

SEA WATER DESALINATION MACHINE WITH RO UV PURIFIER

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Abstract

Drinking water is prime requirement for humans to survive. There is huge increasing in population in past few decades and thereby the usage of water is also drastically increased. Due to this, the drinking water usage is almost depleted and this results in need for usage for sea water in future. The seawater is covered by 96.5% on the earth. In this paper is mainly concentrated on seawater desalination. Several filtration techniques are available these days. Work has been carried out for low cost desalination technique. In this work, boiling process, condensation process and mechanical filtrations are used. The final purified water is stored in tank. The boiler and condensation design calculations are included in this paper.

Keywords: Fabrication of sea water desalination, reverse osmosis, Boiling process and filters.

Introduction

Both humankind and the ecology depend on fresh water as a resource. But, the rising need for pure, safe drinking water is necessitated by the adoption of economical water treatment techniques because of population boom, fast economical progress, and urbanization [1-3]. Contrastingly, it would seem that saltwater and brackish water desalination procedures have been the most essential strategies with the greatest potential to significantly increase the reliable source of water by doubling the quantity of freshwater produced. As over 96.5 percent of the water is present on the Earth comes from ocean sources, even a little amount of fresh water could have a significant influence on the problems of fresh water shortage. Despite that, sewage treatment and recycling technique has emerged in recent years as a potential approach for achieving conservation and sustainable. Reusing wastewater reduces risks to the environment while also relieving demand on fresh water supplies [4,5].

The scarcity of water has compelled the quest for new freshwater resources. Many sections of the nation have muddy, saline, or polluted water. Salt concentration is a serious issue in Visakhapatnam coastal district. Clean water is a big issue for the country, particularly in rural and tribal regions. There are various methods for purifying water for drinking, including chlorinated capsules, pot chlorination of groundwater, quick and

slow sand filtration procedures, fluoride treatment, RO plants, and so forth. Therefore, in work, water filter is developed. [6-7] the fundamental idea underlying this research is reverse osmosis (RO) with help of boiling and condensation.

Problem Identification

Water is a vital source for living beings. The pure and fresh water need is high. The population is increasing day-by-day and for that sufficient amount of drinking water is very important. But to provide the drinking water is a challenging task for municipalities. To fulfill this requirement, fabrication machine is planned to purify the sea water. To convert the Sea water into drinkable water is a challenging task and this task is an expensive one. So many doesn't prefer this type of purification. But in this paper, main concentration is on the purification and desalination of sea water.

Methodology

Initially, a boiling and condensation process is used. For that, 3Kg gas cylinder and 5liter pressure cooker is taken and the pressure cooker is filled till $3/4^{\text{th}}$ level of sea water. Once the boiling starts, sea water is converted in to steam. But the steam present doesn't have any salt in it. Again to gain the water from the steam, a condensation process is applied. For that, a 12mm copper pipe is used. It is tightly fitted to pressure cooker nozzle and to control the space and to improve the heat transfer performance is pipe is made in to helically coiled heat exchanger. To obtained more heat transfer enhancement, water tub is considered instead cooling of air. The helical pipe is submerged in to the water and another end of the pipe is connected to a tank. In this way of process, from sea water, the salt content is separated and the further step is purification. The heat transfer related calculation from boiling to condensation process is presented below.

Radius of coil outer diameter is 12 mm, Radius of coil Inner diameter is 11.5 mm, length of coil is 1570 mm and mean diameter is 140 mm.

Boiler capacity is 3 liters; Max pressure induced by boiler is 0.034 M.Pa.

The Water quantity is initially taken as 2Kg.

Initial water temp in boiler is 30 C.

Outlet steam temp is 80 C after 10 minutes of time.

$$\text{Heat transfer rate} = \frac{m \times C_p \times \Delta T}{\text{time}}$$

$$= \frac{2 \times 4.19 \times (75 - 30)}{600}$$

$$= 0.628 \text{ KW}$$

$$\text{Mass of steam flow rate} = \frac{\text{Heat transfer rate}}{h_{fg}}$$

$$= \frac{0.628}{2085}$$

$$= 0.000301 \text{ Kg/sec}$$

$$\Delta l_{mtd} = \frac{(T_w - T_i) - (T_w - T_o)}{\ln\left(\frac{T_w - T_i}{T_w - T_o}\right)}$$

$$\Delta l_{mtd} = \frac{(30 - 75) - (30 - 32)}{\ln\left(\frac{30 - 75}{30 - 32}\right)}$$

$$= 13.8^\circ \text{C}$$

$$U = \frac{q}{A_o \times \Delta T_{lm}}$$

$$q = 0.000301 \times 4182 \times (75 - 32)$$

$$= 54.12 \text{ W}$$

$$U = \frac{54.12}{0.059 \times 13.8}$$

$$= 66.47$$

$$h_o = \frac{1}{\frac{1}{U_o} - \frac{d_o}{d_i \times h} - \frac{d_o \times \ln\left(\frac{d_o}{d_i}\right)}{2 \times k}}$$

$$= \frac{1}{\frac{1}{66.47} - \frac{0.012}{0.0115 \times 200} - \frac{0.012 \times \ln\left(\frac{0.012}{0.0115}\right)}{2 \times 0.6}}$$

$$= 106.3 \text{ W} / \text{m}^2 \text{C}$$

Final tank temp can be calculate as below

$$T_{\text{tank}} = 30 + \frac{54.12}{0.03 \times 106.3}$$
$$= 46.9^{\circ} \text{C}.$$

After 10 minutes the tank water is measure with help of thermo meter. It was 48°C.

