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Comparison and Assessment of Numerical Models for Uncovered Collectors

Elimar Frank, Klaus Vajen
Universität Kassel, Institut für thermische Energietechnik, 34109 Kassel, Germany
Phone: +49 561 804 3892, www.solar.uni-kassel.de, solar@uni-kassel.de

Abstract

Different model equations with varying complexity have been proposed in literature for the description of the thermal behaviour of uncovered collectors. Most of these models are derived from the energy balance at the absorber surface, and many consist of a single equation which takes into account a spatially averaged absorber surface temperature, such as (EN 12795-2 2002). However, the absorber surface temperature is difficult to measure. Based on the energy balance, the absorber temperature can be eliminated from the model equation and attributed to measurable temperatures introducing a suitable linearisation of the temperatures that appear in the long-wave irradiance term in the fourth power (cf. Vajen et al. 2005). This leads to different model equations depending on the linearisation (e.g. between surface and sky temperature, surface and fluid or fluid and ambient). The choice of the most suitable linearisation has to be derived from the operation conditions of the collector.
In the presentation, a systematic comparison of linearised model equations including EN 12795 will be given and advantages and disadvantages of the different equations will be pointed out. For given operation conditions the sensitivities of the model parameters has been investigated. By this it can be derived which model is more suitable depending on the operation conditions. A non-linearised model equation is used as reference.
In the systematic comparison it can be noticed that EN 12795 contains a term that can not be motivated physically whereas essential terms are missing. For the special application of preheating water for a district heating net in Bishkek (Kyrgyzstan) a parameter determination for different model equations will be carried out based on measurement data. The results of the model calculations with the non-linearised model that is based on the energy balance will be compared to the calculations with EN 12795. By this, a recommendation shall be given if (and in which way) the standard for uncovered collectors should be changed.

Literature:
(EN 12795-2 2002)   Thermal Solar Systems and Components, Part 2: Test Methods.
(Vajen et al. 2005)   Klaus Vajen, Elimar Frank, Christopher Jipp, Investigation and
                        Comparison of Different Model Equations for Unglazed Collectors,
                        Proceedings of ISES Solar World Congress, Orlando, 2005, in print.