SOLAR WATER PURIFIER

Shubham Mhatre[1],Vrushab Punewar[2],Enyat Ali Rounak[3],Shahid Khan[4]
[1], [2], [3] Students of *Department of Mechanical Engineering,*
[4] Assistant Professor *Dept. Mechanical Engineering,* ***Agnihotri College of Engineering, Nagthana (Wardha)***

***Abstract*— In all generations of human beings water plays a very crucial role for everyone.As,we know that impure water can cause various kinds of disease which are life threatening .In all over the world many countries has facing water issues most of them they don't have water to drink. We have observed that small villages and middle class families are not able to buy a water purifier and also many villages are facing electricity issues. There is limited conventional energy also they effect on environment. In this research paper, we are using non-conventional method which Solar based Water purifier which runs on solar energy. We have to achieve the purification process on next level where it's accessible & affordable for all humans. The**

Solar panel used for generate direct current which is stored in battery. This purifier is used for filtering process to remove the unwanted bacteria, dirt from water this process completely execute with the help of solar energy. The rotation of the motor helps to remove impurities by operating a motor that pumps water through a system of filters, pumps and hoses located in purifier. In this purifier we have used the technique of operating the motor used for lifting water using solar panels.

Keywords*— *Small Scale, Solar Panel, RO Membrane.

I. INTRODUCTION

Water is one of the most significant resources on this earth. Earth is covered from water is 70% and 30% is land. Humans as well as animals are fully dependent on water to survive and to live healthily. Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids as well as gases from water. As we Survey from doctors shows that to maintain a healthy lifestyle, an average intake of water in male/female approximately 3.7 litres/2.7 litres of water .In India near about 2439 peoples died in 2018 because of water borne disease such as cholera,diarrhea,typhoid and almost 1.5 million were diagnosed with this disease. A water resource should be safe

and reliable but also affordable to people. The available water in many areas in the country is brackish, saline or impure. Salinity is a major problem in the coastal areas of thane and Mumbai district.RO is the Process available for water purification, and sunlight is one of the source of Conventional energy that can be utilized in our system as energy source.RO Filtration is most Stable method for purification of contaminated water the RO system has semi permeable membrane that filters excessive minerals and other soluble presents such as bacteria,Fungi,algae, viruses in the water. Particles as tiny as 0.0001 microns are effectively removed by the system while rotating the motor. In India pure drinking water is a major problem in urban/rural area .There are many traditional methods available for water purification of drinking water Chlorine tablets, pots chlorination of wells, Slow and rapid sand filters, Fluoride removal ,but this methods has very difficult procedure also purification level is less than RO.In this paper we are designing which is works on Solar panel to lift up the water in tank and provide electricity to RO system for Purification process .If any environmental problem or power failure will be happen such as flood or something then the solar purifier has store their energy in battery so this process will be continue to work as Solar energy. It is an portable purifier which is easy to assemble where you can use it on rural areas where there is lack of Electricity. This Purifier provides pollution free Working.

1.2 Objectives

- To provide pure water for all and it's affordable for everyone.
- Detaching sediments and particulate matter from drinking water.
- Destroying pathogen, viruses, bacteria's and other diseases causing elements from water, thus making it purified.

II. LITERATURE REVIEW

- ***TRADITIONAL METHODS***

All over the countries, rural groups have adopted simple and simple and rudimentary remedy techniques that in particular intention at filtering out the visible impurities from the water collected from nearby assets. Even though those traditional methods are expedient and can remove sure sort's particles from the water, they don't offer water necessarily of what could can be taken under the present situation of drinking quality water. This is ideal process for rural communities and in most cases with easy step of disinfection they may yield water loose from pathogens. There are several methods.

a) Filtration along Winnowing Sieve
b) Filtration through Cloth
c) Filtration through Clay Vessels

a) Filtration along Winnowing Sieve: This type of filtration is used when the water source is polluted by air-borne impurities such as dry leaves, stalks, and coarse particles. The raw water is passed through a winnowing sieve, and the impurities are filtered. This kind of filter is widely used in villages of the Bamako area, Mali. This method cannot be used when the raw water is highly turbid or muddy, since the sieve cannot filter fine suspended particles in raw water.

b) Filtration through cloth: In villages they use white skinny cotton material or a discarded garment is used as the filter medium. This filter can clear out uncooked water containing such impurities as plants bacteria, insects, dust particles or mud debris. This purification process suspended particles present in water may be removes in only small amount. This practices of fabric filtration is pretty common in villages in India.

c) Filtration through Clay Vessels (Earthen Pot):In Clay vessels with a appropriate pore size are every so often used to filter fairly turbid water. Muddy water is gathered in massive clay jar or pot and allowed to rest on lower surface of pot, then the water in jar will trickle through the porous clay wall in jar. The trickled water is composed in a vessel (clay pot) through setting it at lowest of the porous clay jar.

