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Testing of a solar still

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Abstract
Solar distillation is used to produce drinking water or to produce pure water for lead acid batteries, laboratories, hospitals and in producing commercial products such as bottled water. It is recommended that drinking water has 100 to 1000 mg/l of salt to maintain electrolyte levels and for taste. Some saline water may need to be added to the distilled water for acceptable drinking water. This work showed the simple method of water distillation by the use of solar still. The experiment was performed at university of Nigeria, Nsukka. The 22 litres of brackish water used in the experiment yielded maximum volume of 3.6 litres. The maximum temperature recorded in the experiment was 33 °C.

Keywords: Brackish water, solar still, Temperature, Purification, Radiation

1. Introduction

There is almost no water left on earth that is safe to drink without purification after 20-25 years from today [1]. This is a seemingly bold statement, but it is unfortunately true. Only 1% of Earth's water is in a fresh, liquid state, and nearly all of this is polluted by both diseases and toxic chemicals [2]. For this reason, purification of water supplies is extremely important [3]. Keeping these things in mind, we have devised a model which will convert the dirty/saline water into pure/potable water using the renewable source of energy (i.e. solar energy). The basic modes of the heat transfer involved are radiation, convection and conduction. The results are obtained by evaporation of the dirty/saline water and fetching it out as pure/drinkable water. Solar energy can be used to supply the energy required to heat water by making use of a solar still [4]. A solar still operates on the same principle as that of rain formation: water from the ocean evaporates, then cools, condenses, and returns to earth as rainwater [5]. When the water evaporates, only pure water vapor is formed while contaminants are left behind in the still basin and the distillate flows to the collection gutter by gravity [6]. Single-basin stills have been much studied and their behaviour is well understood [7]. Efficiencies of 25% are typical [8]. Daily output as a function of solar irradiation is greatest in the early evening when the feed water is still hot but when outside temperatures are falling. Material selection is very important. The cover can be either glass or plastic. Glass is considered to be best for most long-term applications, whereas a plastic (such as polyethylene) can be used for short-term use. Sand concrete or waterproofed concrete are considered best for the basin of a long-life still if it is to be manufactured on-site, but for factory-manufactured stills, prefabricated ferro-concrete is a suitable material.

Multiple-effect basin stills have two or more compartments. The condensing surface of the lower compartment is the floor of the upper compartment. The heat given off by the condensing vapour provides energy to vaporize the feed water above. Efficiency is therefore greater than for a single-basin still typically being 35% or more but the cost and complexity are correspondingly higher [9].

Wick stills - In a wick still, the feed water flows slowly through a porous, radiation-absorbing pad (the wick) [10]. Two advantages are claimed over basin stills. First, the wick can be tilted so that the feed water presents a better angle to the sun (reducing reflection and presenting a large effective (area). Second, less feed water is in the still at any time and so the water is heated more quickly and to a higher temperature. Simple wick stills are more efficient than basin stills and some designs are claimed to cost less than a basin still of the same output.

Emergency still - To provide emergency drinking water on land, a very simple still can be made. It makes use of the moisture in the earth. All that is required is a plastic cover, a bowl or bucket, and a pebble [11].

Hybrid designs - There are a number of ways in which solar stills can usefully be combined with another function of technology. Three examples are given:

- Rainwater collection. By adding an external gutter, the still cover can be used for rainwater collection to supplement the solar still output.
- Greenhouse-solar still. The roof of a greenhouse can be used as the cover of a still.
- Supplementary heating. Waste heat from an engine or the condenser of a refrigerator can be used as an additional energy input.

2. Materials and Method

Collection of water

The water used in this experiment was collected from brackish water in Edem water pond Nsukka in Nsukka local Government Area Enugu State. The water contains impurities with some micro-organisms. The change in colour of the water was due to some of the impurities found there and also due to the exposure of the water to sand.

Experimental Method

The collected water from the pond was measured to ascertain the volume of water to be fed into the solar still basin. This is actually to ensure that appropriate volume of the distillate

could be evaluated each day. The 22 litres of brackish water was poured inside the still basin painted black. The solar still was appropriately designed to avoid water linkage from the still basin in other to evaluate the accurate volume of the distillate obtained.

3. Results and Discussion

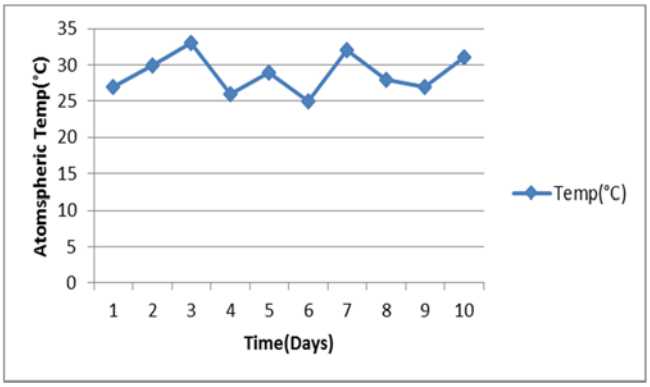

Fig 1: A graph of Atmospheric Temp ( ) Versus Time (Days).

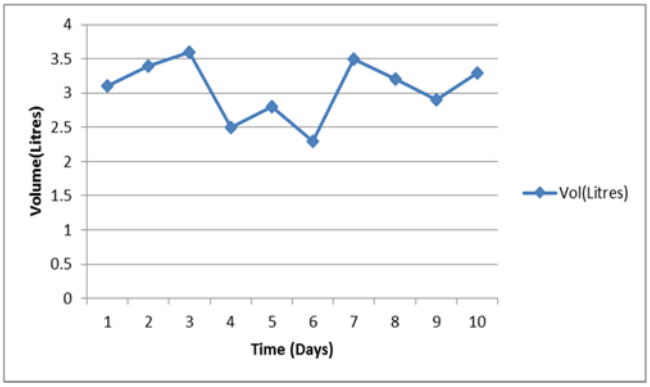

Fig 2: A graph of Volume (Litres) Versus Time (Days)

The experimental result indicated a positive response of distillate yield to solar radiation. These simply indicate that more solar radiation gives more distillate and vise versa. It was also observed that atmospheric temperature was not steady during the experiment. The results obtained showed that maximum distillate yield was 3.6 litres at 33 °C maximum atmospheric temperature.

4. Conclusion

Good drinking water could be obtained from simply evaporating the brackish water contain in basin and allowing the distillate to be collected through a channel into a collecting trough.

5. Reference

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