DESALINATION OF SEAWATER BY USING SOLAR ENERGY

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ABSTRACT

The origin and continuation of mankind is based on water. Water is one of the most abundant resources on earth, covering three-fourths of the planet`s surface. However, about 97% of the earth`s water is salt water in the oceans, and a small amount of 3% is fresh water. This small percentage of the earth`s water which supplies most of human and animal needs exists in ground water, lakes and rivers. It would be feasible to address the water-shortage problem with seawater desalination; however, the separation of salts from seawater requires large amounts of energy which, when produced from fossil fuels, can cause harm to the environment. Therefore, there is a need to employ environmental-friendly energy sources in order to desalinate seawater.

After a historical introduction of desalination used to convert seawater into fresh water. It also covers a variety of systems, which can be used to harness renewable energy sources, these include solar collectors, photovoltaic, solar ponds and geothermal energy. Both direct and indirect collection systems are included. Indirect collection systems employ two subsystems; one for the collection of renewable energy and one for desalination. For this purpose, standard renewable energy and desalination system are most often employed. Only industrially-tested desalination systems are included in this project and they comprise the phase change processes, which included the multistage flash, multiple effect boiling and vapor compression and membrane processes, which included reverse osmosis and electro-dialysis. The project also includes a review of various systems that use renewable energy sources for desalination. Finally, some general guidelines are given for selection of desalination and renewable energy system and the parameters that need to be considered.

So from this project we are going to represent the feasible study of desalination plant to reduce the dependence on the natural sources of water by replacing it with the sea water which is available abundantly to the city. We are designing the plant which will be economical as well as ecofriendly.

KEYWORDS: *Desalination, Reverse osmosis, Electro-dialysis, Photovoltaic.*

1. INTRODUCTION

The only nearly inexhaustible sources of the water are the oceans. Their main drawback however is their high salinity. Therefore, it would be attractive to tackle the water shortage problem with desalination of this water. Desalinize in general means to remove salt from seawater or generally saline water.

According to World Health Organization (WHO), the permissible limit of salinity in water is 500 parts per million (ppm) and for the special cases up to 1000 ppm and seawater normally has salinity in the range of 35000-45000 ppm in the form of total dissolved solids. Excess brackishness causes the problem of taste. Stomach problems. The purpose of a desalination system is to clean or purify brackish water or seawater and supply water with total solids within the permissible limit of 500 ppm or less. This is a accomplished by several desalination methods that will analysed in this project.

Desalination processes require significant quantities of energy to achieve separation of salts from seawater. It has been estimated that the production of 100 mld water requires 60MW energy per year. Given concern about the environmental problem related to the use of fossil fuels, oil are much widely available, it is questionable if we could afford to burn it on the scale needed to provide fresh water.

1.1 Desalination

Desalination is a process that extracts mineral components from saline water. More generally, desalination refers to the removal of salts and minerals from a target substance as in soil desalination, which is an issue for agriculture.

Saltwater is desalinated to produce water suitable for human consumption or irrigation. One by-product of desalination is salt. Desalination is used on many seagoing ships and submarines. Most of the modern interest in desalination is focused on cost-effective provision of fresh water for human use. Along with recycled wastewater, it is one of the few rainfall-independent water sources.

Due to its energy consumption, desalinating sea water is generally more costly than fresh water from rivers or groundwater, water recycling and water conservation. However, these alternatives are not always available and depletion of reserves is a critical problem worldwide. Currently, approximately 1% of the world's population is dependent on desalinated water to meet daily needs, but the UN expects that 14% of the world's population will encounter water scarcity by 2025.

Desalination is particularly relevant in dry countries such as Australia, which traditionally have relied on collecting rainfall behind dams for water.

1.2 PROBLEM STATEMENT

Desalination is an immense part of our world. It provides us a supply of water to go around, since not many in areas have access to water, it is needed. It makes the whole process easier, instead of going to rivers for a supply of water. It is a major source all over the world, since it gives us the supply of fresh water all over the world, where in areas brisk water is scarce, for example Australia. One of the main reasons why desalinating water is important, is because of the uses of the invigorating water.

METHODOLOGY

There are various methods adopted for desalination of salt water which are listed below.And we have adopted Solar desalination process which is economical and consumes no energy other than solar energy.

