Solar Heating Terminology

Solar Constant

The solar constant is the average rate of solar energy arriving at the outer edge of the earth's atmosphere, before any losses. The generally-accepted value is 429.2 BTU per hour per square foot. The actual rate of radiation varies about 3 percent either way from the average. If all of this energy could be collected and used, it would take about three hours to collect all the energy used on earth for a full year!

Insolation

(Derived from three words: INcident; SOlar; radiation) Insolation is the rate of solar energy arriving on a specific flat surface perpendicular to the line of the sun. At sea level, the least possible loss is 29 to 30 percent. The maximum possible insolation is therefore about 70 to 71 percent of the solar constant., or about 320 BTU per hour per square foot. No solar collector, regardless of shape or design can deliver more than this maximum possible value, without energy input from some other source.

Efficiency

Efficiency of any energy-consuming device or system is the ratio of output divided by input, and can never be more than 1.0 or 100 percent.

Solar Fraction

The solar fraction is the ratio of solar energy used divided by total energy used in the same application. It cannot possibly be more than 1.0 (or 100%). Note that solar fraction is distinctly different from efficiency.

Wavelength Conversion

Solar radiation, mostly in the form of visible light, is contained in a "channel" of short wavelengths. When it is absorbed, it becomes thermal energy and has been converted to wavelengths about ten times longer, in a new "channel".

Greenhouse Effect

Many transparent materials will pass light freely, but will not freely pass the longer wavelength "channel" of thermal (heat) energy. Greenhouses and many solar collectors use this effect by applying glass or plastic covers to prevent re-radiation of the thermal energy.

Black Body

A "black body" is any material capable of absorbing radiant energy, and therefore also is capable of re-radiating the energy. A "perfect" black body absorbs and re-radiates 100% of the radiant energy striking it. "good" black bodies are used in solar collectors and they absorb and re-radiate (if not cooled) 90 to 96 percent of radiant energy arriving

Selective Surface

Certain special coatings can be used in solar collectors to reduce the re-radiation ability without appreciably reducing energy-absorption ability. The only such "selective" surface now well-proven and in common use is a special black chrome electroplate.

Absorber

In a solar heating collector, the absorber is that portion of the collector which receives the radiant energy from the sun and converts it to heat at longer wavelengths. It is usually a flat black surface with high absorbtance, i.e. a black body.

Collector

A solar collector is the entire assembly, including at least the absorber and heat exchanger, and any insulation, glazing, plumbing and enclosure.

Flat Plate Collector

The flat-plate solar collector is one of many possible types of solar collectors. It is the most efficient type of collector for use with temperatures between the freezing and boiling points of water and up to about 350 degrees F. when used with air as the working medium. Flat plate collectors are normally used with the flat surface facing south and tilted to an angle appropriate to the intended use.

Tracking Collector

A tracking collector is any type of collector installed to move and follow the sun, and may include flat plate collectors.

Concentrating Collector

Concentrating Collectors use a specially-shaped reflecting surface to concentrate radiation in an area smaller than the reflector, thus producing a higher temperature. Concentrating collectors must track the sun for full effectiveness, and can not collect more solar energy than the same area flat plate collector.

Diffuse Radiation

Diffuse radiation is light energy arriving by reflection or scattering from some direction other than directly from the sun. Diffuse radiation is accepted by flat plate collectors but not by concentrating collectors. Therefore flat plate collectors will produce on cloudy days while concentrating collectors will not.

Conduction

One of the three ways in which heat is transferred or lost. Conduction transfer or loss occurs due to the temperature difference between two surfaces of the same material, and the heat transfer is directly through the material.

Convection

he second of three forms of heat transfer. In this form of transfer, liquid or gas, such as air is heated, then moves away from the source of heat, being replaced by cooler material which repeats the process of carrying away heat.

In natural convection, the heated fluid becomes lighter due to expansion and rises away from the source, being replaced by cooler, heavier fluid.
In forced convection, the fluid is driven by some outside force, such as a fan, pump, or wind. It is heated by contact with the source of heat and carries the heat away as it is moved by the outside force.

Radiation

The third method of heat transfer or loss. Radiation occurs by transfer of energy through empty space. The amount of heat transferred by radiation is proportional to the difference between the fourth powers of the absolute temperatures of the radiating surface and the radiation receiver surface. When solar collectors are operated at higher temperatures, the radiation losses increase very rapidly with temperature and are the largest losses responsible for loss of efficiency. At lower temperatures, radiation losses are small and conduction and convection losses are the main sources of loss. Both convection and conduction losses are proportional to temperature differences.

Therm

A therm (or thermal unit) is a term commonly used to express the heat equivalent of a quantity of natural gas for billing purposes. A therm is equal to 100,000 BTU, or 29.3 KWH

Temperature vs. Energy

Knowledge of temperature is necessary to knowledge of thermal energy, but is not enough. Both the temperature and quantity of material containing the energy must be known. One could not reasonably expect a match flame at 2,000 degrees to be able to heat a swimming pool, but solar collectors at 90 degrees will do it readily if we use enough of them.