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OCEAN THERMAL ENERGY CONVERSION: A BETTER SOLUTION

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ABSTRACT

Today the world is facing major problems like pollution and global warming. And it is because of the world's heavy dependence on fossil fuels for electricity. Most of the countries those are still using diesel generators as their main source of energy are facing environmental problems. The practical alternative energy sources which can meet the global demand without causing any damage to environment are very less. Ocean Thermal Energy Conversion (OTEC) is a concept that has the potential to address this growing issue. It is basically a mechanism that uses the temperature difference between warm surface seawater and cold deep ocean water, to produce electricity. TEC was first proposed in 1881 and from then onwards it has been dormant. This paper is a review of basic concept of OTEC types of OTEC, and services of OTEC.

Keywords: *Components, deep seawater, ocean thermal energy conversion.*

I. INTRODUCTION

Because of growing world population and environmental problems, it is very clear that in 21st century the conventional resources of energy such as coal, uranium, and oil become unreliable. The considerable solutions to this problem are energy sources like solar, wind, and geothermal power. But if we compare above alternatives we come to know that ocean thermal energy is highly abundant, very stable and easily applicable in many industrial fields.

Ocean thermal energy conversion (OTEC) is a process which uses the heat energy stored in the ocean.The temperature difference between warm surface water and cold deep seawater is used by OTEC to produce electricity. As the oceans are continually heated by the sun and cover nearly 71% of the Earth's surface, this temperature difference contains a high amount of solar energy which could potentially be used for human use.OTEC also allows the release of massive amount of deep sea water which is rich in minerals and is applicable in several industries other than producing electricity. [1]

II. HOW OTEC WORKS

The working of basic OTEC plant is shown in fig1.The main components are evaporator, condenser, turbine, power generator, and pump these components are connected via cold water pipes that contain working fluids, typically ammonia and propane.

The warm surface water is taken to the evaporator through pumps which transfers heat to the working fluid i.e. it is heated up to 25 to 30 degree Celsius and evaporated to vapor.

Working fluid is then turning into high pressure vapor. The vapor then rotates the turbine and flows through it.

The turbine is coupled with the generator and it activates the generator, thereby producing electricity.
The vapor is cooled in the lower pressure condenser by the nearly freezing water taken up from the ocean depths.
The working fluid is sent back to the evaporator after condensing to reuse and to repeat the cycle.

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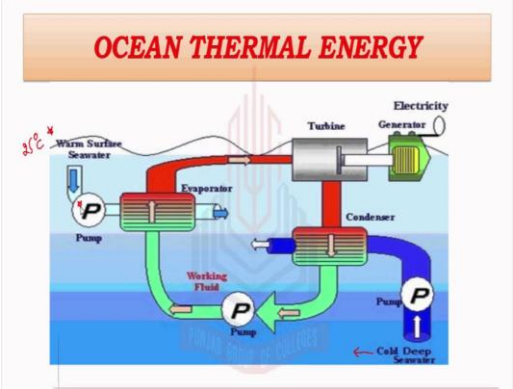

Fig1- A basic OTEC system [1]

There are three types of OTEC system and they are as follows:-

- **Closed cycle system**

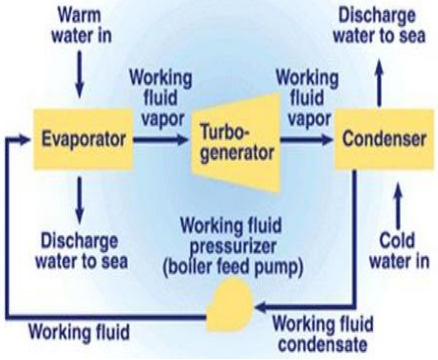

Fig2:- Closed cycle system [1]

In the closed cycle OTEC system, warm seawater vaporizes a working fluid such as ammonia, which is flowing through an evaporator.

The vapor expands at moderate pressure and rotates a turbine coupled to a generator that generates electricity.

