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Sea Water Distillation with Help of Solar Energy

Prof. A.S.Pawar , Ms. Priyanka Hindurao Panaskar, Ms. Pratibha Jagannath Desai, Ms. Prajakta Anandrao Patil,Mr. Shivam Anil Pawar,

Jaywant College of Engineering & Management,
Kille Machindragad, Dist: Sangli, (Maharashtra)

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ABSTRACT: Humans cannot drink saline water. But, saline water can be made into freshwater. But, fresh water can be in short supply in some parts of the country. And, as the population continues to grow, shortages of fresh water will occur more often, if only in certain locations.

The seawater distillation is the process of separation of salts from seawater .In that water is converted into a steam by using solar energy concentration. By using steam which is produced under high temperature impacts on the blades of steam turbines which results generation of electricity. The distillation of seawater is obtained by utilizing a thermal energy source. Water is heated and producing water vapor that in turn condenses to form distilled water.

Our aim is to accomplish this goal by utilizing and converting the incoming radioactive power of the sun's rays to heat and distill dirty and undrinkable water, converting it into steam and after that steam is converted into clean drinkable water. A solar parabolic trough is utilized to effectively concentrate and increase the solid angle of incoming beam radiation, increasing the efficiency of the system and enabling higher water temperatures to be achieved.

Keywords; distillation; Steam Turbine; Electricity generation; Condenser

I. INTRODUCTION

The scarcity of fresh water resources and the need for additional water supplies is already critical in many arid regions of the world and will be increasingly important in the future. Many arid areas simply do not have fresh water resources in the form of surface water such as rivers and lakes. They may have only limited underground water resources, some that are becoming more brackish as extraction of water from the aquifers continues.

The seawater distillation is the process of separation of salts from seawater which requires large amounts of energy. About 70% of the planet is covered in water, yet of all of that, only around 2% is fresh water, and of that 2%, about 1.6% is locked up in polar ice caps and glaciers. So of all of the earth's water, 98% is saltwater, 1.6% is polar ice caps and glaciers, and 0.4% is drinkable water from underground wells or rivers and streams. And despite the amazing amount of technological progress and advancement that the current world we live in has undergone, roughly 1 billion people, or 14.7% of the earth's population, still do not have access to clean, safe drinkable water. A few of the negative results of this water crisis are:

-Inadequate access to water for sanitation and waste disposal

-Groundwater over drafting (excessive use) leading to diminished agricultural yields

-Overuse and pollution of the available water resources harming biodiversity

-Regional conflicts over scarce water resources

Thermal Processes In the phase-change or thermal processes, the distillation of seawater is obtained by utilizing a thermal energy source. Water is heated and producing water vapor that in turn condenses to form distilled water. The thermal energy may be obtained by a conventional fossil-fuel source, or by a renewable energy sources such as nuclear energy, geothermal energy, and solar pond.

In addition to these problems, according to Water Partners International, waterborne diseases and the absence of sanitary domestic water is one of the leading causes of death worldwide. For children less than 5 years old, waterborne disease is the leading cause of death, and at any given moment, roughly half of all hospital beds are filled with patients suffering from water-related diseases. Clearly, having affordable potable water readily available to everyone is an important and pressing issue facing the world today.

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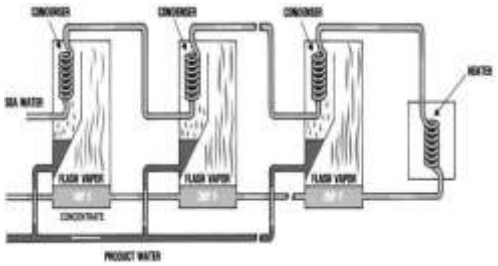
In a steam turbine, high-pressure steam from the boiler expands in a set of stationary blades or vanes. The high-velocity steam from the nozzles strikes the set of moving blades (or buckets). Here the kinetic energy of the steam is utilized to produce work on the turbine rotor. Low-pressure steam then exhausts to the condenser. Steam enters on one side of the turbine rotor through the nozzles, pointing at the surface of the turbine blades, and leaves from the opposite side of the roto

The motivation for this project is the limited availability of clean water resources and the abundance of impure water available for potential conversion into potable water. Our project goal is to efficiently produce clean drinkable water from solar energy conversion. To achieve this goal, a system was designed incorporating a parabolic solar trough coupled with a custom designed distillation device. The incoming solar radiation from the sun is focused and concentrated onto a receiver pipe using a parabolic trough, heating the incoming impure water, at which point it is sprayed into our custom designed distillation device where it evaporates and is re-condensed into pure potable water. Future goals for this project include calculation refinement, material research/testing, and fabrication.



All over the world, access to potable water to the people is narrowing down day by day. Most of the human diseases are due to polluted water resources. Even today, under developed countries and developing countries facing huge water shortage. The groundwater quality problems present today are caused by contamination and by over exploitation, or by combination.

