STRATEGIES TO IMPROVE THE EFFICIENCY OF OCEAN THERMAL ENERGY CONVERSION (OTEC)

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Abstract-This paper give out different ways of ocean thermal Conversion (OTEC) strategies to improve the efficiency of OTEC plants. Ocean's are world's Logged Solon collecting. OTEC is one of the pollution free alternative source of resource of energy. in the future OTEC is considered as a successfulThe conversion strategies primarily focus on open cycle, closed cycle and hybrid. The most commonly used heat cycle fa OTEC open cycle open cycle engines use vapor from the seawater it self as the working fluid. Although it is an eco-friendly resource, this does not mean that it is a purely clean resource. negligible may Cause environmental influence that will be mentioned in this paper.

Keywords- Ocean thermal energy conversion, power generation, plant efficiency.

1. Introduction

The population growth, quick development of large country likeChina, India and Brazil, ever spreading desires of human beings obtain comfort and fast exhausting non-renewable energy resourcesare leading the world to a well forseen energy crisis. ocean thermal energy conversion produces electricity from the temperature differencebetween warm water of oceans and the colder deep water &solar Panels produce electricity while the ocean's surface creates thermal energy.The OTEC Technology first came into picture in 1881 by a French Scientist P. P. Arsene Dr Arzenval. Later Dr Arzonvals student George cloud.

plant in ratanzas, Cuba in 1930. The System generated 22kw of electricity with a low pressure turbine the plant was destroyed in a storm latter, Claude constructed another plant in 1935 (open cycle plant), this time aboard a 10000Ton cargo vessel Moved of the cost of Brazil.

In 1956, French Scientists designed a 3mw plant for Abidjan, Ivory coast. The plant was never completed, because new finds of Large amounts of cheap petroleum made it uneconomical.

In 1967 J. Hilbert Anderson and James H. Anderson patented the new "closed cycle "design. This produced power at lower cost then oil & coal.

In 1981, Tokyoelectric power company successfully produce 120kWof electricity, 90kw was used to power the plant and remainingelectricity was used to power a school and other places In 1981 also saw a major development in OTEC technology when Russian engineer, Dr.Alexander Kalina, used a mixture of comment and water to produce electricity.

In 1994 saga, university designed and constructed a 45 kw plant for the propose of testing a newly invented Uehara cycle, also named after its inventor Uehara. This cycle included absorption and extraction Processes that allow this system to outperform the Katina cycle by 1-2%.curently the institute of Ocenenergy saga university, is the leader in OTEC power plant research and also focuses many.

In 1974, the U.S established the Natural Energy laboratory of Hawaii Authority at Keahole point on the Kona court of Hawaii. Hawaii is the best U.S OTEC location, due to its warm surface water, access to very deep, very cold water and high electricity cost

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The laboratory has become a leading test facility for OTECtechnology.

In 1979, an open cycle OTEC was formed by the solar energy ResearchInstitute (SERI) with funding from the U.Sdepartment of Energy Evaporates and suitably configuresdirect- contact condenser were developed and patented by SERI Dr Bharathan at the national Renewable Energy laboratory (NREL) developed the initial conceptual design for up-date 210kw open cycle OTEC experiment - This design integrated all components of the cycle, namely, , the evaporator, condenser vacuum vessel, withthe turbine into one Singlevacuum vessel with the turbine mounted on top to prevent any potential for water to reach it.

In 2002, India tested a 1MW floating OTECpilot plant nearTamil Nadu. The plant was ultimately unsuccessful due to a failureof the deep Rea cold water Pipe.

In 2006,Makai ocean Engineering was awarded a contract from the U.S. office of Naval Research (ONR) to investigate the potential for OTEC to produce nationally significant quantities of hydrogen in at Sea floating plants Located in warm tropical waters.