The condenser is used to convert the steam again back into working fluid. It is done by using cold deep sea water which is brought from the ocean depths through water pipe.
The condensed working fluid is pumped back to the evaporator.
The working fluid remains in a closed system and circulates continuously. [4]

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- **Open cycle system**

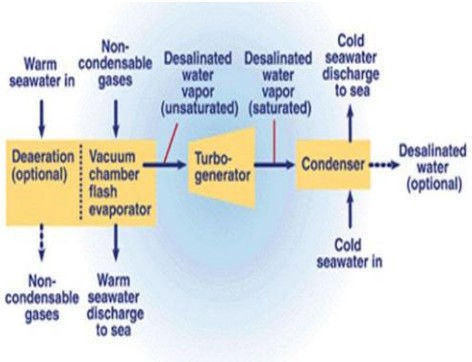

Fig3:- Open cycle system [1]

In an open cycle OTEC system warm seawater is used as a working fluid.The warm seawater is flash- evaporated in a vacuum chamber to produce steam at an absolute pressure about 2.4 kilopascals.The steam is applied to a low pressure steam turbine which is coupled to a generator to produce electricity.The steam coming out from the turbine is condensed by cold seawater pumped from ocean sea depths.In case if, surface condenser used in the system, then the condensed steam remains isolated from the cold seawater and provides a supply of desalinated water.

Hybrid cycle OTEC system:-

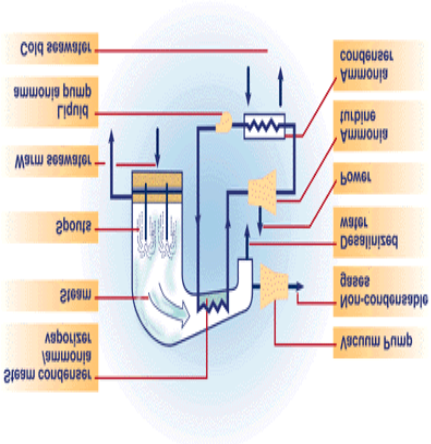

Fig4:- Hybrid cycle system [1]

A hybrid cycle system utilizes the features of both closed and open cycle systems.

In a hybrid OTEC system, warm seawater enters in a vacuum chamber where it is flash-evaporated into steam, which is similar to open cycle system.The steam vaporizes the working fluid of a closed cycle loop on the other side of an ammonia vaporizer.

The vaporized fluid then turns the steam turbine that produces electricity.The steam condenses within the evaporator and provides desalinated water.

III. SITE SELECTION CRITERIA

The temperature difference between surface water and deep ocean water must be at least 20 degree Celsius .The OTEC plant must have an ocean depth of 700 m or more. There should be proper study of meteorological

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conditions like hurricanes. Sufficient manpower should be available to run the power plant. The cost of shoreline sites must be affordable.

IV. APPLICATIONS OF DSW

After successful utilization of DSW in the OTEC plant the temperature of water is still low and cold. So it could be used as a chilling source for air conditioning. The DSW is rich in mineral concentration and having many medicinal properties. Hence high quality mineral water can be produced. DSW has a high nutritional value that's why it could be effectively used for aquaculture to increase the growth rate. The most common method of lithium production is extraction of lithium chloride from seawater. As DSW is much more pure and cleaner than surface seawater, so it is economically more suitable to extract lithium. It is also used as a valuable source for food, cosmetics and pharmaceutical industries. [7]

V. CONCLUSION

No fuel is burned in this plant as warm seawater is uses as a heating source and carbon dioxide emission is less than 1%. Nutrient rich cold seawater always increases mariculture. OTEC plant produces desalinated water for industrial and agricultural uses. The major drawback of an OTEC plant is that it requires high capital cost. OTEC is only feasible at relatively isolated sites i.e. deep tropical oceans. OTEC has not been demonstrated at a full scale over a prolonged period.

OTEC results in massive flow and then influence most the natural condition of ocean near the plant. It can cause changes in thermal structure, salinity gradients, carbonates and turbidity. These changes can be harmful to marine ecosystem [2]. It is ecologically controversial. The existing OTEC power plants ranges from 22KW to 1.25MW
The fossil fuels are going to be consumed completely in future so we can't rely on them in future. So we have to find alternative sources. OTEC could be the best alternative to the fossil fuels. .OTEC has more constraints in site selection as compared to solar and wind power plants. But it has ability to become a power solution to the global issues

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