II. OBJECTIVE

Following are the proposed objectives of the sea water distillation by solar energy:-

To provide distilled water by eliminating salts and other contend from sea water.

To create electricity from steam turbines.

III. LITERATURE REVIEW

Author Name - **Soteris A. Kalogirou**

Title - Seawater desalination using renewable energy sources. Published- 17 March 2005

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 tiny 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. The only nearly inexhaustible sources of water are the oceans, which, however, are of high salinity. 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 environmentally-friendly energy sources in order to desalinate seawater.

Author Name - **Ali M. El-Nashar**

Title – Multiple Effect of Distillation of Seawater Using Solar Energy. Published – 2008

This section explains briefly the different commercial desalination processes [Eltawilet al. (2008)].Distillation processes mimic the natural water cycle as saline water is heated, producing water vapor, which in turn is condensed to form fresh water. These processes include: multi-stage flash distillation (MSF), multi-effect distillation (MED), and vapor compression distillation (VC). Forty percent of the world's desalination capacity is based on the MSF desalination principle. However, other distillation technologies, such as MED and VC distillation, are rapidly expanding and are anticipated to have a more important role in the future as they become better understood and more accepte

Author Name - **Klaus M. Retzlaff ,W. Anthony (Tony) Ruegger**

Title -"Turbine Research and Development for Improved Power Plants" Published – April 14, 1986

The focus of this paper is predominantly on the latter type of efforts to advance the state-of-the-art in steam turbine technology. The history of steam turbine development can be described as an evolutionary advancement toward greater power density and efficiency. Power density is a measure of the amount of power that can be efficiently generated from a steam turbine. Improvements in efficiency have been brought about largely through two kinds of advancements. The first type of advancement is improvement in mechanical efficiency by reduction of aerodynamic and leakage losses as the steam expand through the turbine. The second type of advancement is improvement in the thermodynamic efficiency by increasing the

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temperature and pressure at which heat is added to the power cycle.

METHODOLOGY Flow chart

CASE STUDY

Vishakhapatnam, Andhrapradesh

Basic data

- State - Andhrapradesh

Area – 11,161 km²

- Population – 42,88,113
- Population growth rate – 11.89 %
- Temperature – 30-40 º c
- Lack of electricity – 20% people facing problem
- Lack of fresh water – 30% people facing problem
- Basic parameters -
- **Pump**

A pump is a device that moves fluids, slurry by mechanical action. Type of pump used – Centrifugal pump

Why this pump is selected?

Centrifugal pump perhaps the most common type of pump in operation today. Centrifugal pumps are widely used because of their design, Simplicity, high efficiency, wide range of capacity and head, smooth flow rate and ease of operation and maintenance.

Working-

The used kinetic energy of motor to move liquids. An engine is attached to the axis, which then rotates the pump impeller, which is reminiscent of an old ship's ―water wheel‖.

Operating data of the centrifugal pump

- Capacity - 9.6m3/sec
- Head - up to 4m
- Temperature - up to 100c
- Pump size - 500mm
- Power -50HP
- No. of pumps - 6
- **Pipe**

Choice of material for seawater pipeline systems will depend upon the particular environmental Situation and the nature of the application. It will be affected by availability, price and political considerations, as well as the life expectancy; previous performance in similar situations will also influence the decision.

Of the materials considered in this paper, 90/10 copper-nickel is the one most widely used and most likely to fulfill the majority of requirements for the future. In considering behavior in seawater, account has to be taken of many factors including:

- Rate of general and/or localized corrosion under steady state flow conditions
- Possibility of crevice corrosion and of deposit attack or pitting, particularly under stagnant or slowly moving conditions.
- Resistance to stress corrosion cracking
- Effect of variations in composition of seawater including salinity, oxygen content, suspended material, pollutants, etc.
- Effect of chlorination of seawater, if practiced.
- Velocity limitations
- Effect of variation of temperature, possible spheres of operation being anywhere from arctic to tropical regions. In some applications hot brine has to be handled.
- Possible galvanic effects between different materials

It must also be borne in mind that in the marine environment external corrosion of piping systems can be a hazard, e.g. occurrence of crevice corrosion due to ingress of chloride beneath sheathings, laggings, brackets, etc. There have been many recorded cases of piping systems failing prematurely from the outside.

- **90/10 Copper nickel alloy**

The material that appears most nearly to meet the broad requirements of a wide range of seawater pipeline applications is 90/10 copper-nickel (Figure 2). It has a long history of satisfactory use as material for both heat exchangers and pipelines in marine applications.

` 90/10 copper-nickel is not susceptible to stress corrosion, crevice corrosion or pitting attack in seawater and chlorination within normal limits has no significant adverse effects. The material has good resistance to marine befouling and surfaces remain relatively clean indefinitely in contact with untreated seawater.

