Feed water heating system by green solar energy: A proposal

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Abstract: - Electricity is an important need in economic development of a country. Fossil fuels such as coal, oil and natural gas are the main resources of energy to produce electricity in power plants all over the world. In India coal is used as fossil fuel to generate maximum electricity. Reduction of fossil fuel use is a burning issue now a day, because it creates air pollution. In recent days maximum carbon dioxides emits from the thermal power plant chimney. To reduce the use of fossil fuel, use of renewable energy source is a better choice. Among them solar energy is very promising, because it is free and available to everyone. In this paper a method of feed water temperature increasing method by use of sun light has been proposed.

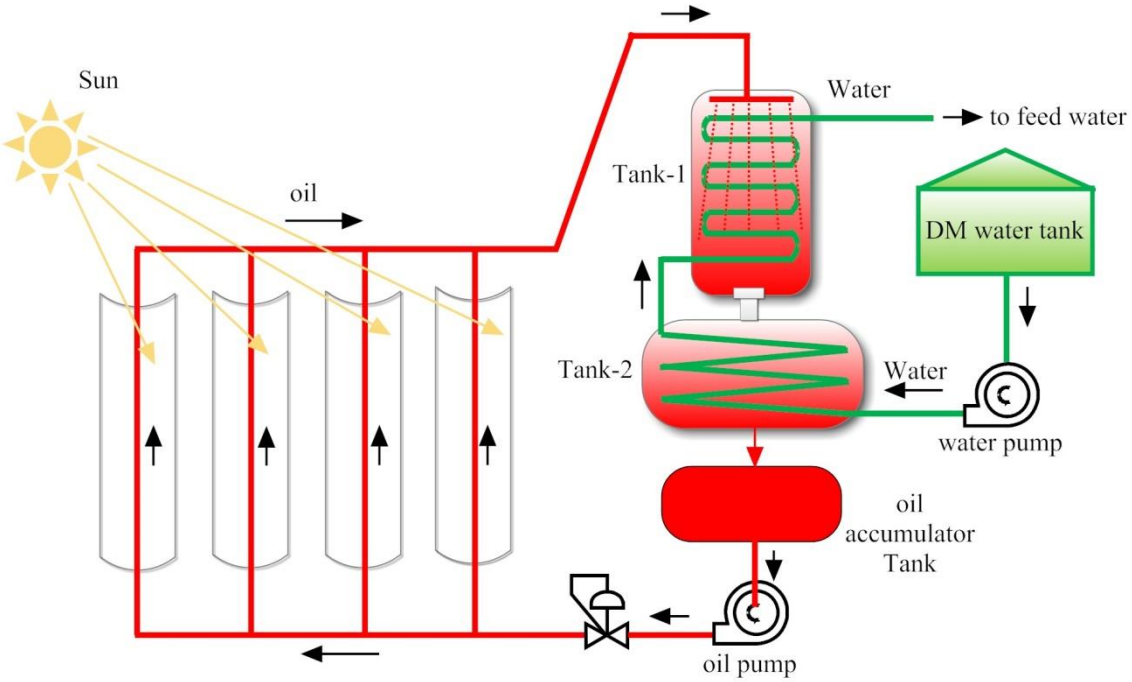
Key-Words: - Feed water heating system, solar heater; renewable energy.

1 Introduction

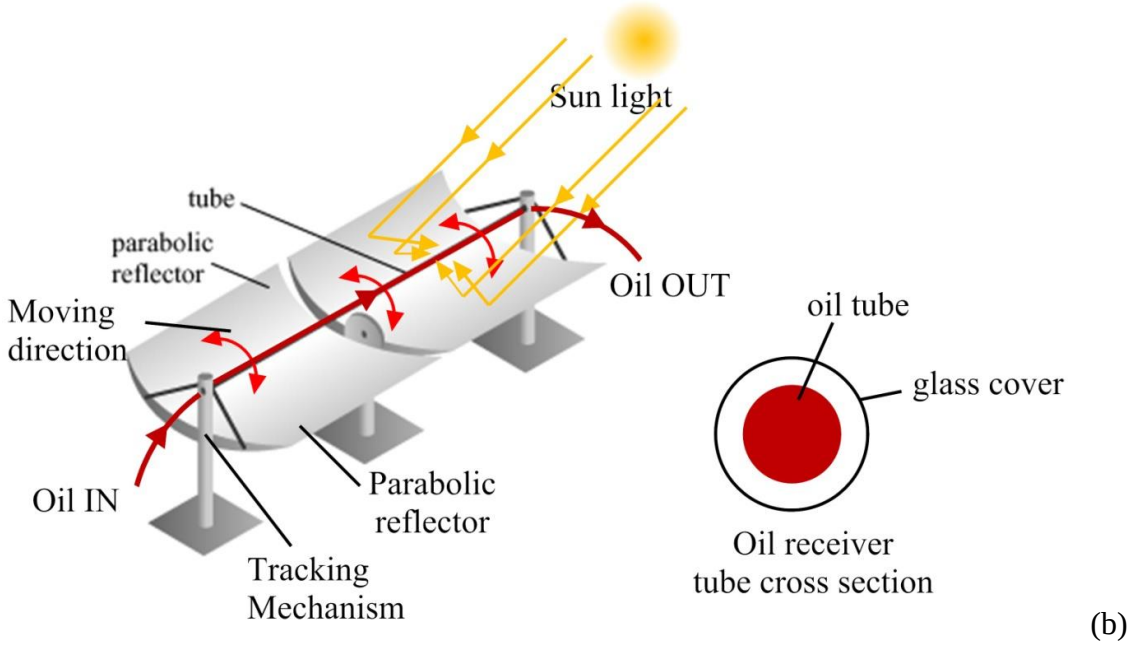
In many countries thermal power plants fulfill the maximum demand of electricity today. But it makes air pollution by emission of CO_x, NO_x and SO_x in atmosphere. To decrease the environmental pollution many technology has been proposed and implemented in recent years. Carbon capture and storage (CCS) is an important issue in this century [1-3]. Beside this, pressures have been developed to the power generating sector to think about some unconventional green thinking of power generation. In many power stations solar panel has been installed in open space particularly at the large roof of the power house. But this process is very cost effective and that power cannot be transferred directly to the high voltage power grid [4]. That separate process can not reduce the carbon use in thermal power plant for commercial use. On the other hand different qualities of oil are used in thermal power plant. After using some years the oil quality degrades. The boiling point of this oil increased due to mixing of different impurities. Also reject oil from waste water has been captured. This oil cannot be used further. We know that the specific heat of oil is lower than water so it can be easily increase to higher temperature. Using parabolic mirror arrangement we can increase its temperature by sun light. Then heat exchange can be done to the feed water through coil type heat exchanger. By this process we can increase the temperature of the feed water by green energy

