Retraction

Retraction: Design and fabrication of solar water distillation with conventional solar still (J. Phys.: Conf. Ser. 2054 012008)

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This article has been retracted by IOP Publishing following an allegation that this article may contain tortured phrases[1] and potential inconsistencies. IOP Publishing has investigated in line with COPE guidelines and have found tortured phrases to be masking overlap of other work [2-3]. As such, the journal has lost confidence in the validity of the findings presented in this research and agree this article should be retracted.

IOP Publishing wishes to credit PubPeer commenters and the Problematic Paper Screener for bringing the issue to our attention.

The authors agree to this retraction.

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Design and fabrication of solar water distillation with conventional solar still

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Abstract. The project of design and fabrication in “solar water distillation” is producing pure water from solar energy is of great importance the world over, our work is production of clean water effectively from saline water with utilization of solar still can produce sufficient amount of pure water from saline water. The solar energy is given as input which evaporates the sea water. The evaporated water gets condensed in above internal glass surface. The condensed water gets collected in a container and the collected water is noted down as output reading. In this conventional solar still with an extra addition of a phase changing material releases heat when there is no solar energy the heat released by this phase changing material evaporates the saline water when there is no sunlight to improve the productivity of the solar still during sunset condition also the still gives better performance with phase changing material (pcm). The comparatively cheap and compact system depends on non-conventional energy. The inspiration of the venture is restricted to accessibility of clean water assets of sullied water accessible for expected change in to compact water.

Keywords: Solar still, distillation, saline water, condensed water, phase changing material, pure water.

1. Introduction

The water problem has already manifested itself in various parts of Bharat, with varying degrees of magnitude and intensity at different seasons of the year. The water problem is not caused by natural forces; rather, it is the product of human activity. The rapidly growing population of India, as well as its ever-changing habits, will exacerbate the need for water. The quality of today's water resources is being lowered by widespread contamination of surface and groundwater. The majority of classical water distillation methods are very energy intensive and require both fossil fuels and electrical power to operate. A solar still, on the other hand, uses a rather shallow water basin inside a totally enclosed, greenhouse-like building. The vapour produced inside the still condenses on the inner facet of its translucent cowl, which is naturally cooled from the skin. The indication for everyone is the inventory of drinking water. Even if many water sources are conceivable across the planet, just one of the Earth's water bodies is in a current, fluid condition, and almost all of it is regularly contaminated by microorganisms and dangerous manmade chemicals. However, there are numerous physical and
Consolidating inexhaustible elective energy and desalinization would produce a reasonable inventory of water what's more like energy. This blend is exceptionally esteemed on the grounds that it restricts and decreases contamination discharges and ozone-depleting substances created by the ignition of petroleum products. In this way, we can say that sun-oriented refining is by all accounts a promising philosophy related with notice substitute gratitude to turning out water. A few sunlight-based stills plans are arranged and a lot of having them discovered huge applications.

The expanding requests put on the world office undermine biodiversity and the stock of water for food creation and diverse significant human longings. Water deficiencies exist effectively in a few areas; with more than one billion people while not sufficient beverage. Moreover, 90th of the irresistible illnesses in non-industrial nations are communicated from polluted water. Horticulture devours concerning 70th of freshwater worldwide as an illustration somebody thousand litres (L) of water are required to supply one kilo of cereal grains, and 43,000 litres to supply one metric weight unit. Instead of enormous growth, new water supplies may come through conservation, recycling, and better water-use efficiency. Rivers, lakes, ponds, and tanks are the four most common sources of surface water. In India, there are around 360 rivers and their feeders with a length of more than 1.6 kilometres apiece. The average annual flow out and out of the conduit bowls in Bharat is 1,869 cubic kilometres. India contains an enormous lineation and furthermore, the coast is amazingly indented in certain states. Along these lines, various tidal ponds and lakes have molded. The States like Kerala, Odisha, and West Bengal have enormous surface water assets in these tidal ponds and lakes. Despite the fact that water is for the most part briny in these water-bodies, it's utilized for fishing and flooding bound assortments of paddy crops, coconut, and so on in India has verifiably been a partner provincial economy, and concerning two-third of its populace are dependent on agribusiness. Henceforth, the advancement of the water system to increment horticultural creation has been assigned an extremely high need inside the 5 Year Plans, and utile conduit valleys come very much like the Bhakra-Nanga, Hirakud, Damodar vale, Nagarjuna Sagar, Laxuri Gandhi Canal Project, and so on are taken up. Truth be told, India's water interest right now is overwhelmed by irrigational wants. Agribusiness represents a considerable lot of the surface and well water work out; it represents 89% of the surface water and 92 percent of the groundwater work out. Exploratory assessments contemplated that the water temperature isn't actually the wick temperature, which the wicks immersing emissive power making a fundamental driving force on the dissemination of water. Daylight-based still adequacy improved considerably than customary single inclination sun controlled still, where the get-together and evaporating an area of the present model is more than bowl zone. From solar still we may produce maximum up to 4.1 kg m$^{-2}$.

