Solar Air Heaters

Air stream is heated by the back side of the collector plate in flat plate collector. Fins attached to the plate increase the contact surface. The back side of the collector is heavily insulated with mineral wool or some other material. If the size of collector is large, a blower is used to draw air into the collector and transmit the hot air to dryer. The most favorable orientation of a collector for heating only is facing due south at an inclination angle to the horizontal equal to the latitude plus 150. The use of air as the heat transport fluid eliminates both freezing and corrosion problems and small air leaks are of less concern than water leaks

Disadvantages:

1. Need of handling larger volumes of air than liquids due to low density of air as working substance.
2. Thermal capacity of the air is low.
3. They have relatively high fluid circulation costs (especially if the rock heat storage unit is not carefully designed)
4. They have relatively large volumes of storage (roughly three times as much volume as for water heat-storage)
5. They have a higher noise level.
6. The system has difficulty of adding conventional absorption air-conditioners to air systems
7. The space is required for ducting.

Types of Air Heaters

1. Non porous absorber in which air stream does not flow through the absorber plate
2. Porous absorber that includes slit and expanded material, transpired honey comb and over lapped glass plate

1. **Non-porous absorber plate type collectors:** A non-porous absorber may be cooled by the air stream flowing over both sides of the plate. In most of the designs, the air flows behind the absorbing surface. Air flow above the upper surface increases the convection losses from the cover plate and therefore is not recommended if the air inlet temperature rise at the collector are large. Transmission of the solar radiation through the transparent cover system and its absorption is identical to that of a liquid type flat-plate collector. To improve collection efficiency selective coating may beapplied provided there is no much cost. Due to low heat transfer rates, efficiencies are lower than liquid solar heaters under the same radiation intensity and temperature conditions. Performance of air heaters is improved by:

(a) Roughening the rear of the plate to promote turbulence and improve the convective heat transfer coefficient

(b) Adding fins to increase heat transfer surface. Usually turbulence is also increased which enhances the convective heat transfer. Absorption of solar radiation is improved due to surface radioactive characteristics and the geometry of the corrugations, which help in trapping the reflected radiation.

2. Collectors with porous absorbers:

The main drawback of the non-porous absorber plate is the necessity of absorbing all incoming radiation over the projected area from a thin layer over the surface, which is in the order of a few microns.

The solar air heating utilizing a transpired honey comb is also favorable since the flow cross section is much higher. Crushed glass layers can be used to absorb solar radiation and heat the air. A porous bed with layers of broken bottles can be readily used for agricultural drying purposes with minimum expenditure. The overlapped glass plate air heater can be considered as a form of porous matrix, although overall flow direction is along the absorber plates instead of being across the matrix. efficiency cannot be improved. Too many surfaces and too much restriction to air flow will require a larger fan and a larger amount of energy to push the air through. The energy required for this cancels out saving from using solar energy, particularly if fan is electrical and if the amount of energy which is burned at the power plant to produce the electrical energy is included.

Applications of Solar air heaters

- Heating buildings.
- Drying agricultural produce and lumber.
- Heating green houses.
- Air conditioning building sutilizing desiccant beds or a absorption refrigeration process.
- Heat sources for a heat engine such as a Brayton or Stirling cycle.

WIND ENERGY

Introduction: The wind turbine captures the wind's kinetic energy in a rotor consisting of two or more blades mechanically coupled to an electrical generator. The turbine is mounted on a tall tower to enhance the energy capture. Numerous wind turbines are installed at one site to build a wind farm of the desired power generation capacity. Obviously, sites with steady high wind produce more energy over the year. Two distinctly different configurations are available for turbine design, the horizontal axis configuration and the vertical-axis configuration. The horizontal-axis machine has been the standard in Denmark from the beginning of the wind power industry. Therefore, it is often called the Danish wind turbine. The vertical-axis machine has the shape of an egg beater and is often called the Darrieus rotor after its inventor. It has been used in the past because of its specific structural advantage. However, most modern wind turbines use a horizontal axis design. Except for the rotor, most other components are the same in both designs, with some differences in their placements.

SPEED AND POWER RELATIONS

The kinetic energy in air of mass m moving with speed V is given by the following in joules: (1) The power in moving air is the flow rate of kinetic energy per second in watts:

Two potential wind sites are compared in terms of the specific wind power expressed in watts per square meter of area swept by the rotating blades. It is also referred to as the power density of the site, and is given by the following expression in watts per square meter of the rotor-swept area: (4) This is the power in the upstream wind. It varies linearly with the density of the air sweeping the blades and with the cube of the wind speed. The blades cannot extract all of the upstream wind power, as some power is left in the downstream air that continues to move with reduced speed.

WIND SPEED DISTRIBUTION Having a cubic relation with power, wind speed is the most critical data needed to appraise the power potential of a candidate site. The wind is never steady at any site. It is influenced by the weather system, the local land terrain, and its height above the ground surface. Wind speed varies by the minute, hour, day, season, and even by the year. Therefore, the annual mean speed needs to be averaged over 10 yr or more. Such a longterm average gives a greater confidence in assessing the energy-capture potential of a site. However, long-term measurements are expensive and most projects cannot wait that long. In such situations, the short-term data, for example, over 1 yr, is compared with long-term data from a nearby site to predict the long-term annual wind speed at the site under consideration. This is known as the measure, correlate, and predict (mcp) technique. Because wind is driven by the sun and the seasons, the wind pattern generally repeats over a period of 1 yr.

RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF ENGINEERING & TECHNOLOGY