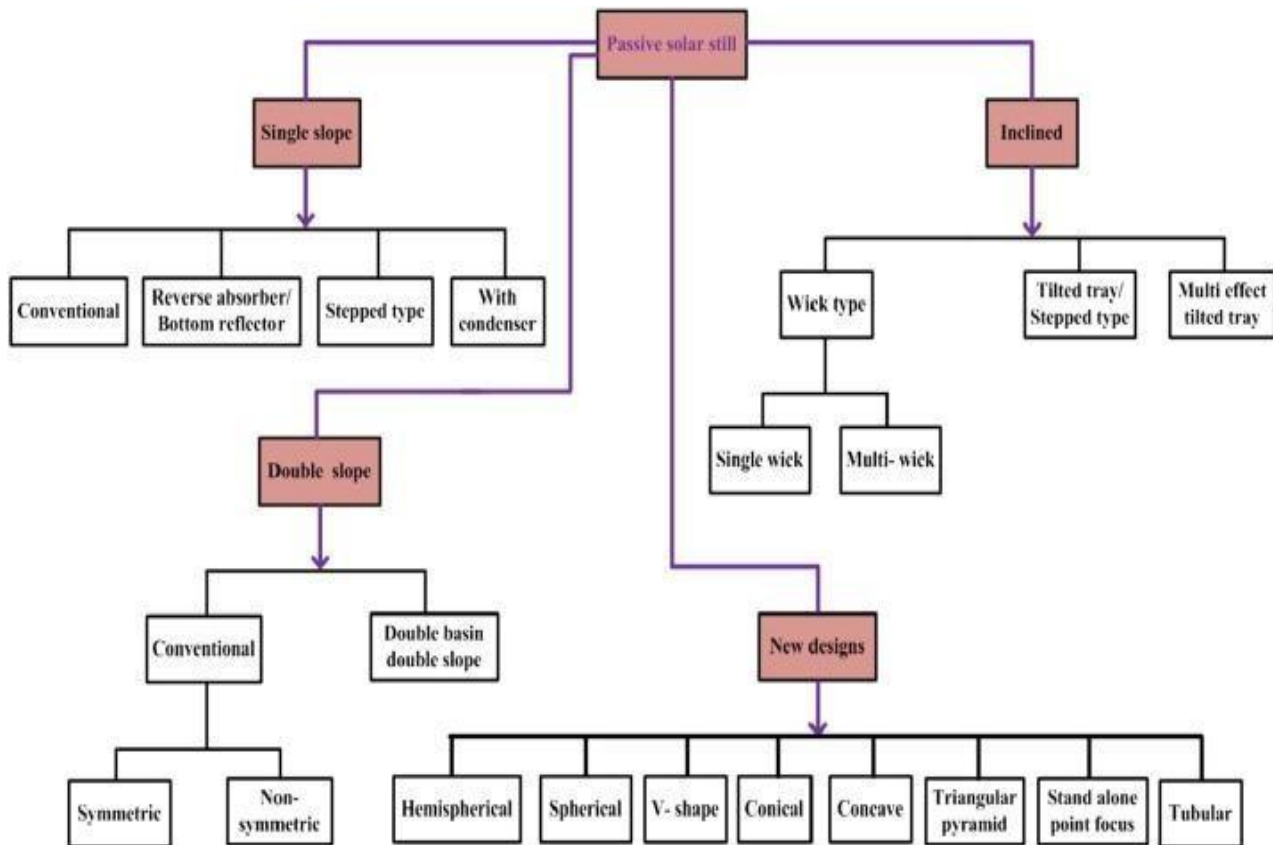


Fig.2 Performance of Solar Still

The important parameters namely

1. Sky temperature,
2. Ambient temperature,
3. Wind velocity,
4. Solar radiation,
5. Salt concentration,
6. Algae formation on water and mineral layers on basin liner

Affect significantly the performance of solar stills. It is observed that there is about 10–15% effect in overall daily yield due to change of climatic and operational parameters within the expected range.

Various studies on solar stills of multiple designs to increase the productivity of potable water and efficiency of solar still have been carried out theoretically and experimentally. The work done by previous researchers in obtaining distilled water using solar energy is work carried out.

