DESALINATION OF SEA WATER USING SOLAR ENERGY AND ITS APPLICATION

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Abstract—*The two sided solar still makes distilled water from salty/brackish water, yielding approx. 0.8 to 1 liter of water per day. The design is a self-supporting, stackable unit made by transparent, thermo-formable polycarbonate material also knows Acrylic. Based on the evaporation rate of 8.8 liters per square meter, the salty/brackish water evaporates and forms droplets on the cone's inner wall. This simple, utilitarian solution will improve the lives of the world's population and is a powerful example basic problem solving. With that, attaching simple circuit can give us automatic irrigation system which opens and closes the flow of water automatically depending on soil water content.*

Keywords—thermo-formable polycarbonate, automatic irrigation,astable multivibrator, monostable multivibrator

1. INTRODUCTION

Desalination can be defined as any process that removes salts from water. Desalination processes may be used in municipal, industrial, or commercial applications. With improvements in technology, desalination processes are becoming cost-competitive with other methods of producing usable water for our growing needs.

Conventional boiling distillation consumes three kilowatts of energy for every gallon of water, while solar distillation uses only the free, pure power of the sun. Expensive filtration and de-ionizing systems are even more expensive to purchase and use, and will not totally purify the water by removing all contaminants. Absolutely pure water is essential for use in fuel cell power generators, scientific research and many medical and plant usage.

Wehave designed a device which uses the abundant solar energy to transform salty undrinkable water into drinkable clean water with less impurity. It could also be useful in irrigation where the ground water has high salt contents. It would be economical so that farmers across the country could afford it. With that there is a circuit design which has motor connected so that it, automatically, opens or closes the irrigation supply depending on the water level in the soil. This will be very useful for the people living in coastal region or the areas where salt content is more in groundwater.

2. DESIGN AND CONSTRUCTION

2.1 Solar Still Basin:

Solar Still basin is where all the evaporated water will get collected after sliding down from taper cover top. This is made up of acrylic sheets

Dimension: 113*81*16 cm.

Fig 2.1 Solar still Basin

2.2 Brackish Water Holder

Two mild steel rectangular shaped tanks are coated black (to increase consumption of solar energy) are kept in the solar basin. They should be made of material that has high conductivity.

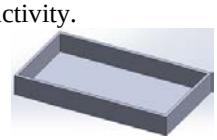

Fig 2.2 Brackish water container

2.3 Taper Top Cover

It is the elongated pyramid like structure kept on the water still to trap the water evaporated. It is made of acrylic sheet. As it has light weight and shatter proof it is required material for the component. Dimensions of the taper top cover are 61*46 cm.

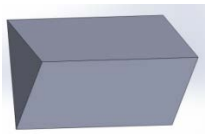

Fig 2.3 Acrylic Top Cover

2.3.1 Calculation for taper angle

Furthermore, the orientation of the receiver tube has a huge effect due to the large variety of incident angles the sun makes with the receiver. Therefore to minimize the average angle of incidence over a year period a North-South axis and East-West tracking was chosen with a tilted trough equal to the regions latitude. The angle of incidence is given below.

$\cos\theta=(\cos2\theta z+\cos2\delta*\sin2w)1/2$

$\cos\theta z=\cos\varphi*\cos\delta*\cos w+\sin\varphi*\sin\delta$ 1

Where θ is the incident angle, w is the hour angle in degrees; Φ is the regions latitude in degrees, δ is the declination

$\delta=23.45*\sin(360*(284+n)/365)$ 16

Where n is the day of the year.

2.4 Clean Water Collector

This is water collector kept in bottom of the setup. Water from the solar still comes from the pipe to this collector.

Fig.2.4 Clean water collector

2.5 Pipe

The nylon pipe ensures the water collected in the still goes to the collector.

Fig. 2.5 Pipe

2.6 Hex inverter 7404

The main function of the inverter is to give the complemented output for its input i.e. it will give output which is opposite to input. For example, if the input is low to the inverter, then the output will be high. 7404 IC will be having six independent inverters; Operating supply voltage is around 4.75V minimum to 5.5V maximum, normal supply voltage is 5V. The pin configuration of Hex Inverter 7404 is shown below.

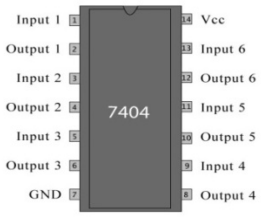

Fig. 2.6 Hex Inverter 7404

2.7 IC 555 as monostable multivibrator

A monostable multivibrator (MMV) often called a one-shot multivibrator, is a pulse generator circuit in which the duration of the pulse is determined by the R-C network, connected externally to the 555 timer. In such a vibrator, one state of output is stable while the other is quasi-state (unstable). For auto-triggering of output from quasi-stable state to stable state energy is stored by an externally connected capacitor C to a reference level. The time taken in storage determines the pulse width. The transition of output from stable state to quasi-stable state is accomplished by external triggering. The schematic of a 555 timer in monostable mode of operation is shown in Fig 4.8.

