ABSTRACT

Assessment of techno-economic viabiity of solar energy systems is based on long term performance. The popular design methods for active as well as passive solar energy systems require certain preprocessed parameters in addition to meteorological information on appropriate time scale.

The present thesis deals with defining monthly average transmittance-absorptance product for flat plate collectors and optical efficiency for concentrating collectors consistent with the definition of monthly average daily utilizability. The procedure involved comparing the monthly average daily useful energy gain for flat plate collectors obtained by hour by hour summation procedure with the monthly average daily useful energy gain obtained as a product of heat removal factor, monthly average daily solar radiation on the collector aperture, monthly average daily utilizability and monthly average transmittance-absorptance product. In the second calculation, transmittance-absorptance product is an all day average value on the mean day of the month. The differences and an examination of the definition of monthly average daily utilizability established that the transmittance-absorptance product needs to be defined as a weighted average of the instantaneous transmittance-absorptance product and solar radiation on the collector aperture above the critical radiation level.

An equivalent mean day (EMD) calculation has been proposed and validated to obtain the monthly average transmittance-absorptance product for flat plate collectors and the optical efficiency for concentrating collectors tracked in the five principal modes according to the above definition.

A method to estimate the monthly average shading factors for receivers shaded by finite overhangs taking atmospheric transmittance into account has been developed and validated. The procedure involved developing simple equations relating finite shading factor values to the infinite values which are easily calculable in terms of the tilt factors for different planes. The present approach is valid for south facing as well as non-south facing receivers.

Finally, expressions for the monthly average shading factors for infinite wingwalls, analogous to the expressions for infinite overhangs, have been developed and validated. A feature of these algorithms is that they take into account the monthly average daliy diffuse fraction and are valid for south facaing as well as for non-south facing receivers.

Key Words: Transmittance-absorptance product, Optical efficiency, shading factors, Overhangs, Wingwalls.