1.1. Single slope solar basin still:

Among various distillation processes, solar distillation is a particularly appealing and easy technology, and it is particularly well suited to small-scale units in places where sun energy is abundant for the production of pure water from saline water. The still have provided with an inclination angle of 13 degree for longitudinal axis of construction for better absorption of solar energy.
2. Materials and methods

2.1 Materials employed in solar still:

2.2.1 Plywood: Ply board is shaped of 3 or extra-thin layers of wood protected along with partner glue. Each layer of wood, or handle, is once in a while situated with its grain running at right points to the neighbouring layer to downsize the shrinkage and improve the strength of the completed piece. It’s used as stuff that will not permit the warmth to pass out. Ply board of 15mm thick is employed for this setup.

Table 1. Materials employed

| Sl. No | Parameters                   | Values (units)   |
|-------|------------------------------|------------------|
| 1     | Plywood                      | 1.25 x 1.25 (meters) |
| 2     | Angular pieces (side wood)  | 0.6 x 0.4 (meters)  |
| 3     | Thickness                    | 0.02 (meters)     |

2.2.2 Copper tubes: Copper tubes are used as a instrumentality for part ever-changing material, the copper (cu) is chosen for higher thermal conduction concerning 399 [W/(m*K)]. Copper is simple to figure and has glorious heat conduction, corrosion resistance with sturdiness. It’s obtainable in 2 basic varieties of plumbing tube and heating and cooling tube and with each drawn (hard) and toughened (soft) tempers.
Table 2. Pipe parameters

| Sl. No | Parameters            | Values (units) |
|--------|-----------------------|----------------|
| 1      | Length of pipe        | 0.25 (meters)  |
| 2      | Diameter of pipe      | 0.02 (meters)  |
| 3      | Thickness of pipe     | 0.002 (meters) |

2.2.3 Mild Steel: The soft-cast steel sheet is employed for basin construction. The thickness concerning 0.4mm is chosen soft-cast steel is simple and low-cost obtainable for construction, thermal conductivity of soft-cast steel is concerning forty five W/k/m. Breakage resistance is strong in soft-cast steel. Even though cold, mild steel, like critical higher carbon steels, is bendable. This indicates that the material has a high tensile and impact strength. Under stress, higher carbon steels tend to shatter or crack, whereas soft-cast steel deforms.

2.2.4 PVC pipes: PVC stands for vinyl polymer the density of PVC is extremely dense compared to most plastics (specific gravity around one.4) PVC is instantly obtainable and cheap. Rigid PVC is {extremely is incredibly} hard; PVC has extremely sensible enduringness. The thermal conductivity concerning zero.19W/(m k) and most temperatures vary from 212 °F (100 °C) to five hundred °F (260 °C) relying upon manufacture additives to the PVC temperature about Melting.

2.2.5 Silicon Silicate: Sturdy SEAL 3200 BRONZE General purpose sealer is economic grade single part. Carboxylic acid cures polymer sealer that vulcanizes on exposure to wetness in air at temperature to supply a versatile elastomeric sealant. It’s appropriate for all common construction and glazing application. It is simple to use and offers glorious adhesion to a spread of nonporous substrates such as glass, glazed ceramic tiles and metal. It’s proof against gas, ultra-violet radiation and temperature extremes.

2.2.6 Glass: Glass might be a relentless substance that can be clear or hazy and weak in nature. It's industrial facility made by combination technique. During this technique sand is joined with lime, pop, and a couple of various admixtures this cooled rapidly. Glass is utilized in development reason the sun powered actually is warmed by greenhouse gases. Radiation inside is noticeable and short-wave infrared differ in the still entering from the sun in reasonable prime cowl that is consumed by the basin.

