1.INTRODUCTION

Due to environmental issues and limited fossil fuel resources, more and more attention is being given to renewable energy sources. In the recent years solar energy has been strongly promoted as a viable energy source. One of the simplest and most direct applications of this energy is the convergence of solar radiation into heat. Solar radiation can be widely used for water heating in hot water systems, swimming pools as well as a supporting energy sources for central heating installations. The energy of the solar radiation is in this case converted to heat with the use of solar panel. Using the sun's energy to heat water is not a new idea. More than one hundred years ago, black painted water tanks. Water is a basic necessity of man along with food and air. Fresh water resources usually available are rivers, lakes and underground water reservoirs. About 71% of the planet is covered in water, yet of all of that 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps and 0.001% in the air as vapor and clouds, Only 2.5% of the Earth's water is freshwater and 98.8% is groundwater.

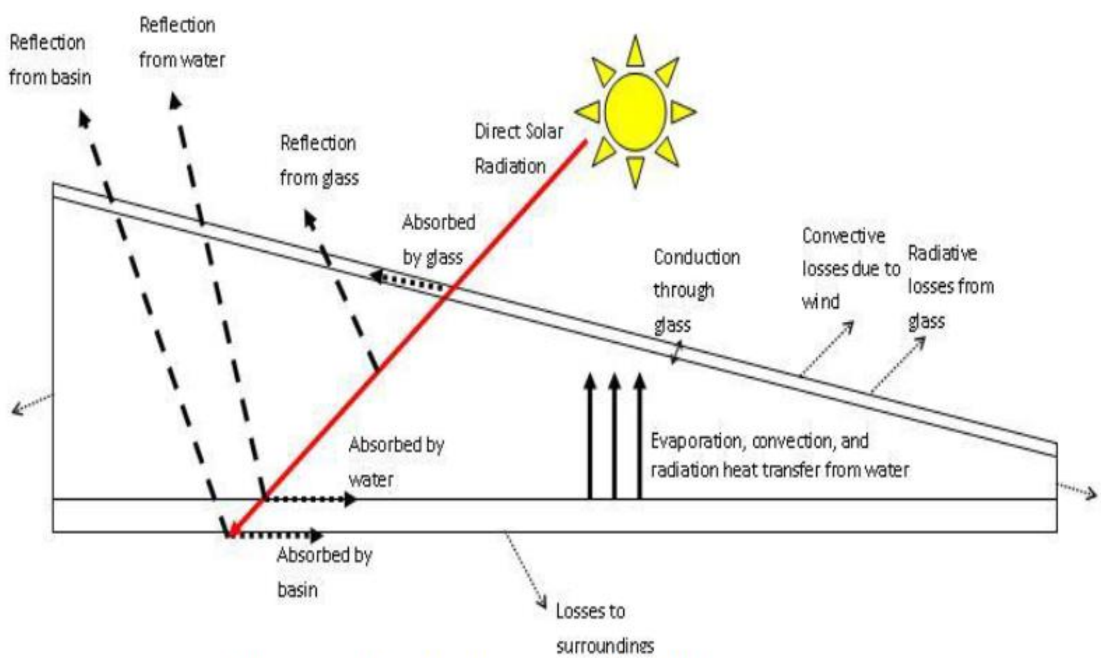

Fig 1.Conceptual diagram of Solar Still

- Square pyramid solar still is a device the is used to produce fresh distilled water by harassing solar energy to make evaporation inside the solar still.
- New design of the top cover has been implemented for different inclination angle to study its performance.