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A. ALAUDEEN et al (5 MAY 2013)

The daily efficiency of various combinations was calculated of them coconut coir and wick combination produced 16.36%, nearly 3% increase in efficiency when compared to conventional still. Theoretical analysis was also performed and compared with experimental results. A maximum deviation of less than 10% between theoretical and experimental analysis was obtained. Cost analysis was also performed for this still, and a payback period of 320 days is required for this still which is 80 days less than that of the conventional still.

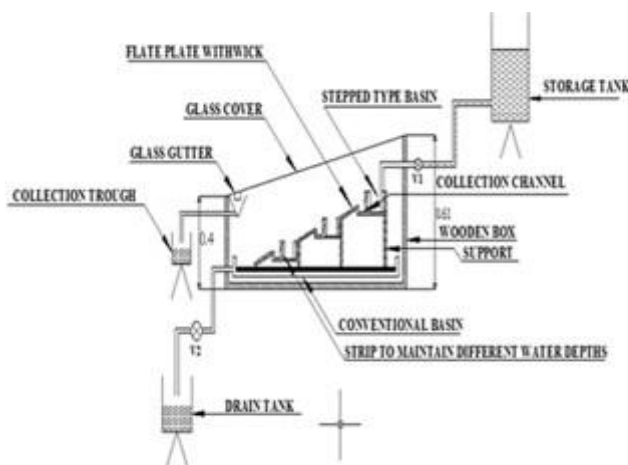


Fig.3 Sectional view of the stepped

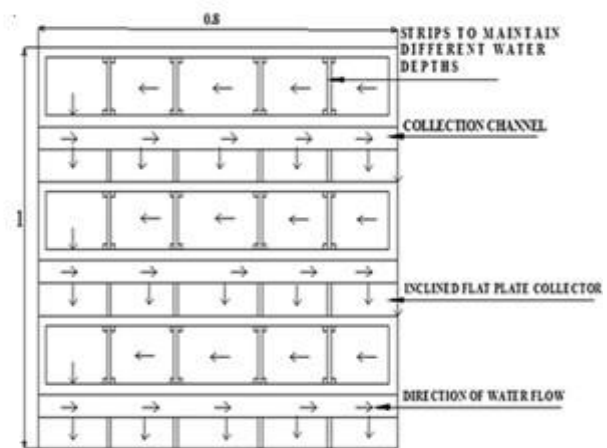
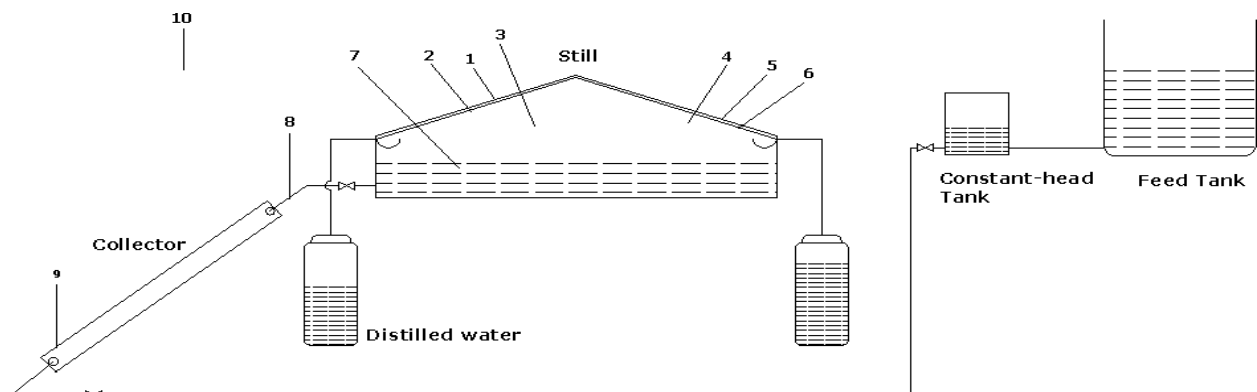


Fig.4 Top view the Stepped type type solar still basin

Rajesh .A.M et al (2 July 2009)

The production rate varies accordingly with respect to solar intensity. The productivity of the still increases by 42 % in case of bore well water , 45% in case of river water and 40% in case of sea water when FPC. This is due to enhancement of basin water temperature by FPC. An amount water collected primarily depends on the peak temperature and length of duration of highest temperature of basin water.

