Comparison studies on Low Temperature Thermal Desalination and Open cycle OTEC Plants

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National Institute Ocean Technology (NIOT) has established its first ever Low Temperature Thermal Desalination (LTTD) plant using ocean thermal gradient in the year 2005 at Kavaratti Island of Union Territory of Lakshadweep. Subsequently, five more plants have been put up based on the experience gained. All these plants draw power from local grids driven by diesel generators and hence it is important to find ways to provide this energy using a renewable form. Efforts at NIOT are now focused on powering desalination using Open Cycle Ocean Thermal Energy Conversion (OC-OTEC) principle. This study compares technical parameters of LTTD and OC-OTEC powered desalination plants. In an LTTD plant, the surface sea water from upper layers is flash evaporated in a low pressure flash chamber and the resultant pure vapor is condensed in a surface condenser that makes use of cold sea water at 12oC – 13oC from the deeper layers of the ocean at a depth of 300 – 350 m. In the OC-OTEC powered desalination plant, the generated water vapor from the flash chamber drives a turbine and generates electricity, before being condensed back to drinking water using deep sea cold water at 8oC to 9oC drawn from the ocean depths of 900 – 1000 m. Hence this OC-OTEC powered desalination plant is designed in a way that the entire parasitic power requirement is met from the power generated by the OC-OTEC turbine to make the plant self powered. In this study, the temperature distribution between the components and its percentage of sharing in both LTTD and OC-OTEC are compared. Flash chamber cum de-aerator considered in the plants is a single stage flashing type evaporator with an inbuilt de-aerator to remove the partial Non-Condensable Gases (NCG) such as Oxygen, Nitrogen, Carbon di-oxide, etc The condenser (Shell & Tube type) used in these plants is one of the expensive components. To obtain an optimum condenser design, a trade-off between fixed and operating costs of the condenser is needed. In this study, flash chamber parameters, condenser parameters of both LTTD and OC-OTEC are compared. The vacuum system plays a vital role in the operation of the LTTD and OC-OTEC desalination plants. Estimation of vacuum system load is critical and should be done precisely to come up with a proper selection of vacuum system during the design phase of these plants. In this study, parameters of the vacuum systems of both plants are compared. Also seawater pump parameters also presented. Comparison of the LTTD plant parameters with the OC-OTEC powered desalination plant parameters shows that by increasing the length of the deep sea cold water pipe, increasing flashing area in the flash chamber, reducing the condenser tube side pressure drop, reducing hydraulic losses in the plant piping and introducing of the turbine by proper distribution of the available temperature gradient make the plant self-powered.

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6. Area of research:

Design & development of Ocean thermal gradient, waste heat and solar thermal energy based desalination systems

Design & development of OTEC cycles, Design & development of evaporators and condensers for OTEC cycles.

7. List of Publications :

Journal Publications: 3
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8. Patents filed / Granted with details

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