Desalination of Sea Water for Preparation of Drinking Water

P. Siva Naik¹, K. Naveen Kumar², B. Praveen³, Dr. Kamalini Devi⁴

^{1,2,3} Students, ⁴Associate Professor, Vidya Jyothi Institute of Technology, Hyderabad

Abstract

The purpose of the rhythmic movement study is to build up a sun based box authority, development chamber and charcoal channel for desalination of sea water, filtration of got water test without hardly lifting a finger technique which offers various focal points. Sun controlled box finder, development chamber and charcoal channel were created, sun arranged box authority contains aluminum sheet cleaned on one side with sun based keen film which is fixed perfectly healthy using an iron packaging. A copper pipe covered with dim paint on outside surface of the copper pipe and is fixed at the purpose of assembly of the figurative finder, copper pipe is encased using a glass plate which is fixed can't avoid being fixed informative power and a plastic Can is used as saline water amassing tank which is covered with dull paint on outer surface. Development chamber includes plastic box which has two on either sides one for straight and another for outlet through which a wound copper pipe is fixed. By then it is stacked up with coolant, for instance, water, the saline water amassing tank, sun controlled box authority and development chamber are related by strategies for pipes, a valve is fixed at the inlet daylight based box finder to control discharge in copper pipe, a tee crossing point is given at outlet of copper pipe so the unevaporated water can be disengaged from water exhaust. Charcoal channel involves a layer of 10mm stone spread at the lower some portion of the plastic holder, followed by a layer of 6.25mm stone and a layer of charcoal which is accordingly followed by a layer of coastline sand whose thickness is a component of infiltration rate. After filtration the water test is attempted to know the proportion of minerals present in it.

Keywords: daylight based box finder, development chamber, charcoal channel, desalination, coolant, water vapor, infiltration

I. INTRODUCTION

Water has been seen as a major fundamental opportunity. Colossal measures of new water are required in various bits of the world for green, mechanical and local livelihoods. Beginning today, just about one fourth of mankind is encountering lacking new water supply. Inferable from the anticipated advancement of people around the planet (especially in the non-modern countries), the recently referenced situation will be a steadily expanding number of essential throughout the span of the accompanying twenty years or close. Dry season and desertification are growing out and out, including more broad and more broad zones of the planet. More than two-third of the world's surface is covered with water. Water availability will remain predictable in the near future. An enormous segment of the open water is either present as seawater or ice sheets in the Polar Regions. About 97% of the world's water is impactful and rest is new water. Under 1% new water is inside human reach. Regardless, imaginative progression, unlimited new water hangs on earth will be only 0.3% of the world water. Agribusiness uses two-third of available new water. The degree of overflowed surface should augment by 1/3 of each 2010 and significantly in 2025. Mechanical and local water use increases at double the speed of people increase. Water use extended sevenfold since 1900. Inside and out, the world's water use rate is increasing as expected, overwhelming by various occasions the speed of people advancement. The availability of good quality water is on the decline and water demand is on the climb. Generally speaking availability of new water for present day necessities and human usage is limited. Diverse mechanical and developmental activities actually have achieved extending the tainting level and self-destructing the water quality. Water insufficiencies and deceitful water quality are seen as critical hindrances to achieve viable unforeseen development and improvement in the individual fulfillment. The water interest in the country is growing brisk on account of reformist extension in light of a legitimate concern for water for water framework, quick industrialization, and people improvement and improving life rules.

The flow water resources are decreasing

- Due to conflicting dispersal of storm water and irregular drought,
- Excessive maltreatment of ground water sources and its lacking re-invigorate,
- Deterioration of water quality on account of the arrival of local and present day effluents without acceptable treatment.

Country joins a significantly intermittent illustration of precipitation, with half of precipitation falling in decisively 15 days and over 90% of stream streams in definitely four months. The water interest in our country is extending brisk due to reformist extension in light of a legitimate concern for water for water framework, quick industrialization, people advancement and improvement in life standards. The water resources are getting dissipated in essentially two communicates that are western Rajasthan and ocean side zones of Tamil Nadu.

Seawater, brutal water and water have different levels of pungency, which is ordinarily conveyed by the full separated solids (TDS) obsession. Water is viewed as consumable when its TDS is under 500 mg/L. Seawater contains a TDS of around 35,000 mg/L and unpleasant water contains a TDS between that of consumable water and seawater. Waste water is another grouping containing separated salts commonly inside the low saline level. The readied water from waste water may be used for country developing, cooling water and other amassing applications. Since the projected amassing and commonplace developing requirements would be definitely more noticeable than that of family necessities, reuse a great deal of waste effluents anyway desalting look good for future water the chiefs. Seawater desalting is being applied at 58% of presented in general cutoff, followed by pungent water desalting considered for 23% of presented limit. Eliminating water from seawater requires an authentic plan of energy, both warm and mechanical. Harmless to the ecosystem power driven desalination is getting more useful despite its exorbitant system since it uses free trademark fuel sources and conveyances no destructive effluents to the environment. Radiation is by and large picked over other maintainable influence sources since its atomic influence is likewise direct applied to drive desalination structures without the unavoidable energy setback related with energy change keep with the second law of thermodynamics.

