

Ph.D. Thesis Title : Studies on Thermal Performance Evaluation of Box Type Solar Cookers
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ABSTRACT

The present study aims at providing relevant insights into the thermal performance of box type solar cookers primarily focusing on the effect of absorber tray temperature on the value of First Figure of Merit (F_1). The focus of the study is on thermal characterization of the box of the box type solar cooker - The booster mirror has thus been considered as external to the box for augmenting the solar radiation. Experiments were conducted on a control (reference) solar cooker during different periods of the year for the above purpose. A simple correlation (in analytical form) has been developed for the top heat loss coefficient (U_t) of box type solar cooker that is able to capture the variation of F_1 with absorber tray temperature. From the study presented in the thesis it may be inferred that the value of F_1 be determined for moderate temperature (absorber tray temperature in the range of 110-120 °C) conditions and the same can then be used for determining the value of Second Figure of Merit (F_2). The proposed correlation can be used to scale up/down the values of F_1 for use in calculating the values of second figure of merit (F_2) besides deciding a representative value of F_1 for characterization of the box type solar cooker. For the case of control cooker, the correlation for U_t was verified with the values obtained through experiments.

Experiments were also performed on the control cooker to study the variation in the values of F_2 . It was noted that if the values of F_1 obtained at T_p of 110-120 °C are used for calculation of F_2 , the variation in the values of F_2 is reduced. For this purpose, the values of F_1 as obtained in the present study for moderate temperature were used. Despite variation in the time required for heating water up to a certain desired temperature during different periods of the year, the values of F_2 were reasonably stable indicating the suitability of the existing approach for its determination. Studies performed on the control cooker to decide the termination temperature (T_{w2}) indicated that the same should preferably be 10 °C below the boiling temperature of water between: 85-90 °C.

In order to study the applicability of the proposed correlation for U_t for commercially available family type box solar cooker, experiments were conducted on five different designs of the same. It was observed that the proposed equation is able to predict the trend of variation in U_t (specially with respect to absorber tray temperature) for these box type solar cookers.