EXISTING SYSTEM

Sourav Kumar Ghosh and Md. Mamunur Rashid et. al. [1], (2020), This research work uses solar energy as an energy source and stores it in a batteries which is a free source of energy. This energy is then used by inexpensive heating coils to heats the water to a specific temperature (below boiling points).After condensation, the cold water undergoes futher purification through the filtering chalk. At this stage, the water condenses again to give water room temperature. Through this process, we obtain clean drinking water. We went through almost at every stage of a product development process ,from gathering customer requirements to finalizing the design. [1].

K. Dikgale, D.F. Ntobela, B.G.V. Mendes, et. al.[2], proposed that solar-powered water purification systems is thus regarded as an important means of producing clean water. Solar energy poses no polluting effect and has become a dependable energy source for usage. The design of a solar-powered water purification system is based totally on the thermal method by using the thermal heating system principle which converts sunlight rays into heat. The most vital aspect is the absorption of heat to induce evaporation of water. Research shows that flat plate collectors produce heat at relatively low temperatures (27°C to 60°C) and are commonly used to heat liquids. A solar-powered water purification system consists of a solar collector that absorbs sunlight to ensure vaporization, which is the first stage of purifying and a filter that removes contaminants. Four different concepts have been developed. [2]

Gazi Nazia Nur, Mohammad Ahnaf Sadat et al. [3] proposed that Conventional energy sources are limited and they cause environmental pollution. By using a renewable energy source as solar power to purify water, these problems can be avoided. Solar water purifier is an advancement of current water purification system. Design methodology of the solar water purifier is presented in this paper. Solar water purifier takes solar power as energy source and stores energy in a battery. Main components of solar water purifier are solar panel, battery, heating coil, filtering chalk, double layer condenser and several water vessels. This purifier uses filtering mechanism to remove dirt from water and boiling mechanism to kill organisms. Through this process, pure drinking water is achieved. [3]

Lamma OA & Abubaker M. Outhman et al. [4] proposed that impact of reverse osmosis on purification of water Raw water reverse osmosis technology has taken many leaps towards the development of energy efficient and high yielding systems. The reduction in energy consumption, improvement in membrane life and increase in energy recovery emerged as the primary criteria for research in this field. The key objective of the work involves the optimization of the variables involved in the pre-treatment process of different water sources (pond, canal and surface water) reverse osmosis plant which would lead to an increase in the membrane life by reducing solids content of the raw water. Experiments were carried out to ensure maximum total solids reduction and also reduction of different chemical parameters (BOD, TDS and Bacteria). These parameters were found to be desirable for the discharge from the pre-treatment to be fed into the reverse osmosis part of the plant and RO water plant is used drinking purpose and free from contaminants.[4]

Yogita V.Gaikwad, PoojaV.Gavande et al. [5] proposed that a reverse osmosis purification process. This system contains mainly power supply circuit, purification circuit and control circuit. Power supply consists of solar panel, charge controller, battery and inverter. Purification unit consist of booster pump, Reverse Osmosis system and control circuit contains sensor, microcontroller and relays. High pressure is create by booster pump to carry out reverse osmosis process. The microcontroller keeps watch to level of the water tank and prevents it from the overflow. By using this process we obtain pure water in the water tank.[5]

Dr.S.Prakash, Deepak Toppo. et al., (2017), [6] The basic principle behind this project is reverse osmosis. The solar radiations are collected by solar panel. This energy is then stored in a battery. The battery is connected to the purification unit through a electromagnetic relay. The purification unit

consists of high pressure motor, reverse osmosis system and the water tank. The high pressure creates the necessary pressure required to carry out reverse osmosis. The microcontroller 8051 keeps a watch to the level of water in the water tank and prevents it from over flow. Through this process we obtain the purified water in the water tank. [6]