Case 1 Solar Still inclination angle = 18.58

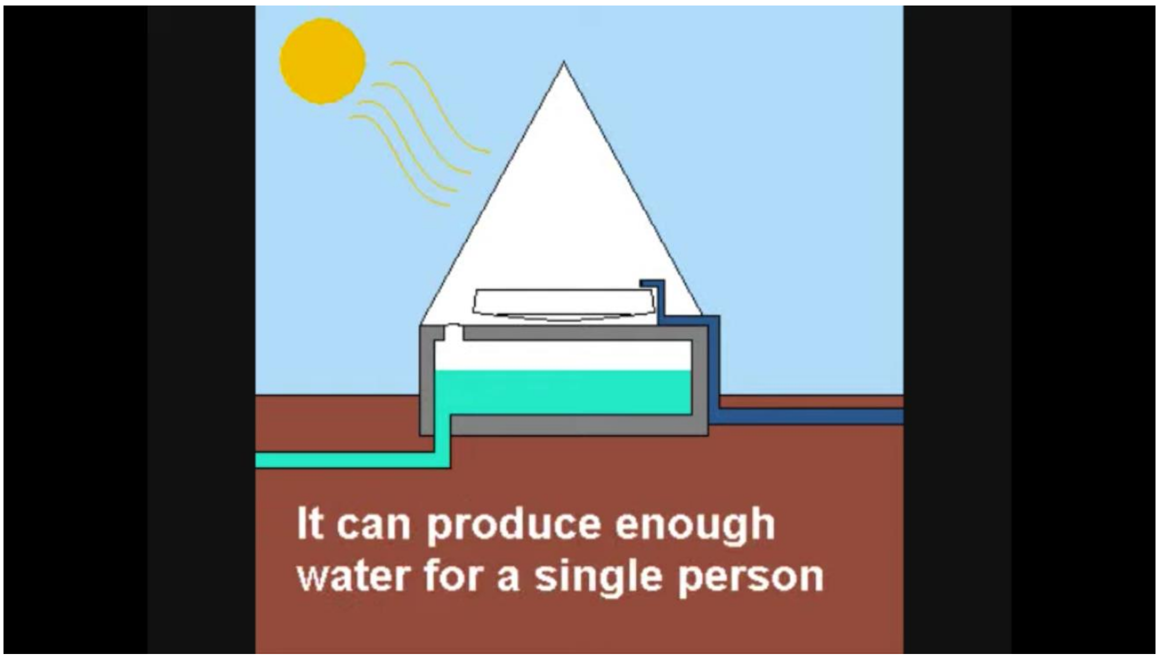

Fig. 2. Basic of square pyramid solar still system.

2.LITERETURE REVIEW

This work presents a few important factors that affect the performance of a triangular pyramid solar still. An experimental work has been conducted to find the effect of water depth on the performance of the triangular pyramid solar still. From the present study, it is concluded that the convective and evaporative heat transfer coefficients are important for designing solar distillation systems and the effect of temperature difference
between the evaporative and condensing surfaces is also important to optimize the operating temperature range. The condensing area of the solar still is more than that of evaporating area. Thus the experimental results showed that the effect of depth of water in the solar still affects the freshwater production.Never the less, outdoor experimental tests were conducted to study the effect of wind speed variations to cool down the glass cover. It was found that increasing the wind speed from 1.5 to 3 m/s and to 4.5 m/s has the effect of increasing the still productivity by 8 and 15.5% respectively. [1]

In this study, the effect of forced convection on the performance of pyramid-shaped solar still is investigated experimentally under outdoors of Tafila City (south of Jordan) climatic conditions. In this work, a solar still with a basin area of 0.95 m2 and a glass cover in the form of a pyramid has been designed and constructed.
The experimental results illustrated that the use of fan work with photovoltaic solar panels is cost-effective and viable in enhancing the evaporation rate and hence freshwater production. Based on the performance evaluation, the daily productivity of freshwater was increased up to 25% compared to free convection solar still. [2]

An exergy analysis has been conducted to show the effect of a small fan on the exergy efficiency in a pyramid-shaped solar still. The tests were carried out in Mashhad (36 360 N), for two solar still systems.[3]

Adequate quality and reliability of drinking water is vital for all inhabitants and for agriculture and industrial applications. Solar desalination is impactful method for getting potable water from brackish/wastewater in hot climatic condition and/or remote area where the scarcity of water as well as for electricity. In recent years,attention has been focused on development of various designs of solar still in order to overcome limitations possesses by conventional single basin single slope solar still. [4]

3.PROBLEM DEFINATION

1. In a conventional solar still, solar still must be located so that its inclined surface faces directly sun and also continuously to be moved as sun travel for gaining maximum solar radiation throughout the day whereas in the case of pyramid solar still, this is not required.
2. In the pyramid solar still, shading of side wall on water surface is less than that in case of conventional single slope solar still.
3. For same basin area, condensation in pyramid shape solar still is higher as condensing area in pyramid shape is higher than that of single slope.

