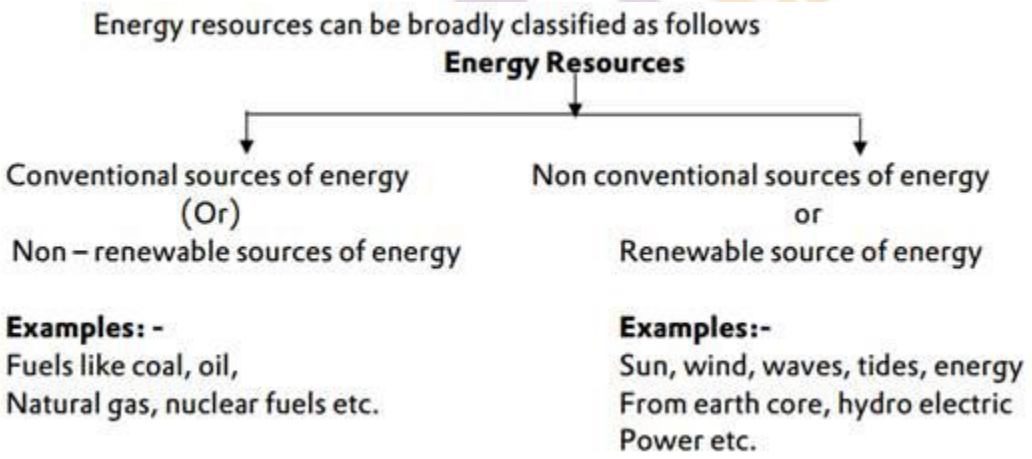
Power Engineering Study Notes for Mechanical Engineering

Power plant engineering deals with the study of energy, its sources and utilization of energy for power generation. The power is generated by prime movers (example Hydraulic turbines, steam turbines, diesel engines). Large amount of power is generated using prime movers in a site or layout called power plants, where all the equipment and machinery required for power generation is located.

Energy: Energy may be defined as the capacity to do work. Energy exists in various forms, such as Mechanical Energy, thermal energy, electrical energy, solar energy etc. Electricity is the only form of energy, which is easy to produce, easy to transport, easy to use and easy to control. Electricity consumption per capita is the index of the living standard of people of a place or country i.e. the utilization of energy is an indication of the growth of the nation.

Power can be defined as the rate of flow of energy and can state that a power plant is a unit built for production and delivery of a flow of mechanical or electrical energy.



Classification of power plants:

A power plant makes use of any one of the energy sources to produce power.

Depending on the type of energy source the power plants are classified as

- Thermal power plant (Steam power plant)
- Internal combustion engine plants
- Gas turbine power plant
- Nuclear power plant
- Solar power plant

- Tidal power plant
- Hydroelectric power plant
- Wind power
- Geothermal power plant

Also Read: [Structure and Properties of Engineering Materials Study Notes for Mechanical Engineering]

Vapor Power Cycles and Combined Power Cycles

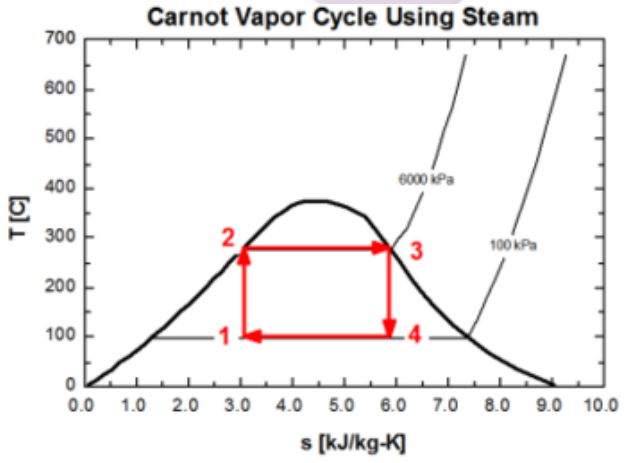
- The term vapor power cycle implies the working fluid is alternatively vaporized and condensed during the cycle, and that the gaseous phase typically exists near the saturated vapor line.
- Steam/water is the most common working fluid used in vapor power cycles. It is cheap, readily available, nontoxic, and has high enthalpy of vaporization.
- Most vapor power plants are steam power plants, whether powered by coal, natural gas, or nuclear.

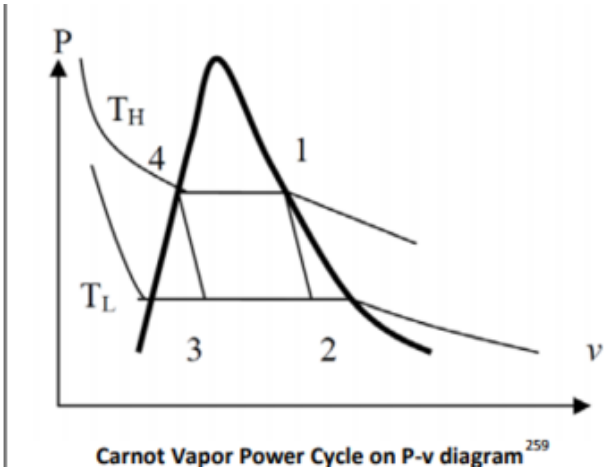
Carnot Idealized Vapor Power Cycle

- The Carnot vapor cycle operates under the saturation dome (representative versions are shown in the diagrams to follow), and has the usual thermal efficiency

$$\eta_{max} = \eta_{Carnot} = 1 - TL/TH.$$

- However, it is impractical as a model vapor power cycle and cannot be achieved in actual devices





Carnot Vapor Power Cycle on P-v diagram[259]

- The barriers to making a real and successful Carnot vapor power cycle, using state numbers shown on the
  left, may be summarized:

- For Process 2-3, limiting the heat transfer processes to two-phase (saturated liquid-vapor mixture) systems severely limits the maximum temperature that can be used in the cycle (Tcr =374 C for water).
- For Process 3-4, the turbine cannot handle steam with a high moisture content because the impingement of liquid droplets on the turbine blades accelerates erosion and wear.
- For Process 1-2, it is not practical to design a compressor that handles two phases

By studying the aforementioned Power Engineering Study Notes for Mechanical Engineering, students can acquire a solid foundation in power engineering principles and concepts. This knowledge will enable them to contribute to the design, operation, and maintenance of efficient and reliable power systems.

Thanks!

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