- **Steam turbine**

As its name suggests, a steam turbine is powered by the energy in hot, gaseous steam—and works like a cross between a wind turbine and a water turbine. Like a wind turbine, it has spinning blades that turn when steam blows past them; like a water turbine, the blades fit snugly inside a sealed outer container so the steam is constrained and forced past them at speed. Steam turbines use high-pressure steam to turn electricity generators at incredibly high speeds, so they rotate much faster than either wind or water turbines. (A typical power plant steam turbine rotates at 1800–3600 rpm—about 100–200 times faster than the blades spin on a typical wind turbine, which needs to use a

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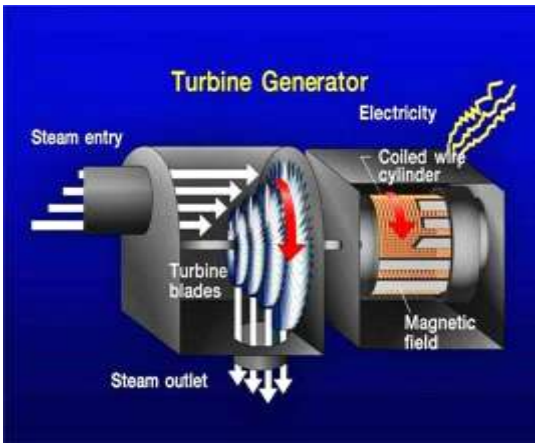
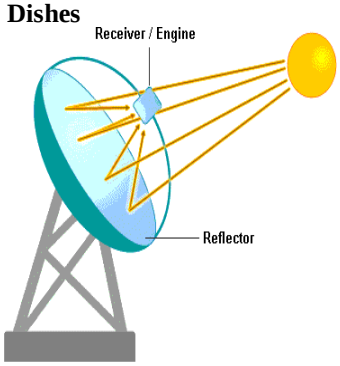
gearbox to drive a generator quickly enough to make electricity.) Just like in a steam engine, the steam expands and cools as it flows past a steam turbine's blades, giving up as much as possible of the energy it originally contained. But, unlike in a steam engine, the flow of the steam turns the blades continually: there's no push-pull action or waiting for a piston to return to position in the cylinder because steam is pushing the blades around all the time. A steam turbine is also much more compact than a steam engine.



- **Solar Dishes**



Solar panels collects solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect.

Types

- Lens Concentrators
- Fresnel Reflector
- Parabolic Dish
- Parabolic Trough
- Solar Furnace
- Central
- Receiver Parabolic dish-

Steam generation rate by 1 solar dish – 38.35kg/ day
Temperature concentrated by 1solar dish – 400 to 600oc Material required for receiver – Stainless Steel

Condenser
In that system steam pressure is reduced, due to which it is easily condenses.

Types of condenser

Jet condenser	**Surface Condenser**
The process is faster	The process is slower
The process is cheaper. The process is simpler.	The process is costlier The process is complex
The process is used sufficient boiler feed water is available.	The process is used where sufficient boiler feed water is not available and the condensed steam reused as boiler feed water.
The process is installed where cooling water is easily and cheaply made suitable for boiler feed.	The process is suitable where cooling water cannot be easily made suitable for boiler feeding.

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In jet condenser, the condensed steam, air, cooling water and uncondensed vapor and other gases are mixed up and cannot be easily separated.	In surface condenser the condensed steam is totally free from cooling water hence can be reused easily as boiler feed water.

RESULTS

Testes	**Sea water reading**	**Distilled water reading**
pH	8	7
Alkalinity	Co_3- = 4 ppm HCO_3-= 6 ppm	Co_3- = 4 ppm HCO_3-= 11 ppm
Chloride Content	19.400mg/lit	88.75mg/lit
Hardness	18-50 mg/lit	25 mg/ lit
Dissolved Oxygen	5.28 mg/lit	9 ppm

IV. CONCLUSION

From this paper it is found that for distillation of sea water solar system is best suitable method. It is simple method to get fresh distilled water from sea water, for its various applications in domestic and industrial sectors. A large area of receiver is painted with black color with maximize the amount of solar energy is absorbed, also availability of material with good thermal energy absorbing properties and resilience in heated salt water. For concentrating sea water the parabolic dishes is used. It is generating the temperature on receiver near about 400 to 600 celcious. Due to which water is get heated and it convert into steam. The mass flow rate of steam is 31.49kg/ sec. the discharge of water through the pipe is 9.6 m3/sec. for that discharging the water centrifugal pumps are more suitable.

Achieving the electricity demand, the steam turbine is used to generating the electricity. The steam which is generated under high temp that steam is highly compacted on blades of steam turbine due to which it rotates and it generate the electricity. The force of steam is required for rotating the blade is 256.32KNThe speed of shaft is 1067rpm. For generating the distilled water from steam, the condensers are used. For that condensation process surface condensers are used.

The world's water and electricity needs are increasingly dramatically. Solar renewable technologies that can be used for sea water distillation. Keeping in mind the climate protection targets and strong environment concerns, future water distillation around the world should be increasingly powered by solar. For that achieving the electricity demand and distilled water demand is fulfilled by solar energy concentration methods.

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