4.COMPONENTS OF SOLAR STILL

Solar still is a simple device which can convert available water or brackish water into portable water by using solar energy. Main components of solar still are:

1.Basin: It is the part of the system in which the water to be distilled is kept. It is therefore essential that it must absorb solar energy. Hence, it is necessary that the material has high absorbtivity or very less reflectivity and very less transmitivity. These are the criteria for selecting the basin materials.

2.Condensate channel: It is the part of the system in which condensed water is collected. Sheet of required dimension is first cut out, and then it is folded by using the folding machine.

3.Black liner: Solar radiation transmitted through transparent cover is absorbed in the black lining. Black bodies are good absorbers. Black paint is used as liner.
A blackened tray is placed at the base of the solar still which acts as a black body to absorb the incident heat. The condensed water from the glass is collected in a pipe placed at an inclination which enables the collected water to flow downwards to the final collection tank.

4.Transparent cover: Glazing glasses used and thickness of 5 mm is selected. The use of glass is because of its inherent property of producing greenhouse effect inside the still. Glass transmits over 90% of incident radiation in the visible range

5.Insulation: Thermocol used as insulator to provide thermal resistance to the heat transfer that takes place from the system to the surrounding.

6.Sealent: M seal and putty is used as sealant to make the distiller leak proof and airtight. UV Glue is used to join Metal to Glass. Silicon Glue is used to join Glass to Glass.

7.Supply and deliver system: Three holes are made in the basin, one for supply and two for delivery.

8.Table: Pinewood table is used to support whole setup. Pine wood has good surface finish. Base of Ply wood is used because of its good strength.

9.Square box: Iron Square Box is used to hold side *(*threaded*)* stand.

5.OBJECTIVES

1.To study the performance of square pyramid solar stills by measuring production of distilled water versus the orientation of the still at 18.58 degree inclination.

2.To study the production rate of distilled water versus different variation of water level.

3.To determine the effect of the ambient temperature with amount of distilled water obtained.

4.To study the efficiency of square pyramid solar still for inclination angle of the glass.

5.To study the effect of the inclination angle on the distillation rate.

6.WORKING METHODOLOGY

1.Solar radiation is transmitted through the top cover transparent glass, heating the water and creating greenhouse effect inside the solar still.

2.Wind current flows by the glass absorbing latent heat of vaporization of water. 3.This is can be improved by providing insulation material and providing black plate absorber

