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How to Minimise the Cost of Ocean Thermal Energy Conversion (OTEC)

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ABSTRACT

OTEC stands for Ocean Thermal Energy Conversion. It use a temperature difference (20 °C) between the upper layer of ocean surface and bottom layer of ocean surface is required to run the turbine to generate an electricity. Ocean covered 70% of earth's surface which is abundant form of solar collector and solar storage capacity. Ocean has an abundant form of renewable source of energy which has a potential to fulfil billions of watts of electricity. Now a days OTEC is required to generate electricity due to sky rocketing price of oil, natural gas and coal. The objective was how to minimise the cost of Ocean Thermal Energy Conversion Plant.

I. INTRODUCTION

OTEC is use a temperature difference **(**20 °C) between the upper layer of ocean and bottom layer of the ocean. Ocean covered a 70% of earth's surface which is a world's largest solar energy collector and has a potential to store energy. Now a day solar energy absorbed by sea is equivalent to 4000 times amount presently consumed by people.

In **1981,** jacques D-arsonval a French physician suggested that extracting heat energy from sea. He also gives a detailed working of closed cycle OTEC that is in closed cycle, we use ammonia as a working fluid which has a low boiling point. The hot in ammonia are flow past one another in heat exchanger so that hot water gives its heat energy to ammonia making it to boil then vaporisation of ammonia flow through a turbine then making it to rotate. After that a generator converts that energy into electricity. Now the warm ammonia should be condensed in condenser through cool water of ocean depth comes through the pipe. Other heat exchangers which cool the ammonia back down to its original temperature.

In 1926, D' Arsonval student George Claude build aprototype on shore energy extracting machine in Cuba .After forty years George Claude propose a used of ocean water as a working fluid .In open cycle we use a process of rankine cycle. It is basically converts thermal energy into kinetic energy through turbine. We use sea water as a working fluid in open cycle of ocean thermal energy conversion. The warm surface of sea is exposed to vacuum and causing it to boil and generate the steam. The cold water is pump through a depth (1000 metre) of the ocean to condense. The constant use of vaporization and condensation is used to drive a turbine then it generates electricity.

II. WORKING OF OTEC

It is of three types:-

1. **OPEN CYCLE OTEC**
2. **CLOSE CYCLE OTEC**
3. **HYBRID CYCLE OTEC**

1. OPEN CYCLE OTEC

In open cycle we use a process of rankine cycle. It is basically converts thermal energy into kinetic energy through turbine. We use sea water as a working fluid in open cycle of ocean thermal energy conversion. The warm surface of sea is exposed to vacuum and causing it to boil and generate the steam. The cold water is pump through a depth (1000 metre) of the ocean to condense. The constant use of vaporization and condensation is used to drive a turbine then it generates electricity.

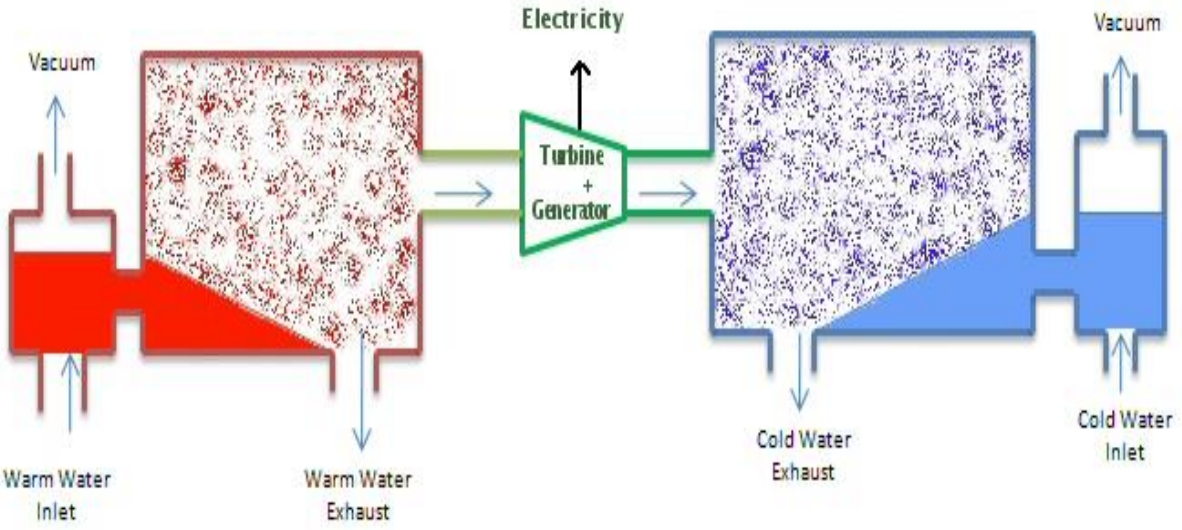

FIGURE OF OPEN CYCLE

2. CLOSED CYCLE OTEC

In closed cycle, we use ammonia as a working fluid which has a low boiling point. The hot in ammonia are flow past one another in heat exchanger so that hot water gives its heat energy to ammonia making it to boil then vaporisation of ammonia flow through a turbine then making it to rotate. After that a generator converts that energy into electricity. Now the warm ammonia should be condensed in condenser through cool water of ocean depth comes through the pipe. Other heat exchangers which cool the ammonia back down to its original temperature. Ammonia is capable to reuse.