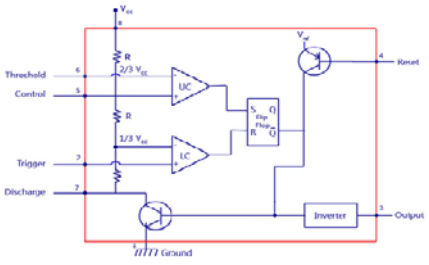

Fig 2.7IC 555 timer block diagram

2.8 IC 555 as astable multivibrator

An astable multivibrator, often called a free-running multivibrator, is a rectangular-wave generating circuit. The block diagram of the 555 timer IC when configured as astable multivibrator is shown in Fig 4.9.

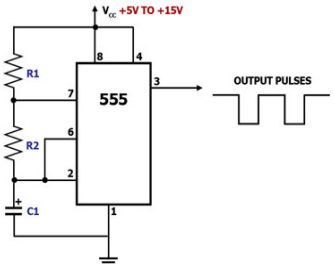

Fig 2.8 IC 555 as astable multivibrator

2.9Transistor SK100

SK100 is a general purpose, medium power PNP transistor. The basic applications of a transistor are switching, amplification and regulation. Its DC current gain ranges from 100 to a maximum of 300.

The transistor terminals require a fixed DC voltage to operate in the desired region of its characteristic curves. For amplification applications, the transistor is biased such that it is partly ON for all input conditions. The input signal at base is amplified and taken at the emitter. BC548 is used in common emitter configuration for amplifiers. For switching applications, transistor is biased so that it remains fully on if there is a signal at its base. In the absence of base signal, it gets completely off.

The emitter leg of SK100 is indicated by a protruding edge in the transistor case. The base is nearest to the emitter while collector lies at other extreme of the casing.

Fig 2.9 Transistor SK100

2.10Relay

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate.

A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT,and DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

Fig 2.10 Relay Switch

3. EXPERIMENTAL SETUP

The figure below shows the assembled experimental setup of the desalination of water.

Fig.3a. Experimental set-up of desalination of water

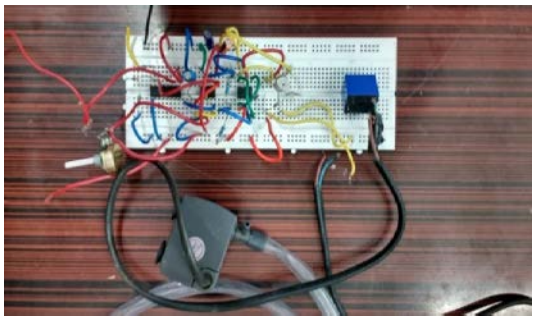

Fig 3.b Experimental setup of soil irrigation system

4. OBSERVATIONS AND RESULTS

After conducting the above experiment we get the following temperature throughout the day. The temperature rise up to 56 degree Celsius is observed. During summer it will increase rather more.

TABLE 4.A TIME V/S TEMPERATURE

Time (Hrs.)	Temperature
10	20
11	26
12	40
13	47
13.30	56
15	45
16	42

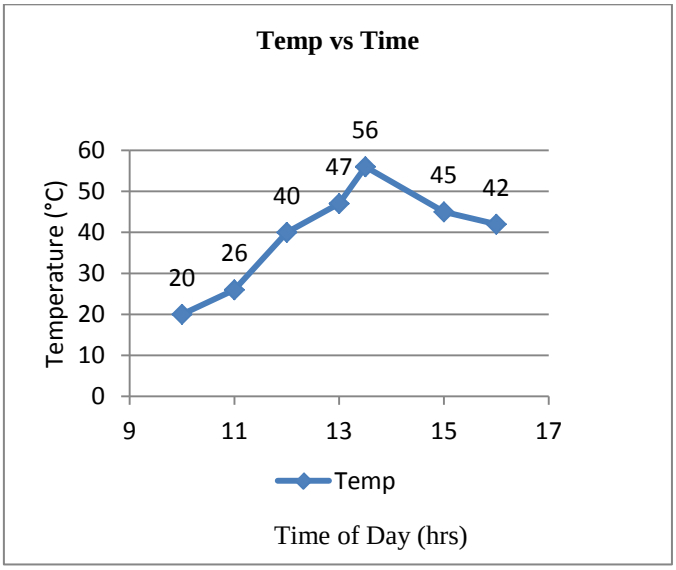

Fig 4.b Graph of temp v/s time

We have observed that when the probes are inserted in the soil containing less water, the motor starts working automatically. Whereas when the soil water content is high the motor switches OFF to save the water.

5. CONCLUSION

1. Thus we conclude that solar still is one of the most economical and easy way to achieve drinkable water.
2. It eliminates all harmful microbes, chemical contaminations, salts, minerals and any other impurities that are suspended in the water using only the free evaporative power of the sun.
3. This solar still has a unique triangular shape that makes it wind resistant, thus causing less damage due to wind.
4. When we connect the circuit to solar still, we get automatic irrigation system. Hence wastage of water is reduced and the salinity of the soil is maintained.
5. If the size of prototype is increased, we can increase the output.
6. Though the installing cost of this device may be high, its maintenance cost is very low and can be definitely affordable for the farmers.

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