III. METHODOLOGY

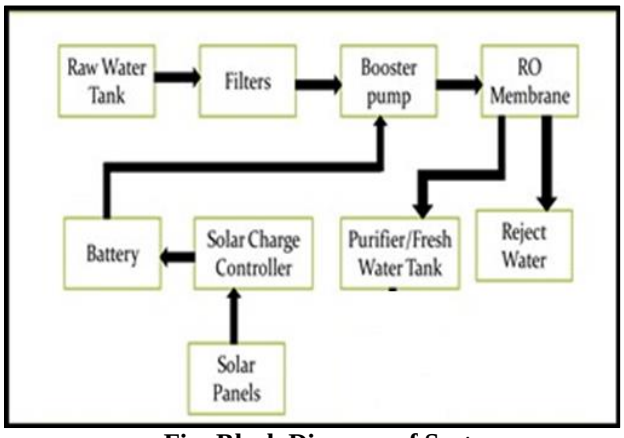

Fig: Block Diagram of System

As shown in the block diagram. Our major Component of this purifier is filters, Solar Panel, booster pump, Solar Charge controller, Reverse Osmosis Membrane etc. In this mechanism purifier is completely dependent on solar panel power. Solar power is used as energy resource and energy is stored in a battery. The solar panel are made of photovoltaic cell which is responsible for converting the sun energy into electrical energy the energy which is obtain from solar panel are stored in battery where the solar charger controller regulates the amperage and voltage that is delivered by solar panel to maintain the batteries load without getting overcharged .The power source then turns on the filters and the motor rotor rotates, pulls the eccentric swing wheel to make eccentric movements, and turns the water scaffold assembly of three cameras connected near the eccentric tread wheel to reverse, driving the diaphragm. The continuous rotation of the engine enables the diaphragm of the RO booster pump to continue to replicate, fulfilling the purpose of pumping and increasing the water after which it enters. The RO membrane can remove all majority contaminants from pushing the water through semi permeable membrane removes all impurities of water. The membrane consist of 3 layers the first layer is made of polyamide sheet the size of layer is 0.2 microns it's does not enter any kind particles and polysulfide layer can removes the nutrients, bacteria,chemical,virus which are present in water the last is polyester base where the purified water pass. After the purification process dirty water gets separated as well as clean water gets separated.

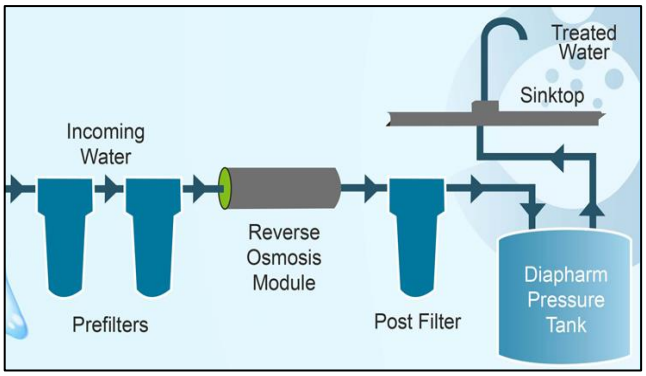

Fig: RO Working

3.1 Components Specifications

- **Solar Panel:** In this model, solar panel is used for collecting the solar energy. Solar panel are made from photovoltaic cell .The amount of power which is completely depend on the intensity of light**.** We are using a mini solar panel of 20-watt for a 12-volt battery that is charged with the help of sunlight. Being light in weight, this portable solar panel finds many applications or uses. The panel is specially designed to charge small batteries up to 10 Ah or 10,000 mAh. Mini solar panels are defined by their size (dimensions), which ranges from 0.6 x 2.55 inches to 14 x 18 inches (equivalent to 1.7 sqft, i.e., comparable to a regular medium sized home mirror).

- **Solar Charger Controller**
  A solar charge controller is an electronic device that controls the power supplied to the battery from the solar panel. This ensures that the deep cycle battery is not recharged during the day and energy is returned to the solar panel during the night so that the battery is not drained. Some charge controllers are available with additional features like lighting and load control, but power management is the main focus.

- **Booster Pump**
  Booster pumps are used to increase water pressure. Usually the osmotic pressure is higher. Purification requires that water flow from a high concentration to a low concentration. Therefore, in order to perform the reverse osmosis process, the high-concentration lateral pressure must be higher than the osmotic pressure.

- **Reverse Osmosis Membrane**
  Reverse osmosis (RO) is a special type of filtration that uses a semipermeable membrane with pores small enough to allow pure water to pass and rejects larger molecules such as dissolved salts (ions) and other impurities. RO units purify water by passing it through a thin, semi-permeable membrane to remove suspended and dissolved impurities and pollutants.

  There are three types of filters in a standard three stages reverse osmosis system.

  - Sediment filter that traps larger particles suspended in water, such as dirt and rust

- The Carbon filter removes VOC, Chlorine and other small contaminants from water.
- Semi-Permeable reverse osmosis membrane that removes virtually all remaining impurities

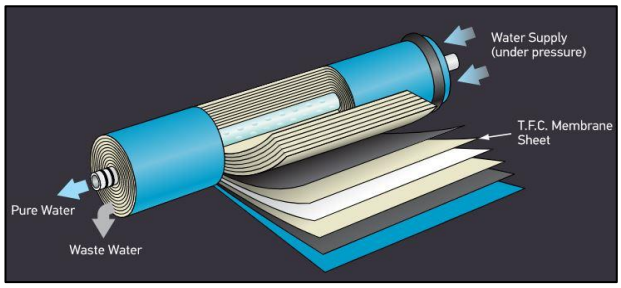

Fig: RO Membrane

➢ **Storage Battery**

It is an essential part of the system. Solar radiation intensity varies from season to season as per the atmospheric condition. It protects the impurities pump from over the voltage by providing Constant voltage of 12V. It has an output voltage of 12v and an output current of 5Amp.