Once the salt content is removed from the water, some mechanical filters are used to purify the water. In that, carbon filter, sediment filter and reverse osmosis and UV filters are used.



Fig 1: filter used in this work.

To operate the purifier, the pump acts as key role. It is operated with 12V DC power. To achieve this AC to DC converter is planned. The pump has 0.1 horse power capacity at maximum RPM. It sucks the water from the storage tank and sends the water into purified collecting tank. In this work, pump is manually operated. Using a chip level program, the pump operating can be automatically tuned. Reverse Osmosis water treatment process is main important to purify the water. With the help of a semi-permeable membrane, two distinct concentrations are isolated. The water or solvent moves from a low to a high concentration region, and this process is known as osmosis, and the driving pressure is known as osmotic pressure . When a hydrostatic pressure greater than osmotic pressure is given to the high concentration portion, the solvent flow is inverted, and it flows from high to low concentration. This process is known as reverse osmosis (RO). Hence, clean water is extracted from saline water during the RO process.

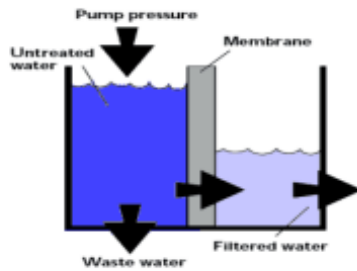


Fig 2: Reverse Osmosis (RO) process.

WORKING PROCESS

Once the DC motor is ON, the water sucks from the storage tank to the sediment filter. High size particles can be removed in this filter. After the sediment filter, the water goes to carbon filter 1 and 2. In this, carbon particles are removed. This water sucked by the pump and transferred through reverse osmosis. In this, purified water and waste water are separated. The purified water is sent to mineral tank. From this, water is sent to UV filter. From this region, bacteria present in the water can be killed. The fresh water is received from the output.

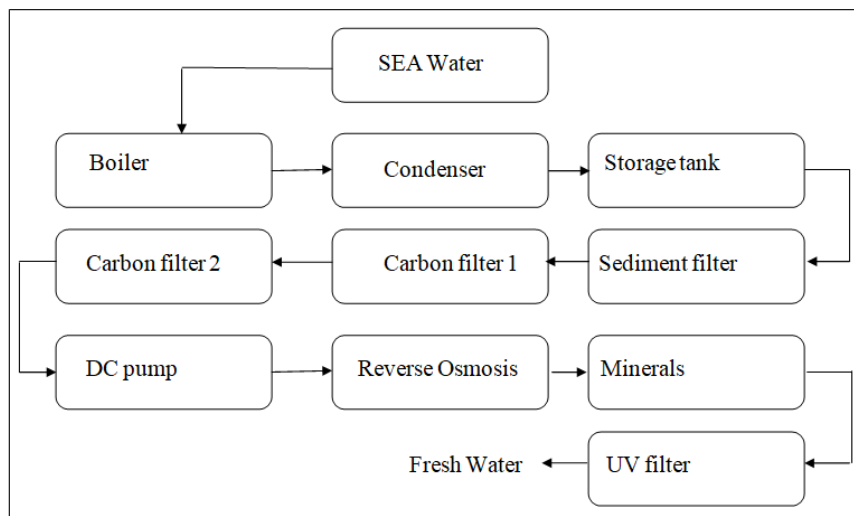


Fig 3: Flow chart for sea water purification.

The final fabricated purifier and desalination model is presented below. To fabricate the project, the mechanical filters pumps are collected from local companies. According to purification methodology, the individual filters are connected in series. To complete this fabricated model, the cost is around 15000

Rupees. With this cost, the sea water is desalinated and purified to convert in to drinkable water. Once the water is converted, its TDS level of 80 is observed.



Fig 4: Sea water purifier.

The main advantages of this project are Rapid desalination of water, Rapid desalination filtration with a RO system, UV sterilisation has been introduced to kill bacteria and viruses, Minimal Design, Easy to Move: Movable Design and Simple Maintenance Procedure.

Conclusion

In this paper, fabrication of seawater desalination at low cost is performed. The sea water purification is a complex task. While in this process, filters and RO had failed initially and this is the problem that was faced in the initial stage. So, by using boiling technique and condensation technique, salt content in the sea water can be reduced. Using mechanical filters such as sediment, carbon, RO and UV filters; purified water can be obtained. The pump is heart of the circuit. At the starting time of the equipment, water purification takes some time. After 10 minutes, purified water level increases. Finally after 15 minutes, 2l of water is produced from this setup.

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