Fig.5 Schematic diagram of experimental set up showing the location of thermocouples



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Piyush Pal et al (06 December 2017)

The MBDSMWSS, in which FRP and Acrylic were used for fabrication of the solar still in combination with wicks arrangement. Making the E, W, and S walls (acrylic) transparent in the solar still allows more solar radiation to impinge on the basin throughout day length. The average 84% and 74% of the fraction (F1) of total input solar radiation (instantaneous) incident on both the glass covers for a typical day in the month of April 2016 and December 2015, respectively. The average 9% and 20% of the fraction (F2) of total input solar radiation (instantaneous) on walls were incident on the south wall for a typical day in April 2016 and December 2015, respectively.

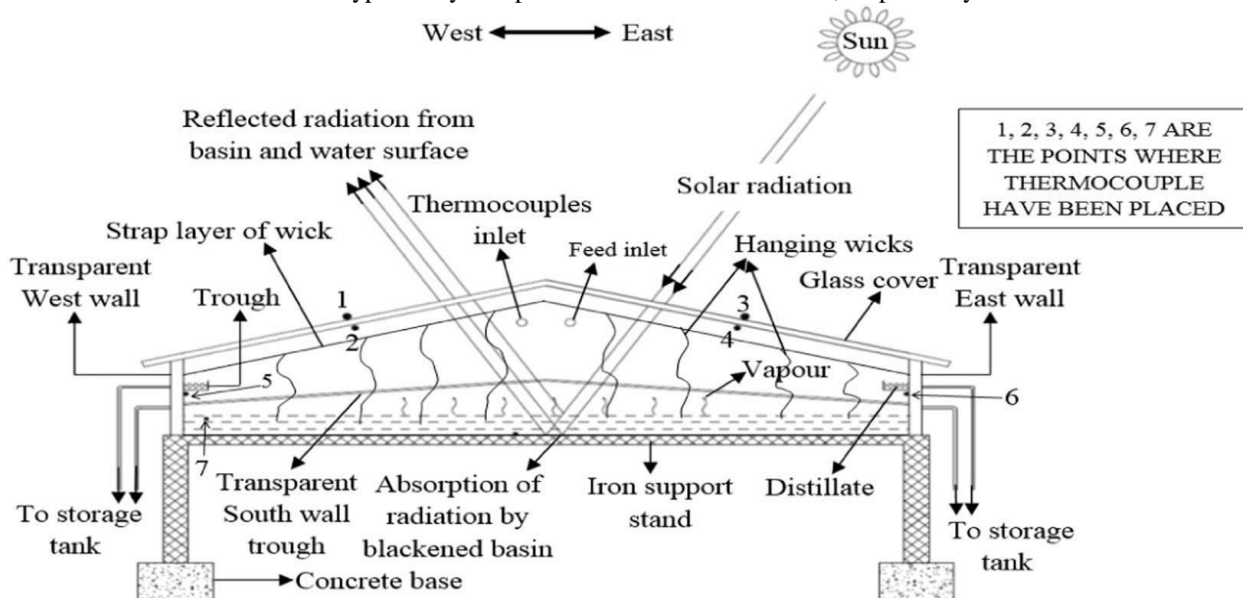


Fig.6 Schematic diagram of modified basin type double slope multi-wick solar still.

S. KALIAPPAN et al (20 May2016)



Fig7 Single basin double slope



Fig. 8 Double basin double slope

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From the experimental investigation we find that, it Providing additional basin increases the total cost a little, but increases the distillate by huge The highest distillate production from both SB and DB solar still occurred with minimum depth (2 cm) of water in basin. It is also noted that, provision of wick or porous or energy storing material in the basin increases the distillate output. Especially for mild steel pieces in the basin gives maximum of 1 220 mL/0.25 m²/day for DB still. The presents of additional basin increases the daily productivity around 75% than single basin still. The night productivity is improved with passive double basin as 49.2%.

