Page No.
Date

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Experiment No - 8

* Name of the experiment - Working and operation of Boiler / Thermal power plant -

* Aim - To study the different components of boiler and its significance in thermal power plant.

* objective - To understand the different parts and working of thermal power plant.

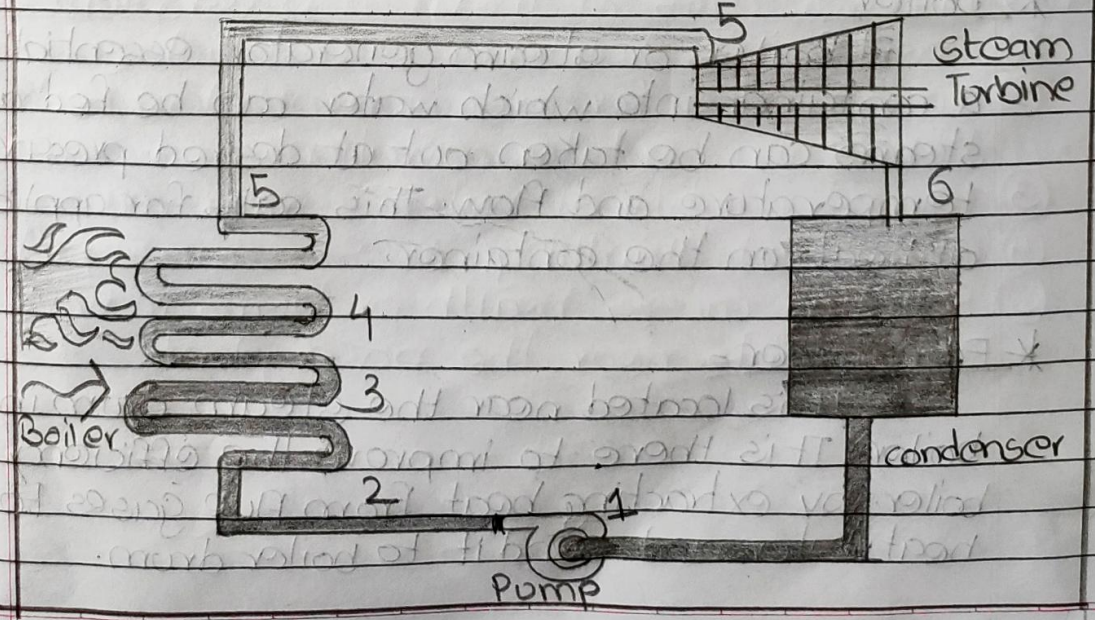
Page No.
Date

Summary

* Thermal Power Plant

Thermal power plant is the most conventional source of electric power generation. At present about 55% of total electricity production in India is from Coal Based Thermal Power Stations. A coal based thermal power plant converts the chemical energy of the coal into electrical energy. This is achieved by burning coal in the furnace releasing the heat of combustion, which raises steam in the boiler, the high pressure, high temperature steam is expanded through the turbine rotating it which is coupled to a generators converting mechanical energy into electrical energy.

- Schematic Diagram of Thermal Power Plant.



Page No.
Date

* Working -

The working fluid in the thermal power plant is water/steam. The ideal thermodynamic cycle for the thermal power plant is Rankine cycle. (Refer the diagram). The process 1-2 is pumping water from condenser pressure to boiler pressure. In boiler the water is heated at constant pressure first to saturation temperature (process 2-3), then it is converted into steam (phase transformation process 3-4) and then it is superheated (process 4-5). The superheated steam then expands in turbine from boiler pressure to condenser pressure (process 5-6) producing mechanical work. The saturated or unsaturated steam coming from turbine condenses in the condenser (process 6-1). The turbine is coupled with generator converting the mechanical energy into electrical energy.

* Boiler -

A Boiler or steam generator essentially is a container into which water can be fed and steam can be taken out at desired pressure, temperature and flow. This calls for application of heat on the container.

* Economiser -

It is located near the steam drum in the boiler. It is there to improve the efficiency of boiler by extracting heat from flue gases to heat water and send it to boiler drum.

Page No.
Date

* Superheater-

It is also located near the steam drum in the boiler. It converts the saturated steam to dry steam. It is used to increase efficiency by extracting heat from the flue gases to heat the saturated steam.

* Fan or draught system -

In a boiler it is essential to supply a controlled amount of air to the furnace for effective combustion of fuel and to evacuate hot gases formed in the furnace through the various heat transfer area of the boiler. This can be done by using a chimney or mechanical device such as fans which acts as pump.

- There are two types of draught -
  i) Natural draught
  ii) Mechanized draught
    ① Forced draught system.
    ② Induced draught system.
    ③ Balanced draught system.

* Steam Turbine -

Steam turbines have been used predominantly as prime mover in all thermal power stations. The steam turbines are mainly divided in two groups-

① Impulse Turbine ② Impulse-Reaction Turbine.

* Condenser -

The condenser condenses the steam from the exhaust of the turbine into liquid to allow it to be pumped.

Page No.
Date

Questions

Q1) What are the advantages of thermal power plant?

Ans → Advantages of Thermal power plant are-

1. Fuel used in cheaper.
2. Space required is less compared to Hydro Power Plant.
3. Portion of generated steam can be used as process steam for various industries.
4. Initial cost is less compared to Diesel Power plants.
5. Plants can be located near the load centre which reduces transmission line cost & loss of energy in transmission lines.

Q2) What are the disadvantages of thermal power plant?

Ans → Disadvantages of Thermal power plant are.

1. Operation & Maintenance Cost High.
2. Time needed for erection of plant is high before it is put to operation.
3. Large quantity of water is required.
4. Coal & Ash Handling causes serious problems.
5. Pollution causes health problems to workers & habitants near the power plant.

Page No.
Date

(33) What are the heat recovery systems in thermal power plant?

Ans) The heat recovery systems in thermal power plant are -

1. An evaporator
2. Super heater
3. Economiser
4. Steam Drum.