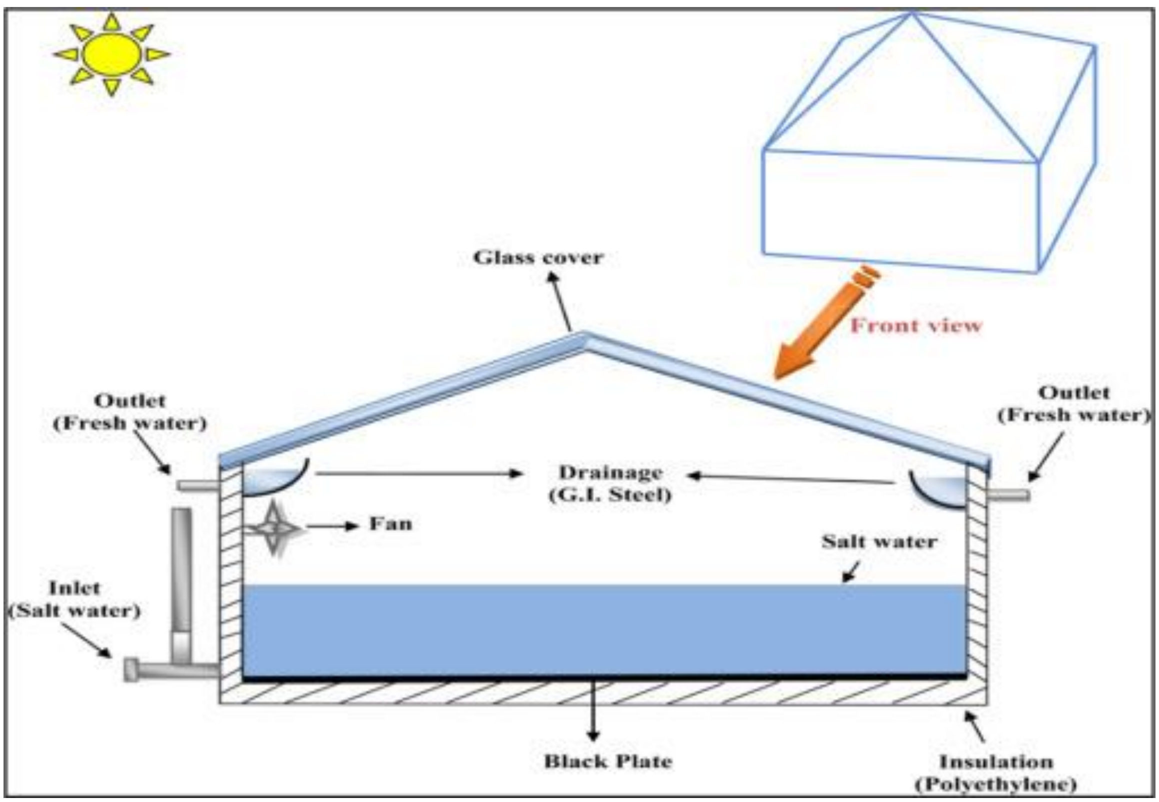

Fig. 3. Schematic Diagram of square Pyramid Solar Still

7.PART IMPLEMENTATION

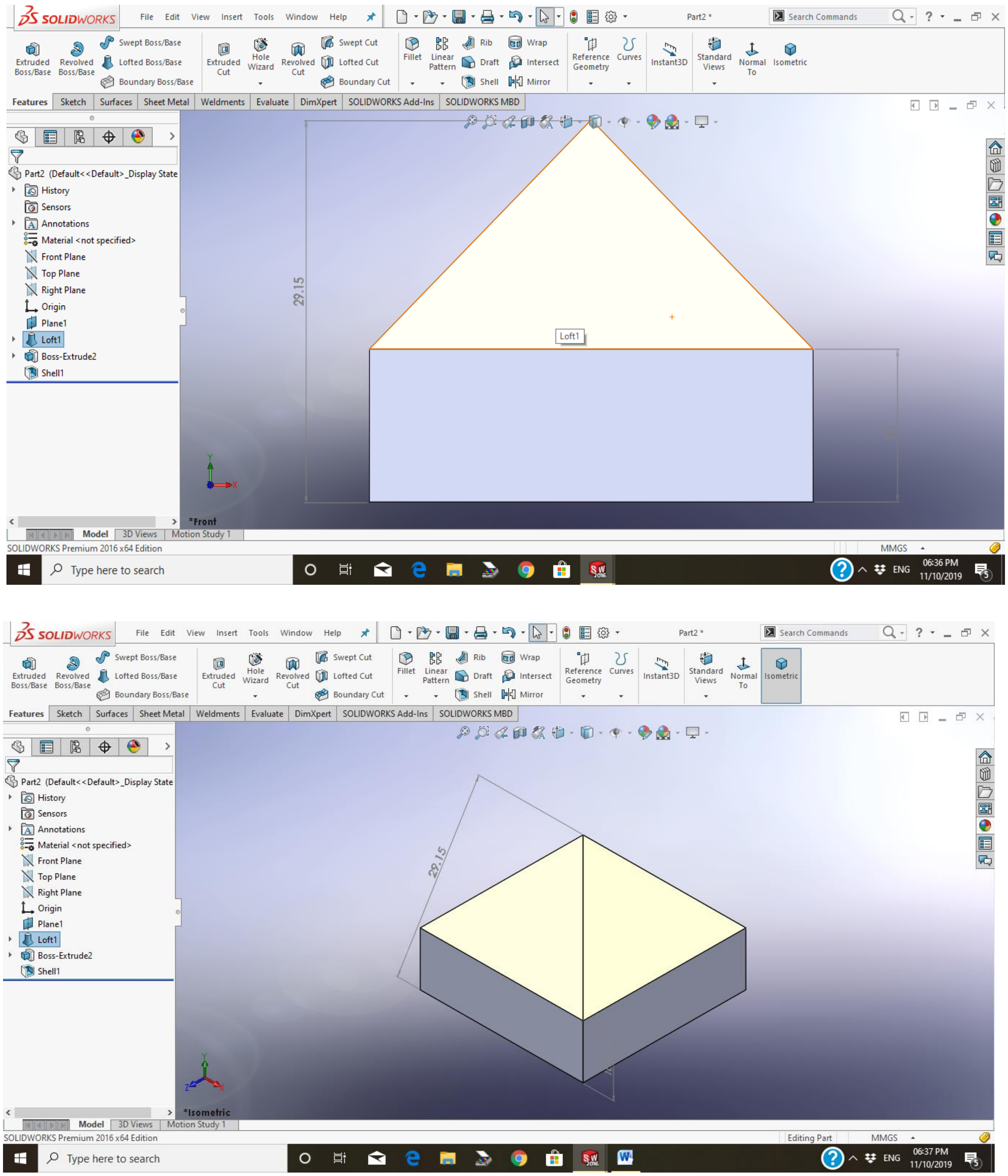

Fig.4. 3D Model

8.DIMENSIONS OF SOLAR STILL

Fig.5.Setup of solar still

Area of basin=30*30cm

Height of basin=15cm

Thickness of glass cover=5mm

Latitude angle=18.58 degree

9. EXPERIMENTAL PROCEDURE AND MEASUREMENTS

In the present experimental work the pyramid solar still with v-corrugated absorber plate and the conventional pyramid solar still has been designed, constructed and tested in the Faculty of Engineering - sppu University- wagholi-Pune (Latitude 18.58oN and longitude 31oE) to studied the effects of a vcorrugated absorber plate on the performance of the pyramid solar still with v-corrugated absorber plate. In the present experimental work the device of measurements used to measure the wind speed, solar intensity, temperature and the distillated water productivity. A vane type anemometer used to measure the wind speed. Solar radiation were measured by a pyranometer and supported at the same direction of glass cover. The temperatures at the different locations (absorber surface, basin water, glass cover, distillate water and ambient) were measured by calibrated K-type thermocouples. The distillated water productivity was measured by a calibrated flask. The depth of the basin water in the both conventional pyramid solar value 2 cm along the working days. The starting time work at 8:00 am and contained to 7:00 pm. During the experimental work the following parameters (wind speed, solar radiation, and temp).

10.FUTURE SCOPE

1.Solar still does not require paid energy.

2.It is a necessary to improve water desalination technologies for the aim of reduce carbon emissions resulting from burning fuel and to use free, clean and renewable source of energy such as solar energy.

3.Pyramid shaped solar still has advantages over conventional still.

4.It is useful in thermo-economic analysis of pyramid solar still.

5.The main objective of the paper is to study the various arrangements and configurations available for the pyramid solar still as well as the various means of increasing its productivity. From the review, it has found that pyramid shaped solar still has attractive advantages over conventional still.