A. S. Zedan et al (18 June 2015)

In the present work, the effects of preheating water entering the still and decreasing pressure in solar still are experimentally studied at Faculty of Engineering, KKU University, Abha City, which lies on the altitudes of 2200 m above sea level, Arabia. The geographical location may be have considerable effect on the increased water productivity, especially for those sites which lie on the altitudes above sea level, where low boiling point of water and also saturation pressure are lower than the level of standard atmospheric pressure. It is found that the water productivity of basin solar still increases with the average solar radiation intensity increased. Preheating the water entering the still increases the water productivity by amount about 27.7% - 29.3%. Decreasing pressure inside the still using vacuum pump improves the solar still water productivity by amount about 21.8% - 23.9%.



Fig.9 (a) Schematic Diagram of Experimental (b) Photograph of Experimental Setup.

Setup.Naga Sarada Somanchia et al (19 Feb 2015)

It is known that, the solar distillation exhibits considerable economic advantages over the other water distillation processes. Because of less cost, fee energy and reduces operating costs. Producing fresh water by a solar still with its simplicity would be one of the best methods to supply fresh water.

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In this experiment Magnesium Sulfate Heptahydrate ($MgSO_4 \cdot 7H_2O$), Sodium Sulphate ($Na_2S \cdot 7H_2O$) used as phase change material and Titanium oxide is a Nano- material used for energy storage material. Among these energy storage materials Magnesium Sulfate Heptahydrate ($MgSO_4 \cdot 7H_2O$) improves the efficiency of solar water distillation.

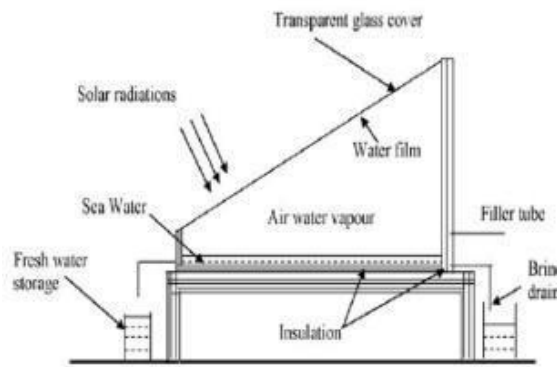


Fig 10: Passive type solar still

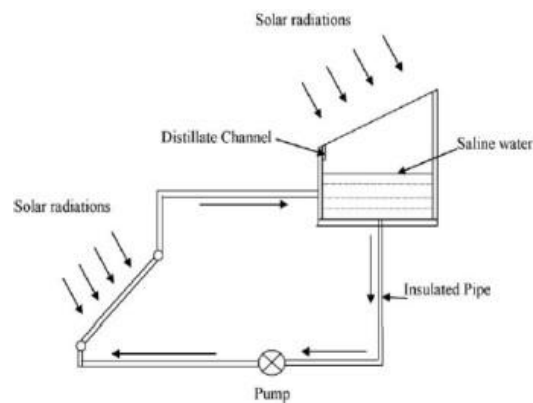


Fig11: Active type solar still

From the above results and discussions it is cleared that production rate was higher on north side compared to south side. The production rate varies accordingly with respect to solar intensity. The productivity of the still increases by 42 % in case of bore well water , 45% in case of river water and 40% in case of sea water when FPC . This is due to enhancement of basin water temperature by FPC .Amount water collected primarily depends on the peak temperature and length of duration of highest temperature of basin water. The hybrid solar still design tested in this study confirms production of high quality drinking water from source water of very poor quality

