1.8.13 Solar Pond

Solar pond is one of the most promising technologies in solar energy utilization for varied purposes. It is a large scale solar energy collector with integral heat energy storage for supplying thermal energy. This thermal energy can be used in various ways, such as, process heating, water desalination, refrigeration, drying and thermal electricity generation.

As we know that fluids, such as water and air, become lighter and rise when heated. Similarly, when water is heated by the sun's rays, hot water from the bottom of the pond rises, reaches the surface and loses whatever heat it has gained to the atmosphere. The result is that the pond water remains at nearly atmospheric temperature. This heat loss by convection can be prevented if dissolved salts are present in the bottom layer of the pond. Thus, the solar energy remains entrapped in the pond. This is the principle on which solar ponds work.

Solar ponds are large-area brine ponds about 1.0 m deep in which vertical gradients of salt concentrations are maintained so that the most concentrated and most dense solutions are at the bottom of the pond. A solar pond consists of three zones. The top zone (or the surface zone) is at atmospheric temperature and has little salt content. The bottom zone is very hot (70 to 90°C) and very salty with specific gravity of about 1.2. It is this zone which collects and stores the solar energy in the form of heat and is hence known as storage zone. Separating these two zones is the gradient zone that acts as a transparent

insulator, permitting sunlight to reach the bottom zone and its thermal energy to remain entrapped there. The useful energy is then withdrawn from the solar pond in the form of hot brine from the storage zone. To maintain the concentration gradient against the slow upward diffusion of salt, the surface must be slightly 'washed' with fresh water and the concentrated brine be supplied at the bottom.

A general layout of a solar pond electric power plant is shown in Fig. 1.14.

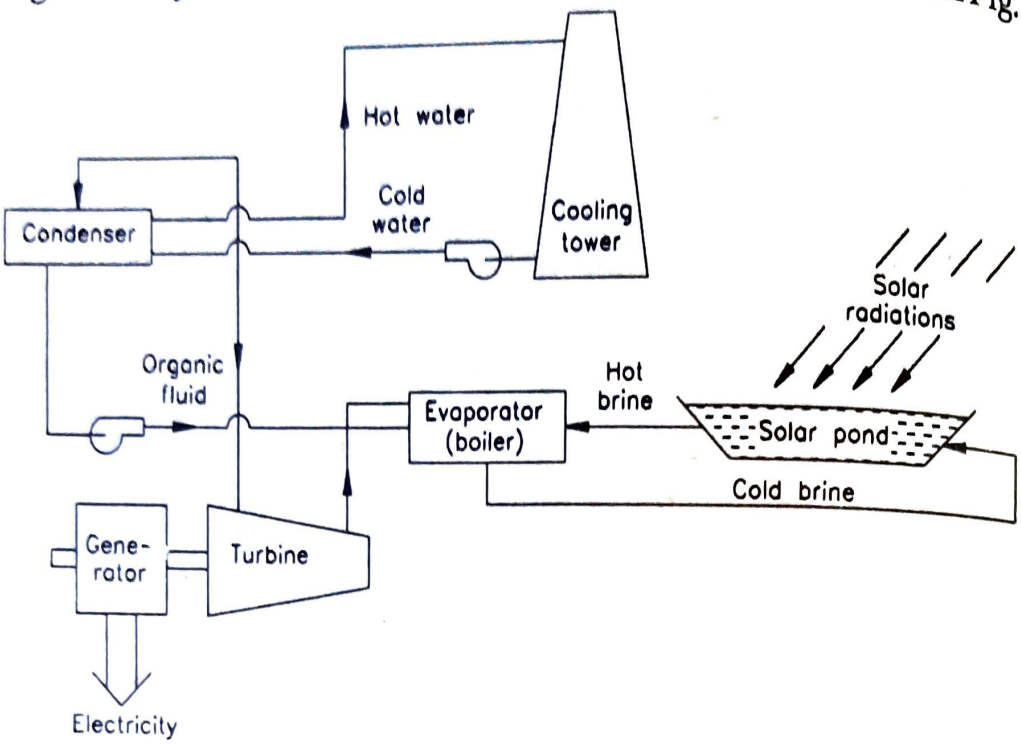

Fig. 1.14. Solar pond power plant.

Merits :

Solar ponds have four major advantages over other solar technologies :

(*i*) They have a low cost per unit area, as the collectors have an in-built large storage capacity.

(*ii*) They can be constructed over large areas enabling the diffused solar radiation to be concentrated on a large scale.

(*iii*) They can supply energy even during the monsoon season.

(*iv*) Solar energy from solar ponds can be utilized for various purposes.

Limitations :

A solar pond multipurpose facility involves high capital cost and, thus, the development of the process and its potential applications are probably less attractive in the developing countries than in industrialized nations.

The Indian Scenario

India is the first Asian country to have a solar pond project in Bhuj, Kutch district of Gujarat. The Bhuj solar pond has been designed to supply about 220 lakh kWh of thermal energy per annum, about 1,25,000 kWh of electricity per annum and about 80,000 litre of potable water per day.