Methods of Desalination

1) Multi-stage flash distillation
2) Multiple-effect distillation
3) Vapor-compression distillation
4) Reverse osmosis
5) Solar desalination

SOLAR DESALINATION

Solar desalination is a technique to desalinate water using solar energy. There are two basic methods of achieving desalination using this technique; direct and indirect. Sunlight may provide heat for evaporative desalination processes, or for some indirect methods, convert to electricity to power a membrane process

Fig1:solar distillation plant

CONCEPT OF MAKING A GOOD SOLAR STILL

The cover can be either glass or plastic. Glass is better than plastic . Glass absorb more sunlight then plastic, construction of material available locally. So, it does not required any external sources. Glazing should have high transmittance for solar radiation, resistance to abrasion, long life, low cost, easy to handle and apply universal availability. Basin tray should have high resistance to corrosion and low cost. Consensate channel should made from aluminium, galvanized iron.

Design Parameter

1.Capacity of model = 102 liters
2. Dimension of model = 1.5*1*0.1
3. Glass size = 1*0.6 & (10mm thick)
4. M.s Angle = 1inch * 1inch
5. G.I sheet (3mm)
6. Plastic pipe for collecting water

WORKING OF SOLAR DESALINATION

We have used solar desalination method for the process of desalination of sea water. In these process the sun energy heats water to the point of evaporation. As the water evaporates, water vapor rises, condensing on the glass surface for collection. It removes impurities such as salt and other wastes as well as microbiological organisms. The end result is clean water which can be further used for drinking purpose as well as for the domestic purposes.

SUPPLY FILL STILL

Water is added in still by manual or by automatic process. Normally water is added once in a day (added 20 liters of sea water) and proper care should be taken while adding or pouring the water but at a enough slow flow rate in order to prevent splashing onto the interior of the still glazing or overflowing into the collection trough.

DISTILLED OUTPUT COLLECTION PORT

Purified drinking water is collected from this port, typically with the glass collection container fitted with pipe. Stills that are mounted on the roof can have the distillate output pipe directly to an interior collection container. A solar still has a top cover made up of glass, which is sealed from the interior and exterior (i.e. air sealed). The interior surface uses a blackened material to improve absorption of the sun's rays. Water to be cleaned is poured into the still to partially fill the basin. The glass cover allows the solar radiation to pass into the still, which is mostly absorbed by the blackened base. The heated water vapor evaporates from the basin and condenses on the inside of the glass cover. In this process, the salts and microbes that were in the original water were left behind. Condensed water trickles down the inclined glass cover to an interior collection through and out to a storage bottle. There are no moving parts in solar still and only the sun's energy is required for operation. Output obtained per day 4-5 litres.

DESIGN OF SOLAR STILL

Design considerations

Different designs of solar still have emerged .The single effect solar still is relatively simple device to construct and operate. This may be classified into active and passive methods. Passive method includes the use of dye or charcoal to increase the solar absorptivity of water, applying good insulation lowering the water depth in the basin to lower its thermal capacity, ensuring vapor tightness by using black gravel and rubber and using reflective side walls. Active method includes the use of solar collector or waste heat to heat the basin, the use of internal and external condenser or applying vacuum inside the solar still to enhance the evaporation/condensation processes, and cooling the glass cover to increase the temperature difference between the glass and the water in the basin and hence increases the rate of evaporation.

Single basin stills have been much studied and their behavior is well understood. The efficiency of solar stills which are well constructed and maintained is about 50% although typical efficiencies can be 25%. 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. At very high temperature such as over 45°C, the plate can become too warm and condensation on it can become problematic, leading to loss of efficiency.Table 1 shows values of water before and after desalination process.

Table 1:Values of water before and after desalination

Parameters	Before Desalination Process	After Desalination Process
Electrical conductivity	19620 uS/cm	47.2uS/cm
TDS	55766 mg/l	27 mg/l
Colour	Brownish, turquoise, blue	Colorless
Taste	Salty	Tasteless
PH value	7.70	6.26
Alkalinity	136 mg/l	4mg/l

Results and Discussions

From the tests conducted it is observed that ,EC value of the sample is 47.2uS/cm whereas for drinking water it should be below 100uS/cm. TDS value of the sample is 27ppm whereas for drinking water it should be

below 500ppm. PH value for drinking water is 6.5 to 8.5 and that of desaline water is 6.26. Alkalinity permissible in drinking water is between 20-200mg/l and that in desaline water is 4mg/l

The desaline water is nearly as pure as demineralized water, as the TDS values are low. This water can be used with any water with high TDS to form a balanced drinking water. Mixture of these two form a perfect drinking water all the parameaters are balanced and added water also needs no purification.

CONCLUSION:

As per the tested results it can be concluded that, TDS parameters are low as compared to drinking water parameters of WHO Global standard. Also bore well water that is groundwater has an average TDS of 1350ppm. If we mix both of them, then the resultant TDS value will be 690 ppm which is within the permissible drinking limits of WHO standards. Therefore, this water can be used for drinking purpose. This also concludes that the model is feasible and practical in the areas where there is shortage of fresh drinking water.

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