S. Irfan Sadaq et al (10 Feb 2018)

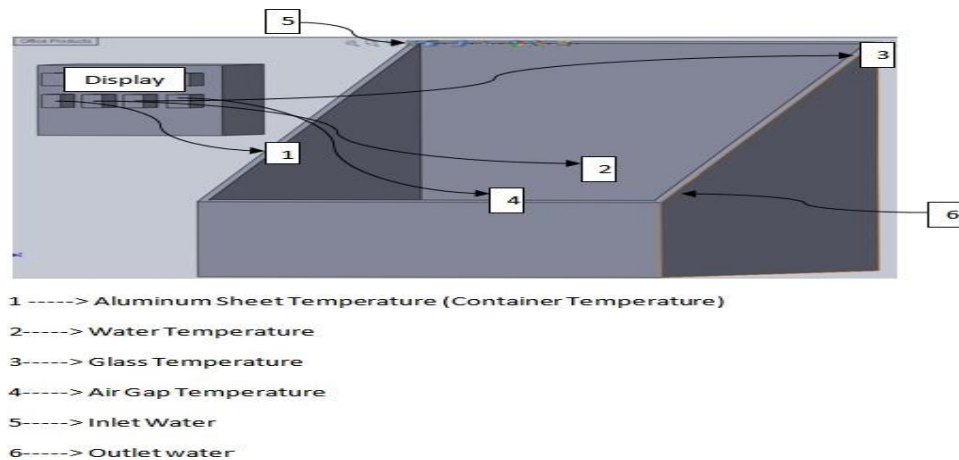


Fig 12: Solid model of SDU / still

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It has been observed that evaporated water temperature are higher from 10:00am to 4:00pm with the slope angle 350 and is maximum i.e. 540C at 3:00pm in the month of march on 30th and 530C at 3:00pm on April 15th, when compared with the same setup with slope angle of 300 on the same days and same time. The variation of evaporated temperature between the angles is observed to be 13%. Efficiency of the collector is 23% high i.e. 12.72% on 30th march with slope angle 350 and 9.74% on the same day with slope angle 300. CFD analysis can be performed on the same SDU to validate the results obtained during experimentation. Aluminum contained can be replaced with copper container.

S Umar et al (23 May 2017)

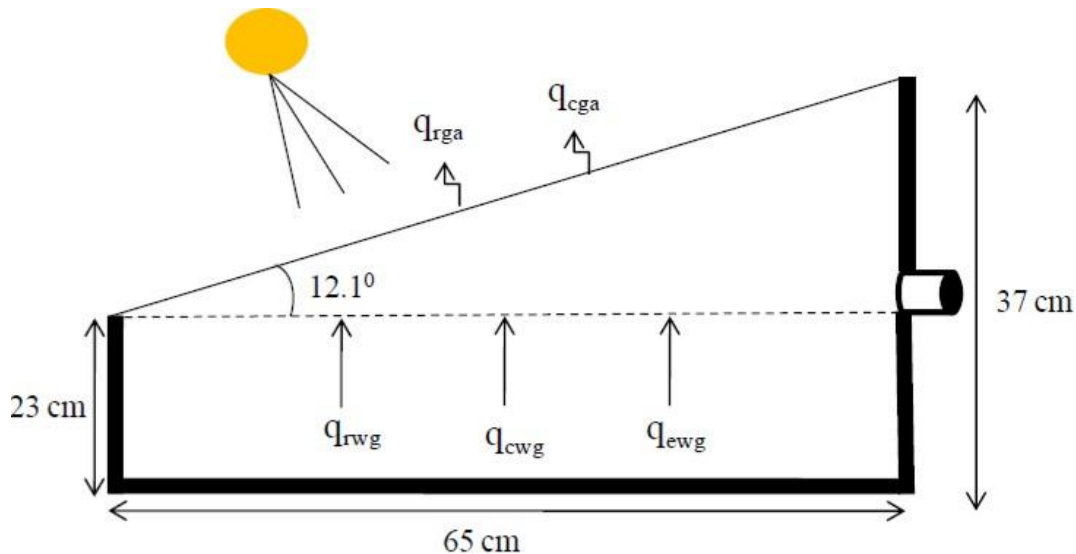


Fig 13: Schematic diagram of modified solar stills

The performance of four different single slope solar stills has been experimentally investigated and analyzed in this study. From the results obtained, still D1 with galvanized iron at the basin and hermetic seal has greater efficiency and distillate productivity of 54.06 % and 1.66 l/m²/day respectively compared to stills D2, D3 and D4 which have daily efficiency and productivity of 50.91 % and 1.46 l/m²/day; 28.20 % and 0.97 l/m²/day; and % and 0.90 l/m²/day respectively. The variation in the efficiency and yield between the still with 4 inch attachments and those without the attachment (and of the same basin materials) is very small, which is less than 4%. Based on this result, the side attachment of 4 inch hand hole can be adopted in the still design since it has negligible effect on the performance of the still.