DESALINATION

Desalination insinuates the technique by which unadulterated water is recovered from saline water using shifting kinds of energy. Saline water is reviewed as either pungent water or seawater relying upon the pungency and water source. Desalination produces two streams - freshwater and a more engaged stream.

Kinds of Desalination system

Desalination systems be two main categories

- phase-change or warm cycles
- Membrane or single-stage measures
- Thermal Desalination

Sea water can be desalinated by Thermal desalination using sun based box specialists effortlessly. Saline water is warmed, conveying smolder that dynamically assembles to outline water. Smoke pressure. Without a doubt these cycles, gathering steam is utilized to give the atomic force expected to deteriorate the water. Because of their high-energy requirements, warm cycles are routinely used for seawater desalination. Warm cycles are good for conveying high perfection water and fit to manage applications. Warm cycles address 55% of the whole creation and their unit limits are higher stood out from film measures.

DESALINATION OF SEA WATER FOR PREPARATION OF DRINKING WATER

General

In this project we are constructing a solar trough collector, condensation chamber and charcoal filter for desalination of sea water, filtration of obtained water sample with simple low cost technique which offers many benefits by referring from above mentioned papers and articles. Solar trough collector, condensation chamber and charcoal filter were constructed. Solar trough collector consists of aluminum sheet polished on one side with solar reflective film which is fixed in parabolic shape using a wooden frame and then trough is fixed on a fame made of PVC pipes. A copper pipe coated with black paint on outer surface of the copper pipe and is fixed at the focal point of the parabolic collector, copper pipe is enclosed using a glass plate which is fixed is fixed parabolic collector and a plastic Can is used as saline water storage tank which is coated with black paint on outer surface. Condensation chamber consists of plastic box which has two on either sides one for inlet and another for outlet through which a coiled copper pipe is fixed. Then it is filled with coolant such as water and sand, the saline water storage tank, solar trough collector and condensation chamber are connected by means of pipes, a valve is fixed at the inlet solar trough collector to control discharge in copper pipe, a brass tee junction is provided at outlet of copper pipe so that the unevaporated water can be separated from water vapors. Charcoal filter consists of a layer of 10mm granite spread at the bottom of the plastic container, followed by a layer of 6.25mm granite and a layer of charcoal which is later followed by a layer of beach sand whose thickness is a function of infiltration rate. After filtration the water sample is tested to know the amount of minerals present in it.

CONSTRUCTION OF SOLAR THERMAL DESALINATION PLANT

The following figures exhibits the design view (Figure 1) and the actual view of the solar thermal desalination plant (Figure 2)

Figure 1. Design view of solar thermal desalination plant

Figure 2. Actual view of prototype desalination plant

Major components of solar thermal desalination plant includes

- Overhead saline water storage tank,
- Parabolic trough collector,
- Condensation chamber.

Material used for the construction of solar thermal desalination plant includes

- **Overhead saline water storage tank**

A plastic water pot of volume 10 liters to which a Sterile disposable PVC tubing liquid glucose sterilization pouch for infusion set is connected to send required discharge (i.e. 1-4ml/sec) at the inlet of parabolic trough collector as shown in Figure 3.

Figure 3. Plastic water pot

Parabolic trough collector

Parabolic Troughs (PTs) are a class of solar concentrators that are curved as a parabola and placed in a straight line. Reflectors are parabolic in shape, such that they concentrate solar radiation over a line focus as shown in Figure 4. The trough is positioned such that its aperture plane is perpendicular to the sun's rays. It tracks the sun in a single axis to transfer energy to fluid circulating through receiver pipe. The larger collector aperture area concentrates reflected direct solar radiation onto the smaller outer surface of the receiver tube, heating the fluid that circulates through it. The solar radiation is thus transformed into thermal energy in the form of sensible or latent heat of the fluid. This system use solar collectors to concentrate the Sun's rays on one point to achieve appropriately high temperatures (more than 200°C). Fig. 28. Represents the prototype picture of trough collector.

Figure 4. Parabolic trough collector

The following materials are used to construct parabolic trough collector: copper pipe, Mylar sheet, aluminum sheet, glass plate, k-type thermocouple.