In July 2011, Makaf Ocean Engineering completed the design and construction of an OTEC heatexchanger. The Test Facility at theNatural Energylaboratory of Hawaii. The purpose of the facility is to arrive at an optimal design for OTEC heat exchangers, increasing. performance and useful life while reducing cost. And in Morch 2013, Makai announced an award to install and operate a 100 kilowatt turbine on the OTEC heat exchanger Test Facility, and once again Connect OTEC power to the grid.In July 2016, the Virgin island Public services commission approved ocen thermalenergy comparations application to become a Qualified Facility. The Company is thus permitted to begin negotiations with the virgin islands waterand power authority (WAPA) for a Power purchase Agreement (PPA) pertaining to an ocean thermal energy(OTEC) plant on the is island of st.croixThis would be the world' s fivecommercial OTEC plant.

2. Different OTECStartergies

a) open cycle:

OTEC system in which warm, surface seawater is the working fluid. In open-cycle ocean thermal energy conversion, warm, surface seawater is placed in a low-pressure container that causes the water to boil, turning a turbine as the steam expands.

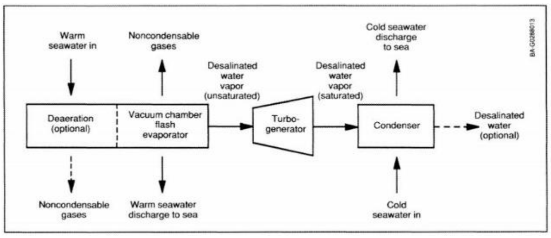

Fig. Open cycle

Then the steam expands through a low-pressure turbinewhich is coupled to a generator to produce electricity. Thesteam exiting the turbine is condensed by cold seawaterpumped from the ocean's depths through a cold-water pipe.If a surface condenser is used in the system, the condensedsteamremainsseparatedfromthecoldseawaterandprovidesasupplyofdesalinatedwatercirculatescontinuously. The most of the OTEC plants build in theearly stagesbelongedtothistype.Theanalysisofthiscycle leadsfollowingequations

b) Closed cycle:

OTEC system in which working fluid with a low-boiling point is circulated. Warm, surface seawater is pumped through a heat exchanger where the working fluid is vaporized and driven through a turbine, which then generates electricity.

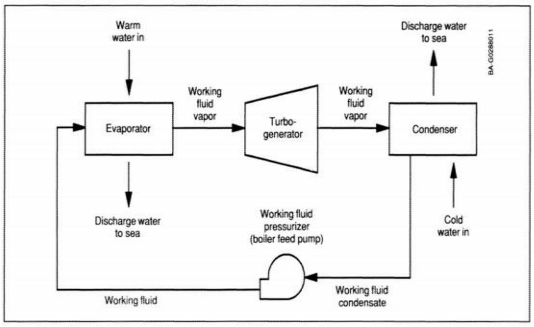

Fig.2. closed cycle

This is schematic of a closed-cycle OTECplant. The working fluid, which is generally a low boilingpoint liquid, is made to a vapour by the warm seawaterflowingthrough aheat exchanger (evaporator). Thevapor expands at moderate pressures and rotates a turbinewhichiscoupledtoageneratorwhichwouldproduceelectricity.Thevaporisthencondensedinaheatexchanger(condenser)byrejectingitsheattothecoldseawaterpumped from the ocean's depths. Then, the condensate ispumped back to the evaporator and the cycle repeats. Thisisregardedasathermodynamicallyclosedsystem,sincetheworkingfluidre-circulatescontinuously.Thissystemdisplayshigherefficienciesthantheopencycle OTECsystem.

c) Hybrid cycle:

hybrid cycle combines the features of both the. closed-cycle and open-cycle systems. • In a hybrid OTEC system, warm seawater enters a. vacuum chamber where it is flash-evaporated into. steam, which is similar to the open-cycle.