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JINESH S. MACHALE et al (09 April 2013)

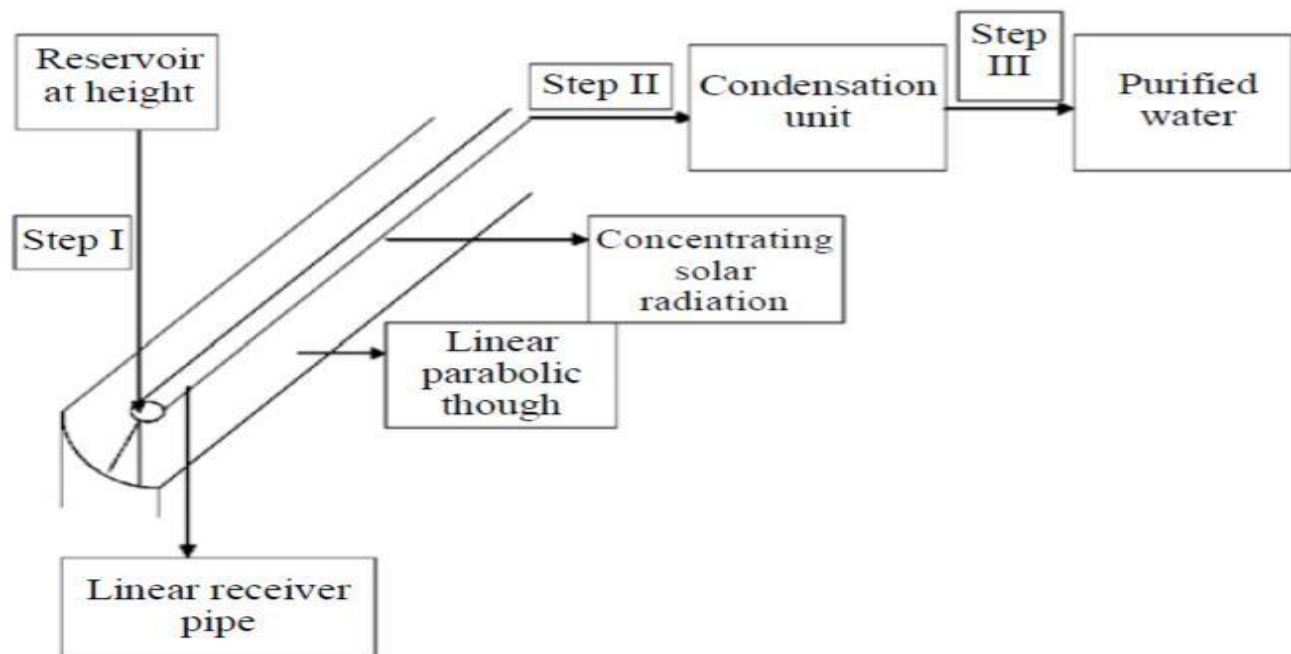


Fig 14: Flow diagram of prototype

An attempt to look into the future is subjective at best, as emphasized above. This method for water purification is better because, no electricity is needed, construction cost of prototype is Rs. 800/- maintenance is almost negligible and experimental values what we are having are under standards.

IV. CONCLUSION

The above investigation presents a clear view of productivity on different types of inclined solar still with different techniques. This section summarizes and presents the investigations carried out:

1. The glass cover angle is equal to the latitude of the place for maximum desalination.
2. The performance of the still with double basin is comparatively high than the single basin stills.
3. The performance of the still can be enhanced with the use of heat observing materials like aluminum, copper-electroplated aluminum, paraffin wax, sand, light cotton cloth, jute cloth, sponge.
4. A minor increase in the solar still productivity has achieved by increasing the environmental temperature.
5. Increasing wind speed causes an increase in the solar still yield.
6. The productivity of a single-sloped solar still has been found to be greater than that of a double-sloped one and glass covers are ideal comparing with the plastic ones.