10.1.Economic aspects of pyramid solar still

A conventional desalination plantuses a conventional form of energy to obtain distillate output; hence the energy cost is important parameter for estimating cost of distillate water. The solar desalination system uses renewable and freely available unlimited source of solar energy but capital investment, maintenance cost, running cost and transmission cost etc. must be considered for the economic analysis of solar desalination plant .Apart from the fabrication, installation, maintenance and labor cost forsolar still, yearly interest rate, annual salvage value and sinking fund factor should be considered for the economic analysis of still [85].Hence, the main aim of researcher is to minimize the cost of distillateoutput per liter / overall cost of still with desirable quality and quantity of pure water. Another tool to analyze economy of system is Energoeconomic (Thermo-economic) analysis, also refereed as energy costing. The analysis is based on cost associated with thermodynamic efficiencies of system, energy destruction and energy losses .Fathetal. [53] have estimated cost of distillate output obtainedfrom the pyramid solar still was 0.03 $/L. Kabeel [83] has estimated cost of liter was 0.065 $ for concave wick type pyramid solar stillwhereas 0.083 $ for conventional solar still which was 28% higher than economy of various available design of solar still and observed that thelowest cost per liter of distillate output was 0.031 $/liter for pyramidsolar still. Wassouf et al. [51] have approximated the cost of $0.046 per solar still for the 4 years life of solar still. Kianifer et al. [85] haveconcluded that cost of distillate water per liter reduced by 8–9% for thepyramid solar still with small internal DC fan in compare to simplepyramid solar still. Payback period estimated by Senthil Rajan et al.[92] for pyramid solar still was 219 days whereas 952 days for conventional solar still. The cost related to pyramid solar still varyconsiderably with location and availability of materials used forconstruction. Thus,pyramid shaped solar still seems to be moreeconomic as well as productive than other design of solar still.

11.COSTING

Sr. No.	Component	Cost in rupees
1	Stainless steel	2000
2	Glass	1000
3	Wooden plates	500
4	Acrylic sheets	2000
5	Manufacturing cost	2500
Total		8000

Table.1.Cost of materials

12.PREPARED MODEL

Fig.6.Stainless Steel 202 Base-18 Guage

Fig.7. Glass Pyramid-1mm

13.INSTRUMENTATIONS

The solar radiation was measured by the pyranometer. The temperature of ambient, cover, water, basin, and insulation were measured by the K-type thermocouple. The wind velocity was measured by the anemometer.

Uncertainty

The measurement of the solar radiation, the temperature of cover, basin, yield, and wind velocity are taken for experiment. The uncertainty of the instrument accuracy and calibration characteristics is calculated by the following equation 54.

$$U(I) = \frac{a(I)}{\sqrt{3}}.$$

Here U(I) is the standard uncertainty of corresponding instruments and a(I) is the accuracy of corresponding instruments given by the manufacturers. The uncertainty of the instruments is shown in Table .

Uncertainty of instruments

Instruments	**Range**	**Accuracy**	**Uncertainty**
Pyranometer	0-2500 W/m2	±1 W/m2	0.57
K- type thermocouple	50°C to 220°C	±0.1°C	0.057
Anemometer	0-15 m/s	±0.1 m/s	0.057
Collecting jar	0-1000 mL	±5 ml	2.88

14.CONCLUSIONS

In this work, the effect of forced convection on the performance of pyramid-shaped solar still is investigated experimentally under out doors of Pune City (wagholi) climatic conditions. It was found thatusing a small power consumption fan work with photovoltaic solarpanels improves the vapor flow and evaporation rate. The daily distillate production has been found to be per day for a solar still with forced convection, i.e.increase in freshwater productivity compared to free convection solar still. Thus from the results it can be concluded that a still with relatively smaller area would give same output compared to conventional design.

15.REFERENCE

[1] Ravishankar Sathyamurthy, Hyacinth J. Kennad , P.K. Nagarajan, Amimul Ahsan.(2014). “Factors affecting performance of triangular pyramid solar still.”

[2] Yazan Taamneh, Madhar M. Taamneh (2012). “Performance of pyramid shaprd solar still.”

[3] Ali Kianifar, Saeed Zeinali Heris, Omid Mahian Rafique (2012). “Exergy and economic analysis of pyramid shaped solar water purification system.”

[4] Kuldeep H. Nayi, Kalpesh V. Modi (2018).“A compressive review on pyramid solar stil.”