Copper pipe

A 1.2m long copper pipe of diameter 15mm and thickness of 0.03mm is used in the trough collector.

Copper pipe acts as heat conducting pipe and it is placed at the focal point of the parabolic trough. Based on the following properties we have selected copper metal as heat conducting pipe:

- **Thermal conductivity**

Copper is known for having good thermal properties, coming a close third behind diamond, then silver in terms of measured thermal conductivity of naturally occurring materials. The typical thermal conductivity of pure copper is $386.00 \text{ W/(m} \cdot \text{K)}$ at 20 degrees Celsius. This means that heat passes quickly through the metal. This is due to the close lattice structure of the copper atoms that vibrate more as the temperature rises, transferring heat internally. Copper also has a high melting point ($1,085^{\circ}\text{C}$), making it ideal for high-temperature applications such as bases for cooking implements like saucepans, heat exchangers in boilers and heat sinks in electrical equipment.

- **Corrosion resistance**

With a high natural corrosion resistance, copper has proven to be a useful metal for outdoor and marine structures and seafaring. It is often used in an alloy form, as 90/10 and 70/30 copper-nickel alloys are very good at standing up to the corrosive effects of seawater.

To create the extremely high corrosion resistance properties of copper-nickel alloys, a chemical reaction takes place between the filmy surface of the metal and the salt-water, protecting the core metal below it. The corrosion rates are impressively low, ranging from 0.0025 to 0.025 mm per year. This has enabled piers, jetties, and docks to be built with a much higher lifespan when plated with these materials. The corrosion resistance of copper is also a major factor in making it a popular choice for domestic plumbing for both water and gas pipes.

Mylar sheet

Mylar sheet of size 0.75m wide, 1m long is used as reflecting surface which is pasted on an aluminium sheet of same size as that of mylar sheet. After that it is fixed in the shape of parabola by using a parabolic wooden frame.

Mylar sheet is selected based on the following reflecting property

- Heat reflection: Because Mylar is impervious to infrared radiation, it has excellent heat-reflective properties, redirecting approximately 90 percent of radiant heat. This property can be used to reflect the sun's heat and keep patients cool. Mylar withstands temperatures up to 150 °C (302 °F).

Design of parabola

The parabola is designed by using the following equation;

$$Y = 4ax^2$$

The focal length is calculated by substituting $a = 1/60$.

The below Table 12 shows the values of x, y and Graph 1 shows the obtained parabola.

Table 1. Values of x, y

X- axis (cm)	Y-axis (cm)
-30	11.25
-28	9.8
-26	8.45
-24	7.2
-22	6.05
-20	5
-18	4.05
-16	3.2
-14	2.45
-12	1.8
-10	1.25
-8	0.8
-6	0.45
-4	0.2
-2	0.05
0	0
2	0.05
4	0.2
6	0.45
8	0.8
10	1.25
12	1.8
14	2.45
16	3.2
18	4.05
20	5
22	6.05
24	7.2
26	8.45
28	9.8
30	11.25

Graph I Design of parabola

Glass sheet

A glass sheet of 0.72m wide, 1m long and 0.03m thickness is used to enclose the copper pipe so that the heat produced at the copper will not get disturbed by wind and to maintain heat inside the enclosed area.

Glass sheet is selected based on the following properties:

One of the property of the glass is that when a sun ray travels through the glass only visible light passes through the glass and 90% of the ultra violet rays is obstructed and are reflected outward of the glass surface.

Condensation chamber

Materials used to construct condensation chamber are: mild copper pipe, coolant, circular plastic pot and a 9V DC pump. A mild copper pipe of length 1.2m, diameter 0.15m and thickness of 0.3mm is coiled with two 2 coils with coil radius of 0.15m (O/O) and pitch distance of 0.05m as shown in Figure 5.

Figure 5. Coiled mild copper pipe

Then that coiled copper pipe is placed inside the plastic water pot and is filled partially with river sand and water which acts like coolant. The inlet of the condensation is connected to the outlet of parabolic trough and outlet of chamber is connected with a 9-DC pump motor. Picture of condensation chamber is shown in Figure 6.