2.2.7 Temperature Sensor: This sensor shows digital readings of temperature in 9-bit. These sensors supply glorious precision and are intended to browse from 0 degree Celsius to 70 degree Celsius and doable to attain ± 0.5 degree Celsius precision. These devices are fully regulated with digital readings in °C. This output device typically consists of a device to measure temperature, ADC converter, I2C interface, and registers for the integrated circuit. This alteration is detected by the integrated circuit and temperature is calculated by it. The rises in temperature readings also happen, when the increase in voltage occurs.

2.3 Product development:

Arrangement of drinking water for all actually stays an overall test disregarding astonishing advancements in science and innovation. A drinking water is that the main element for supporting life in the world. Though water is plethoric, just a little part of the whole amount is utilized for drinking capacities. Inside the beachfront district of Bangladesh, briny or saline water wins everyplace and others are consistently looking for drinking waters. Indeed, even the water of new lakes has turned saline in a few spots. All through catastrophic events like floods or crises, safe drinking water is that the exchange products that are in critical might want first. again in fluctuated places, regardless of whether the harsh regions or inside the plain terrains, endemic wellsprings of water have essentially
20% of ground water in waterfront space of the country has arrived at disallowing states from the mid-80s on account of the ascent of water amount, unrestrained seafood development, temperature variation, and different conditions. Therefore, limitless people inside the waterfront locales of Bangladesh notice themselves catching a monster obstacle due to the mind-boggling presence of saline or dangerous beverage.

2.4 Methods:

In the work, 2 sun based controlled little-sized desalinization units or ‘sun oriented stills’ were planned and stunning abuse locally possible low-esteem materials. In any case, first is a reasonable Polyvinyl Chloride film that result the cowl and the second is an unmistakable optical cowl. Innovation acquainted with develop the stills was rigorously native. Its partner slanted cowl on one feature exclusively, pointing toward the south, as demonstrated in Figure 1.

The unmistakable fronts of every one of the fundamental gadgets beneath the examination had a partner tendency of 13°. In arranging these sun powered desalinization units, the most concerns were accessibility of materials, cost, and intensity, basic development, and straightforward upkeep. The basin and bowl’s aspect divider was made by 1.5 inches thickness picket sections.

The inclined and flat segments are snared befittingly between one another extraordinary abuse stick and furthermore the joints were solid abuse embedded screws. Within the basin has fixed by use of pasted glue dark sheet. This may build the successful spread contrasted with a tiny water pool that is utilized generally.

The gadget owned a different waterway port, washing port, and H2O collection port. An arrangement had made to affirm a consistent arrangement to deal with water. For this, the container with water had set in somewhat increased amount and had been associated with the bowl of the sun powered still through a clinic saline cylinder.

The different was only a six-millimetre thick clear glass sheet. Each cover was appended to the few gadgets abuse fitting mechanical installations. The semiconductor sealer was acclimated construct the joints impenetrable. The gadgets were set on a brought level up in request that the fluid arrangement bottle is put at a fairly lower level.

Tests of a multichannel computerized estimating instrument were embedded and stuck at 3 situations inside each still, closer to waterway, closer the water exit, and in the centre. The tests of 2 advanced hygrometers had moreover embedded with inner side the solar stills and stuck close to the centre. The sunlight based actually is warmed through the greenhouse gases.

The radiation inside is noticeable and short-wave infrared differ in the still entering from the sun in reasonable prime cowl that is consumed by the basin with increment in temperature. This sun powered dishtowel progressively emanates radiation inside the style of infrared beams with a larger frequency that the transparent cowl is kind of misty. So heat gets caught inside and continues gathering within specific duration, expanding the internal temperature.

The temperature arrives at most once the glow acquired from elective energy simply approaches the glow lost to the climate by the gadget. This furthermore makes dissipation of internal water and furthermore, the fume jumps highly. The upper cowl often cools effect of the external air then contains a lesser temperature compared to the wet air inside.

This makes a build-up of fume beneath the straight forward cowl and furthermore the air, that is apparatus and cooling device, descends, to be warmed again to actuate fume from the new wet dishtowel. When the consolidated drops are adequately gigantic all together that their weight on account of gravity will defeat the surface grip powers by use of blanket substance, the water lets
stream fall descend the inwardly disposed area of the greatest cowl related at last gathers in an exposed line place in the base, over which water is taken exterior to the still and got during a capacity bowl.