2 Proposed design and process

The basic design of heat transfer mechanism to feed water is shown in Fig. 1(a). Here heat transfer media is selected as rejected oil of thermal power plants. Actually we require a liquid which has lower specific heat than water. Also the media should have higher fusion temperature. Generally oil has not higher fusion temperature, but rejected oil from many places has higher impurities and it has higher fusion temperature than fresh oil. We can also mix some thermo oil to it to make it higher temperature carrying media. This mixing can be maintained by proper project works. Thermo oil has higher fusion temperature [7]. This oil can be flown through a heat conducting metallic pipe placed at the focus of parabolic mirrors (PTC) by pump. At the focus it gains sufficient heat, as a result its temperature increases. PTC (parabolic trough collector) is a one type of solar concentrator which is used to produce high temperature thermal energy. It is made of ending sheet of reflective material into a parabolic shape. A metallic tube covered with



(a)



(b)

Fig. 1. (a) Proposed feed water heating system, (b) parabolic mirror arrangement system

glass tube (to reduce heat loss) is placed at the focal line of the collector (as shown in Fig. 1(b)). A tracking mechanism is also attached to the mirror assembly which helps to move the whole system with sun movement [8-9]. Normally operating temperatures in parabolic trough CSP plants are between 300 to 400 ^{o}C. To achieve these temperatures aperture widths vary between 6 to 9 m, trough lengths are between 100 to 150 m and geometrical concentration ratios are between 20 and 30 [10]. Now it is passed through two chambers where feed water flows. In these two chambers heat exchange can take place between oil and feed water. Thermo oil temperature can be increased to 400^{o}C [11]. Here the mixing oil temperature can be easily increased to ~200^{o}C, which is sufficient to increase the feed water temperature. Paul et al showed that glass ball arrangement can also increase the temperature of feed water nearly 300^{o}C [12]. Then this hot feed water can be connected to the main feed

water line to the de-aerator for further process. This connection tap can be chosen by measuring the temperature of the output feed water In general, under steady-state condition, the useful heat delivered by a solar collector is equal to the energy absorbed by the heat transfer fluid minus the direct or indirect heat losses from the surface to the surroundings. The useful energy collected from a collector can be obtained from the following formula [13]:

$$Q_u = A_c S - A_c U_L \left(T_p - T_a\right) = mC_p \left(T_0 - T_i\right)$$

Where, Q_u is the rate of useful energy collected in Watt, S is the absorbed incident solar irradiance in W/m^2, A_c is the collector area in m^2, T_p is the average absorber plate temperature in °C, T_a is the ambient temperature in °C, U_L is the Overall heat loss coefficient in W/m^2. °C, T_0 is the desired outlet fluid temperature in °C, T_i is the fluid inlet temperature in °C and C_p is the specific heat capacity of the fluid in kJ/ kg. °C.

The total heat absorption depends upon the climate temperature, particularly sun hours in that region. Also heat absorption depends upon the absorber coatings placed on the metallic pipe through which oil can flow. Properties of some common absorber coatings are given in Table 1 [13].

Table-1: Properties of some common absorber coatings [13]

Materials (absorber coatings)	**Absorptance** (in solar wavelength 0.29 μm to 2.5 μm)	**Emittance** (in solar wavelength 3 μm to 100 μm)
Flat black paint	0.97 – 0.99	0.97 – 0.99
Aluminium paint (bright)	0.3 – 0.5	0.4 – 0.6
Black silicone paint	0.86 – 0.94	0.83 – 0.89
Ceramic enamel	0.9	0.5
Copper Oxide over Aluminium	0.93	0.11
Black copper over copper	0.85 – 0.90	0.08 – 0.12
Black chrome over Nickel	0.93	0.06

3 Conclusion

In this paper a design proposal of solar feed water heating system has been proposed. The main purpose of this proposal is to use reject oil as heating medium as well as to decrease the environmental pollution by using solar power. The actual output temperature of the feed water is an experimental issue and must be obtained after a project work. More research work should be done about this proposal. In very near future a strict environmental laws and restriction rules for random use of fossil fuel may have to follow by every power sector. So this type of research work is an important in this regards.

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