IV. DESIGN CALCULATIONS

DESIGN SOLAR PARAMETERS

The designs of panel are mainly as follows which affects the collector panel performance.

Power for Application: The power required for a particular application directly affects the manifold panel. The larger the panel area, the greater the power received and the greater the cost. **The maximum power of this panel is 18W**.

Angle of Latitude: The angle of latitude is the angle at which the panel should he kept SO as to absorb maximum solar energy. The angle of latitude for any location is the angle between the equator plane of earth and line joining a particular point on earth's surface and the equatorial center of earth.

For determining angle of latitude following procedure is adopted

1. Mark all the three points' i.e.
   - ➢ Earth's center point
   - ➢ Equatorial plane line
   - ➢ Location for which panel is to be designed on world map.
2. Connect the earth point with location point
3. Calculate the angle included between equatorial plane line and earth's center point

As shown in the map for Wardha dist. It is equal to 20^0 therefore collector should be placed at **20^0 facing towards south.**

Average Power Intensity

The average power intensity for any locality is the unit power collecting per day. Reference to the map shows the global radiation of India.

For Vidarbha,

⇨ Average global radiation = 6.1 KWh/sq.m.day

1 KWh/sq.m. = 3.6 MJ/sq.m. day

Avg. global radiation = 6.1 * 3.6

= 21.96 MJ/sq.

i.e (21.96 x 10^6) / (24x60) = 15250 J/sq.m.mm

5250/60 = 254J/sq.m.sec

U/sec = 1W.

Therefore avg. global radiation = 254 W/sq.m.

Angle of Incidence : Its depends upon time of day also the angle of sunrays makes horizontal Surface measured w.r.t ,

As the sun travels the angular distance of 180^0 for 12 hrs. it travels at an angular speed of 180/12 = **15^0/hr**.

The ideal angle of incidence is the angle which makes the sun at angle of Latitude (Q) & incidence =90^0

As angle of latitude = Q = 20^0

Ideal angle of incident = 90^0 - 20^0 =70^0

Area of Collector: The area of collector mainly influences the power generated by a collector. While designing it following procedure is followed.

in = ibn x A x COSǾ

Where, in = power developed

A = area of collector.

Ibn = Average solar intensity

As ideal angle of incidence is 700

In = Ibn x A x COSǾ

6 = 254 x A x cos 70

Therefore A = 0.069066 m

Consider it is a rectangular panel having side ratio as 1:3

I^2 = 0.069066

= 0.325m = 32.5

B=3 x I=47 cm

Panel area = 32.5 x 47 =1527.5 cm^2

Discharge of Water:

Q = AREA X VELOCITY

Now area = 0.01 x 0.01 = 0.0001 mm^2

Now find velocity of water through pipe,

Hf= (4 x f x L x V^2)/Area of c/s x 2g

Hf= difference of pressure head = 4 m

F = coefficient of friction = 0.009

L = total length of pipe = **10.0584 m**

V = velocity of water

4 = (4 **X** 0.009 **X** 10.058 **X** V^2) / 0.0001 **x** 2 **x** 9.8

V = 1.4721 m/s

Q= 0.0001 x 1.4721

Q = 0.000014721 m^3/s => **Q = 0.01472 litre/s**

V. RESULT

The system for purification of water has been built using the most accessible form of source that is sunlight which can be easily captured and accumulated through solar panels, costing no electricity or external energy. On the other hand, the rest of the parts is playing their function to forward the process through motor and further filtering through various filter pumps and RO membrane getting rid of not only dirt, algae, minerals but also unwanted bacteria, viruses, etc. The design and ease to operate makes it more efficient to use as well as affordable for all.

Fig: Solar based Water Purifier

VI. CONCLUSION

This machine is the most convenient and accessible for the disinfection of water where power supply and ways to purify water is unmapped. The simple mechanism and integrated structure rhythmically converts the solar energy through motor and assists the filtration process devoiding water from bacteria, insolubles, minerals and other unwanted viruses giving potable water. It is inexpensive and uses solar energy to purify abundant water, so it can be used anywhere there is no electricity. This could be an area for future research in this era. This type of Water Purifier is not yet on the market. Therefore, We believe that if solar water purifier are effectively implemented by removing limitations so they will be able to attract customer from all sector living in urban and rural areas.

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