The near tests for checking the results for the greatest cowl were tested on numerous times inside the long stretch of April once that is commonly cloudless in the country with the exception of some aeronautical murkiness due to earth particles frequently. At the sun based water of 2 L filled the bowl in every sun based still. This quantity was up to preserve the dishtowels just drenched. The filaments of the dishtowel stay sodden because of capillarity.

To give constant stock water content by way of vanishing, the water in the container was put at marginally upper condition and associated with the bowl over medical clinic salt set with a well-ordered section of water.

The system was started at 09:00 am toward the beginning of the day for both the gadgets and the refined water was gathered at 6:00 pm in the evening, giving an absolute estimation time of 10 hours. The most extreme surrounding condition of the period has noted.

All the gadgets had worked all the while so that all climate and ecological conditions continue as before. The comparative examination was completed in 3 days by showing up to a normal.

The internal condition of the still at various focuses (close to water bay, close to the centre, close to water exit) during various period times has been noted and plotted by giving a comprehension of the warm conduct over 2 devices.

The encompassing conditions had additionally noted all the while. The general stickiness inside the two gadgets at various times was likewise recorded and plotted.

2.5 Overall incident solar radiation:

- Solar radiation is electromagnetic energy that is released by sun as a result of a nuclear fusion process.
- Solar radiation has a spectrum that is similar to that of a black substance with a temperature of around 5800 K.
- The visible shortwave portion of the electro-magnetic spectrum accounts for around half of the energy.
- The remaining half of the spectrum is primarily near-infrared, with a little ultraviolet thrown in for good measure.
- The average incident solar radiation in Chennai, Tamil Nadu, and India Latitude: 13.05° Longitude: 80.25°
2.6 Design consideration:

2.6.1 Methodology:
Solar stills get their name from the fact that they extract or remove impurities. Solar panels work on the same evaporating and condensing principles as rainfall. Seawater evaporates, just to chill, condensate, and fall back to ground as rain. When water has evaporated, only clean water is removed, leaving all impurities behind. Solar stills imitate this natural occurrence. The top cover of a solar still is made of glass, while the inside surface is constructed of a waterproof membrane. To increase permeability of the sun's rays, this inner surface is made of a darkened substance. To partly fill the bowl, cleaning water is put into the still. Solar radiation (shortwave) passes through the glass cover into the still, but is mainly absorbed by the darkened base. As the water warms, the relative humidity of the air between the water's surface and the glass cover rises.

![Figure 3: Schematic representation of basic solar still](image)

2.6.2 Basin construction:
The base also emits infrared (long-wave) radiation, which is reflected back into the still by the glass cover, trapping the solar energy within the solar still. The vapour from the heated water in the basin evaporates and condenses on the inside of the glass lid. The salts and bacteria in the original water are left behind throughout this procedure. Condensed water drips from the slanted glass lid into an inner collection trough and then into a storage container. Solar still has no moving parts and relies only on solar energy for operation. Each morning or evening, the still is filled, and the entire water output for the day is gathered at that time. After the sun sets, the still will continue to generate distillate until the water temperature drops. Each day, feed water that roughly surpasses distillate output should be provided to ensure appropriate cleansing of the basin water and the removal of surplus salts left behind during the evaporation process. The sealing of the base with black silicon silicate is one of the most significant aspects of the design.

2.6.2 Basin construction: It is made up of a shallow section pan of saline water. It is covered with an inclined straightforward rooftop that is powered by the sun radiation. And in a blackened bowl, the...
water is warmed by the flow of same rooftop. Subsequently the water dissipated in the dense under side part of the glass which is cooler. And the distillate is gathered by the glass connected with the basin.

2.6.2.1 Wood work: Compressed wood of thickness about 15mm is chosen for wood in bowl development, it incorporates development of wood wedge rakish side wood covers and front and back covers all (1mm width) (20mm length) nails are utilized to connect the wood carvings are recorded on table.

2.6.2.2 Sheet Construction: The crude material interaction is begun by cutting the sheet metal, there by collapsing up to required elements of (1m^2 x 1m^2) and thickness about (0.5mm)

2.6.2.3 Insulation: In arranging this sun situated distillation plants, the major thoughts had openness of substances, price, and profitability straightforwardness of improvement and effortlessness of help. The basin with edge dividers of bowl had created by use of 1.5 inches thickness poly-styrene foam pieces. The perpendicular and level units had associated suitably to one another by use of paste and the connections had built up. Inside the basin had enclosed by self-stick dull Polyvinyl Chloride film. This will extend the convincing surface zone stood out from a fundamental water pool that is normally used. The devices were separated by place of water bay, exercise in futility place with refined water collecting place.

