Solar Steam generating Systems

Two types of solar steam generating systems; one based on fixed receiver E-W automatically tracked concentrating technology (Scheffler) and the other on fully tracked receiver on dish technology (Arun) are under promotion in the country. Whereas the fixed receiver technology is in promotion for last many years and about 70 systems covering over 20,000 sq. m of dish area have been installed, the fully tracked technology is under pilot scale demonstration and only 10 dishes with area 1690 sq. m have been installed as on date.

Fixed receiver E-W tracked technology

A solar steam generating system based on this technology comprises elliptically shaped parabolic solar concentrators (each of 16 sq. m. size in general) arranged in pairs of sleeping and standing dishes in parallel modules, aligned in a perfect east – west direction. Receivers (heat exchangers painted black) are placed in the focus of each pair of dishes. Above the receiver is a header pipe half-filled with water. Cold water enters the receiver through the inner pipe coming from header. Solar rays falling onto the dishes are reflected and concentrated onto the receivers. Due to the high temperatures achieved, the water within the receiver is converted into steam.

The steam generated in the system is stored in the upper half (empty portion) of the header pipe and if the steam is not drawn, the pressure of steam keeps on increasing. The steam is then drawn / sent to the kitchen for cooking food or to other units for variety of applications including laundry, process heat, sterilization, air conditioning etc. Each set of dishes of the system is connected with a metal wire rope which is further connected to a winch having DC motor fixed with a timer mechanism. This mechanism keeps on moving the dishes in the direction of the sun. This type of tracking system is called central tracking. To ensure that steam is available even when sun is not there (at night and on cloudy days in monsoon) the Solar Steam Generating system is connected with a Fuel fired boiler which acts as a back-up system. A typical photograph of the system installed at Mount Abu may be seen at Annexure-I.

A solar steam system comprising of 96 sq.m of dish area of this technology (6 dishes each of 16 sq. m) may generate around 150 to 200 kg of steam in a day depending on location and various other features can save around 4,500 liters of diesel in a year.
Fully automatically tracked large dish technology

It is a Fresnel paraboloid reflecting concentrator (named Arun 160) mounted on a flat dish with downward facing cavity receiver at its focus designed to absorb the concentrated solar energy and to transfer it for useful application. The concentrator tracks the sun on two axes, continuously facing it to capture maximum amount of solar radiation over a day. The dish concentrator along with the receiver is mounted on a specially designed tower. The system is equipped with a heat retrieval mechanism (which may consist of piping and fittings, insulation, fluid circulating pump, etc.), and system controls related to tracking, thermal system and security/ emergency measures.

The configuration of an industrial process heat solar system depends on the respective application. Broadly, it may consist of one (or more) number of solar dish, specially designed heat exchangers for transferring solar heat to the existing thermal system in the user industry, fluid pre-treatment equipment and storage vessel (if required), apart from piping/ fittings, fluid circulating pump(s), insulation, control valves etc. on application side for delivery of heat as per the requirements. A unit of ARUN-160 dish concentrator having 160 square meter of aperture area was developed and installed at Mahanand Dairy at Latur in Maharashtra for pasteurization of about 20,000 to 25,000 liters of milk under MNRE sponsored R&D and has been working satisfactorily since 2006. The dishes are now being installed at various places for different applications under a field evaluation demonstration project of MNRE.

Each dish of this technology having a weight of around 20 tonne could generate around 600 to 700 of steam in a day depending on the solar insolation and steam pressure. More dishes could be installed for meeting the required steam in an establishment at desired temperature and pressure but the initial investment will be too high. Photograph of a typical two dish system under installation at M/s Maurya Hotel, Delhi for meeting their part requirement of steam for laundry, kitchen and hot water for guest rooms may be seen at Annexure-II.

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A Solar steam cooking system installed at Brahmakumaris Ashram, near Mount Abu in Rajasthan
Solar steam generating system 2 Nos. of Arun dishes at M/s Maurya Hotel, Delhi