Figure 6. Condensation chamber

II. METHODOLOGY

- The overall process is divided into following 4 stages:
- Screening and storing of sea water
- In this stage the sea water firstly passed through screens to avoid intake of unwanted materials and then is stored at an elevation in sea water storage tank (i.e plastic pot) to provide gravity flow.
- Heating of sea water
- In this stage the sun rays are converged and concentrated at the copper pipe which is fixed at the focal point of parabolic trough collector. Once the pipe gets heated more than 110°C (measured by using k-type thermocouple) the sea water is passed through the pipe at low discharge.
- Separation of unevaporated brine and water vapors
- In this stage the unevaporated brine flows down into the brine solution collecting tank and the produced vapors are transferred into the condensation chamber by using a pump. After that the transferred vapors are condensate into liquid form by using a coolant (i.e mixture of river sand and water) and is stored in distilled water storage tank (i.e plastic container).
- Mixing of distilled water to river water, filtration and balancing of mineral focusinterest
- In this stage the obtained distilled water is mixed with river water in a ratio, then the mixed water is filtrated by using charcoal filter which consist of three layers i.e top layer with sand, followed by layer of gravel, and bottom layer consist of a layer of charcoal. Then this filtered water sample is tested for concentration of minerals and then the minerals like Ca, Mg, K, Na are extracted from the obtained brine solution and are added to filtered water to balance the mineral concentration levels in filtered water in a calculated ratio and again obtained water sample is tested for mineral concentration levels. Once the mineral concentration levels satisfies the standards as mention in table no. 9 then the obtained water can be disposed to the surroundings.

TESTS

- Required parameters of these samples were determined by using standard procedure.
- PH: The pH was determined by Elico Digital pH meter which gives direct value of pH.
- Electrical Conductivity: The conductivity was determined by using digital conductivity meter. The Conductivity meter used is Lavibond made Senso Direct Con.200.
- Total Dissolved Solid: The 50 ml of water sample was filtered through ordinary filter paper and water was collected in the evaporating dish of known weight. Further it was heated and water was totally evaporated. Whatever dissolved solid matter was present gets accumulated at the bottom of evaporating dish. The evaporating dish was cooled and weighed. By weight difference method the total dissolved solid is determined.
- Dissolved Oxygen: The percentage of DO was determined by using Lavibond made Senso Direct Oxi.200.
- Coliform test: Total coliform tests was determined by using standard microbial count method as prescribed by EPA method 1604.
- The amount of salts present like chloride, fluoride, sodium, magnesium, sulfate, calcium, inorganic substances.

III. RESULT AND DISCUSSION

The following tabular column shows the assumed values of the test parameters which are referred from central pollution control board, IS: 10500-1991.

Parameters	Sea Water Properties		Remarks According to Who Standard
	Before Processing	After Processing	
Colour (H.U.)	35	10	Safe
PH at laboratory	12.5	7.8	Safe
Turbidity (FTU)	8	3	Safe
Temperature °C	29	27	Safe
Total hardness (mg/l)	900	400	Safe
Conductivity (µmhos/cm)	1200	160	Safe
Total dissolved solids (mg/l)	1900	600	Safe
MPN of coliform per 100ml	200	20	Safe
Chloride (mg/l)	17000	350	Safe
Sodium (mg/l)	8000	3400	Safe
Magnesium (mg/l)	1278	30	Safe
Sulfate (mg/l)	2680	300	Safe
Calcium (mg/l)	450	60	Safe
Potassium (mg/l)	395	30	Safe
Carbon (inorganic) (mg/l)	30	0	Safe
Fluoride (mg/l)	1.4	1.2	Safe
Nitrate (mg/l)	60	35	Safe

IV. DISCUSSION

99% of sea water can be desalinated by using this technique and salts obtained can be used for extraction of minerals and salts. As all the assumed required test parameters like color, PH, turbidity, Temperature, total hardness, conductivity, total dissolved solids, MPN of coliform, chloride, sodium, magnesium, potassium, sulfate, calcium, nitrate, fluoride, carbon are approximately matching the standards according to WHO, so the water which is obtained after processing the sea water by using this method.

V. CONCLUSION

Water is the most common or major substance on earth, covering more than 70% of the planet's surface. All living things consist mostly of water. The never-ending exchange of water from the atmosphere to the oceans and back is known as the hydrologic cycle. This cycle is the source of all forms of precipitation (hail, rain, sleet, and snow), and thus of all the water. Precipitation stored in streams, lakes and soil evaporates while water stored in plants transpires to form clouds which store the water in the atmosphere. Currently, about 75% to 80% of conventional water supply is from lakes, rivers and wells. Making the most efficient use of these limited and precious resources is essential. Otherwise, scarcity of water will be faced by our future generations. This includes using appliances and plumbing fixtures that conserve water, not wasting water, and taking advantage of alternative water sources such as reuse of sea water, grey water. If we do not wake up even now, then we will not have enough good water to go round, and our future generations will be faced with severe crisis of water. The solution to all these problems is to replenish ground water bodies with rain water by man-made means. So, by using this technic one can prepare distilled water or can reuse the sea water.

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