Figure 4. Basin Construction
2.6.2.4 Water leak arrest solution: The water spill capture arrangement is chosen as silicon silicate of gold 6300 overly solid is utilized as the break capture arrangement. This arrangement is extraordinarily made for water release capturing is utilized on the end corners of the sheet bowl to forestall spillage.

2.6.2.5 Water leak test: The water spill test is led the time span around 24 hrs from the silicon silicate applied. The circumstance of water test is around 3 hours with next to each other of water spillage under direct daylight condition is tried as water tight.

2.6.2.6 Phase changing material: The phase changing material utilized di-sodium hydrogen phosphate decacohydrate a combination of thisodium phosphate penta hydrate. The better improvement of warmth move in dusk condition, so during the evening vanishing happens inside the sun oriented still to improve the productivity in yield water.

Table 3. Phase change material used

| Sl. No | MATERIALS USED                  | MOLECULAR FORMULA       | SPECIFIC HEAT (Cp)   |
|--------|--------------------------------|-------------------------|---------------------|
| 1      | Di-Sodium Hydrogen Phosphate Decacohydrate | (Na₂HPO₄.12H₂O)         | 3.184 (kJ/Kg.K)     |
| 2      | Thisodium Phosphate Penta Hydrate       | (H₁₀Na₆O₆P)            | 2.98 (kJ/Kg.K)      |

2.6.3 MODEL SETUP: With every one of the incorporated sensors and the fitted glass rooftop First trial was directed for appropriate dissipation and build-up without spillage in the vanishing to improve productivity of the sunlight based still.

Figure: 5 Model Setup

3. Results and Discussion:

The solar desalination system is tested over a week (05/5/2020 to 12/6/2020) at the location at Mechanical Department block of Sri Sairam Engineering College. and the average values are tabulated in table 4. Output water collected 4.21 lit / day of 20 liters is measured in beakers, the average output of water in 4.2 liters. The average output of water after incorporating PCM product is observed as 5.68 liters. Thus the incremental value of 35% after the usage of PCM is thus observed.
Table 4. Observed readings

| Sl. No | TIMING   | GLASS TEMP | WATER TEMP | SURFACE BASIN | BASIN SHEET |
|--------|----------|------------|------------|---------------|-------------|
|        | HRS      | $T_G$      | $T_W$      | $T_{sub}$     | $T_{B}$     |
| 1      | 9-10     | 49.6       | 51.1       | 52            | 53.8        |
| 2      | 10-11    | 52.0       | 56.4       | 55.1          | 57.6        |
| 3      | 11-12    | 53.0       | 60.4       | 50.3          | 56.6        |
| 4      | 12-1     | 57.4       | 62.6       | 54.4          | 59.4        |
| 5      | 1-2      | 60         | 65.7       | 58.9          | 63.2        |
| 6      | 2-3      | 58.5       | 63.2       | 56            | 60          |
| 7      | 3-4      | 54.3       | 60         | 54.8          | 58.7        |
| 8      | 4-5      | 50.11      | 57         | 50.2          | 56.4        |

i) Variation of solar radiation and ambient temp.

ii) Effect of day and night efficiency with water temp.

iii) Variation of water cool glass temp. with glass cooling effect

iv) Variation of partial pressure in daytime
4. Conclusion:

To improve the efficiency of the sun powered actually, plan is fundamental. There are predominantly three factors that have an effect; the radiation powered by sun, the quantity of bright time, and the plan of the solar still. Configuration components of significance incorporate water profundity, surface territory, the shade of the bowl, glass trend, protection, materials, water’s temperature, air-snugness, wind speed, and temperature contrasts in the solar still and surrounding air. In examinations directed on sun oriented stills, drinking water creation is a significant concern. Sun based stills have a good chance of achieving lower limits in India. Stills are in excess of 20 kilometres away from the wellspring of new water and the salt water TDS is more than 10,000 ppm. In this way, researchers investigated how to improve the proficiency aid to diminish freshwater costs; endeavours ought to be attempted in the accompanying examination to build up a crossover arrangement of water refinement which can defeat the restrictions of all current water decontamination frameworks.

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