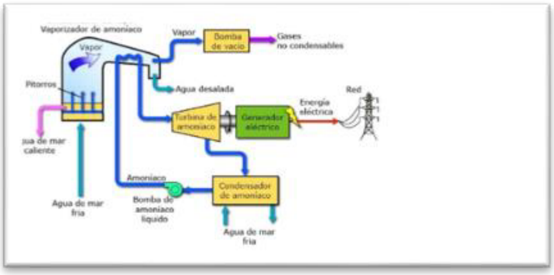

Fig.3.Hybrid cycle

TheHybridsystemsarecombinationoftwotechnologies. Since it incorporates salient features of each,these systems demonstrate higher thermal efficiency. In ahybridOTECsystem,warmseawaterentersavacuumchamber where it is flash-evaporated into steam, similar totheopen-cycleevaporationprocess.Thissteamistransported to the other end of the cycle to vaporize theworking fluid which in a closed-cycle. The vaporized fluidthen drives a turbine and produces electricity. The steamexitingtheturbineisdirectedtoacondenserwhereitproducesdesalinatedwater.

3. Benefits:

- The net energy output of the plant increases by approx. 20.3% which is considerably high.
- Suitably designed OTEC plants will produce little or no carbon dioxide or other polluting chemicals.
- The installation of a pre-heater increases the working time constraint of the OTEC plant in a particular day.
- The use of OTEC as a source of electricity will help reduce the state's almost complete dependence on imported fossil fuels.

4. Drawbacks:

- OTEC-produced electricity at present would cost more than electricity generated from fossil fuels at their current costs.
- OTEC plants must be located where a difference of about 20º C occurs year round. Ocean depths must be available fairly close to shore-based facilities for economic operation. Floating plant ships could provide more flexibility.
- No energy company will put money in this project because it only had been tested in a very small scale.
- The cost of the OTEC plant increases by 21% by installation of a super heater and a pre-heater.

5. Results

Variation of efficiency with distance: The plot for the efficiency variation against the distance is shown in fig. the other loses were assumed to be negligible . fig indicates an extreme reduction in efficiency when the off shore distance is increasing rapidly .

This indicates the importance of minimising the distance between the water fetching points and the power plant

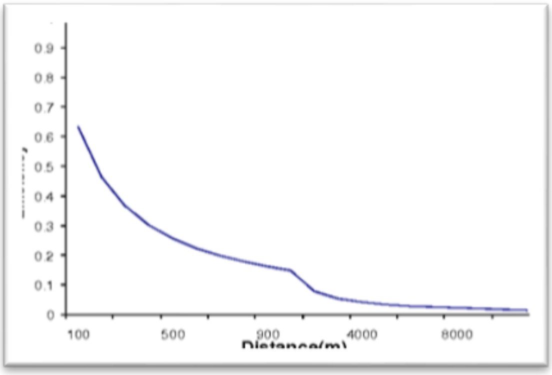

Fig.4.Variation of efficiency with distance

Variation of thermal efficiency with thermal gradient: thermal efficiency mainly depends on the thermal gradient of the proposed location for the OTEC plant. This indicates that the increasing the thermal gradient leads to increasing in the thermal efficiency

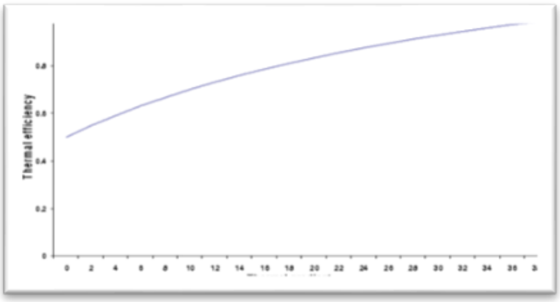

Fig.5.variation of thermal efficiency with thermal gradient

6. Conclusion:

The analysis have evidently shown that of shore distance and thermal gradient directly influence towards the plant efficiency where results have that the optima (compromise between efficiency and thermal gradient) distances for the plant as 2000m from the shore.Indeed, closed cycle OTEC is unlikely to be commercially viable in sizes of less than 40MW in an open cycle OTEC system the sea water it self is used to provide the thermodynamic fluid.Open cycle is eco-friendly because of ammonia is doesn't used in this type of cycle in the other hand closed cycle uses ammonia. So, when compare to closed cycle open cycle is best Ocen thermal energy conversion (OTEC).

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