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7. By increasing the insulation thickness of the still, the productivity increases.
8. Maintaining vacuum conditions in the still improve the productivity.

REFERENCES

1. Alaudeen a, K. Johnson b, P. Ganasundar b, A. Syed Abuthahir c, K. Srithar b,*; Study on stepped type basin in a solar still. Journal of King Saud University Engineering Sciences 5 May2013.
2. Rajesh .A.M, Bharath .K.N; Solar Still Coupled With Solar Collector and Storage Tank.
3. InterJRI Science and Technology, Vol. 1, Issue 2, July 2009.
4. Piyush Pala, Pankaj Yadava, Rahul Deva, Dhananjay Singhb; Performance analysis of modified basin type double slope multi-wick solar still Desalination 422 (2017)68–82.
5. S. Kaliappana, m. D. Rajkamala, v. G. Ganesanb p. Manikandanc; Experimental investigation on single basin and double basin solar desalination int. J. Chem. Sci.: 14(2), 2016.
6. S. Zedan, S. A. M. Nasr Eldin; An Experimental Investigation of the Factors which effect on the Performance of a Single Basin Typical Double Slope Solar Still for Water Desalination Scientific Research Publishing Inc... 2015,7,270-277.
7. S. Irfan Sadaq and Syed Nawazish Mehdi; Experimental analysis of solar distillation unit with various slope angles; International Journal of Advanced Technology and Engineering Exploration, Vol 5(44) ISSN (Print): 2394-5443.
8. Naga Sarada Somanchia, Sri Lalitha Swathi Sagia, Thotakura Ashish Kumara,Sai Phanindra Dinesh Kakarlamudia, Ajay parika; Modelling and Analysis of Single Slope Solar Still at Different Water depthaquatic Procedia 4 (2015) 1477 – 1482.
9. S. Umar, U. K. Muhammad, A. Yakubu , M. Musa, S. B. Muhammad; Experimental Investigation and Performance Analysis of Single Slope Solar Still; international journal of renewable energy research's Umar et al., Vol.7, No.4, 2017.
10. Shyam Verma, Devendra Singh, Dr. Ajay Kumar Sharma; Experimental investigations on a single slope solar still; International Research Journal of Engineering and Technology, Impact Factor value: 7.211 ISO 9001:2008.
11. S. Nanda kumar, P.P.Shantharaman; Fabrication of solar water distillation system; International Journal of Core Engineering & Management (IJCEM) Volume 2, Issue 1, April 2015.
12. Husham M. Ahmed, Faisal S. Alshutal, Ghaleb Ibrahim; Impact of Different Configurations on Solar Still Productivity; Journal of Advanced Science and Engineering Research Vol 4, No 2 June (2014) 118-126.
13. Jinesh s. Machale, prachi d. Thakur, piyush s. Lalwani, gayatri m. Apte; Solar water purification with the help of csp technology; Sci. Revs. Chem. Commun.: 3(2), 2013, 128-132 ISSN 2277-2669.
14. S.W. Sharshir, Nuo Yang, Guilong Peng, A.E. Kabeel; Factors affecting solar stills productivity and improvement techniques; S.W. Sharshir et al./Applied Thermal Engineering 100 (2016) 267–284.
15. Rasika R. Dahake, Priyanka A. Manmode, Rahul P. Ukey, Alisa A. Sakharkar; A Review on Solar Still Water Purification; IJRST –International Journal for Innovative Research in Science & Technology| Volume 3 | Issue 09 | February 2017.
16. K. Kalidasa Murugavel, S. Sivakumar, J. Riaz Ahamed, Kn.K.S.K. Chockalingam, K. Srithar; Single basin double slope solar still with minimum basin depth and energy storing materials; Applied Energy 87 (2010) 514–523.