

Energy Resources and Utilization

CEP

The oceans can provide an inexhaustible amount of energy absorbing radiations which has the same heat content as 250 billion barrels of oil each day. Pakistan borders 1046 kilometres with the Arabian Sea in the south. This strategic location provides an ideal opportunity for the establishment of an Ocean Thermal Energy Conversion (OTEC) system. An ocean thermal gradient electric generating system is proposed for siting. This system would operate a heat engine driven by heat flow from warm ocean water (cooled from 27 °C to 25 °C in the heating heat exchanger of the system) and cooled by heat flow to cold ocean water (which is heated from 3 °C to 5 °C in the cooling heat exchanger of the system). The ocean water used in the different parts of the heat engine is obtained from different depths of the surrounding sea. Using this heat engine electricity can be produced at 90% of the corresponding Carnot efficiency of the heat engine.

Assessment:

- i) . What is the value of the Carnot efficiency of the heat engine? Explain the basis for selecting the parameter values used in calculating this value. [20%]
- ii) . Should the cold ocean water flow through the engine at a rate of 100 million kg/min what is the electric power output of the engine? [30%]
- iii) . What is the corresponding flow rate of warm ocean water? [20%]
- iv) . Friction losses arising in pumping seawater through the engine account for 0.33 of the engine's irreversibility's. Over time we can expect such friction losses to double, due to befouling in the flow circuits. What would be the resulting value of the heat engine's efficiency? [30%]

Sr. No	Attributes
1	Depth of knowledge required
2	Depth of analysis required
3	Extent of stakeholder involvement