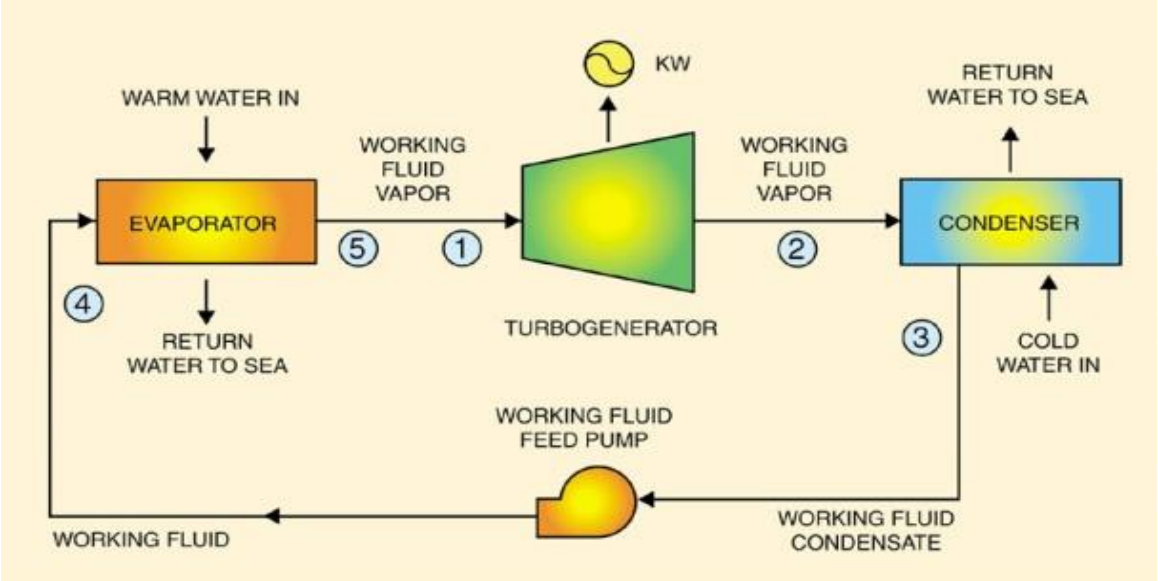

FIGURE OF CLOSED CYCLE

3. HYBRID CYCLE OTEC

In a hybrid cycle the process of both close cycle and open cycle are combined. The warm sea water enters into the vacuum chamber. Then it flash evaporated into steam this is like an open cycle. A low boiling point of working fluid is vaporised into a steam which runs the turbine to produce electricity. This process is similar to close cycle.

III. FACTORS WHICH CAN BE USED TO MINIMISE THE COST OF OTEC

1. Effective utilization of sea water, the temperature difference without high cost of heat exchange is the key to overall economic of OTEC plant.
2. The location of OTEC is closer to shore landing so it required less cable.
3. Limiting the number of cable on ship.
4. The distance to shore from interconnected should be shorter.
5. Reduced the weight of old material by replacing with the modern material.
6. There is a flexible connection and termination to platform.
7. OCEAN THERMAL ENERGY CONVERSION plant is set up in tropicalocean where the temperature difference of upper portion of ocean water and bottom of ocean water is greater than 20 °C.
8. The cable which is used in OTEC should be in planned manner for future upgrade on the platform.
9. The generation and distribution of OTEC is in optimization way.
10. For installation there is required optimization space for sub-station and A.C equipment required less space.
11. The tools and ocean graphics data allow to design of more cost effective platform.
12. Ocean thermal energy conversion can adopt the existing technology and analysed the tools.
13. The material choice should be more Robust.

IV. ADVANTAGE OF OCEAN THERMAL ENERGY CONVERSION (OTEC)

1. Reduce fossil fuel:-
   The dependence on fossil fuel is decreased with increased in the used of ocean thermal energy conversion. With the sky rocketing price of oil, many countries are pushing the company to adopt these clean sources of energy.
2. Unlimited sources of free energy especially in tropical water.
3. OTEC generated electricity with NO GREENHOUSE emission.
4. OTEC has a potential to generate a large amount of electricity.

5. Ocean thermal energy conversion can create cold fresh water which can be used for air condition or drinking water.
6. It does not emit pollutant in atmosphere.
7. IN OPEN CYCLE OF OTEC:- It has an ability to create desalination, fresh drinking water when the warm water is recondense.
8. OTEC is a great option for developing area that not only for domestic power but also need fresh water.
9. The cold water effluent produced through OTEC can also provide useful product that application in agriculture, ice production, hydrogen production, mericulture.
10. Power from OTEC is continuously and pollution free.
11. Drawing warm water and cold water and returning of sea water closed the thermocline could be accomplished with minimum environment impact.
12. OTEC system might help in enrichment of fishing ground due to nutrients from the unproductive depth water to warmer surface water.

V. DISADVANTAGE:-

1. The installation of the OTEC device and maintenance of power plant is high.
2. OTEC can be only performed in tropical ocean, where is a temperature difference at least 20 °C between upper layer of ocean water and bottom layer of ocean about 1000 meter depth.
3. Efficient commercial exploitation is difficult.
4. Land based OTEC power plant pipe of 3 k.m long is required to transport a large volume of cold water from the depth of ocean about 1000 meter the cost of the pipe as about 75% of the cost of the current plant design.
5. In a land based plant, there is a problem of cold and warm sea water. The discharge has to be carried out in appropriate depth of the ocean to avoid the damage of aquatic environment. This required a addition maintenance.
6. OTEC plant needs to be installed as near to national grid.
7. OTEC plant need to safe location from storm.
8. There is small temperature difference between surface water and bottom water. So the efficiency is very low 3-4%.
9. Due to low efficiency of OTEC plant and coupled with high cost and maintenance cost make them uneconomical for small plant.
10. Construction of floating OTEC plant is difficult.
11. The company has not invested money on this project because it had been only tested.

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