

## A figure of merit for selective absorbers in flat plate solar water heaters

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### Abstract:

We derive from first principles an analytical expression for a figure of merit (FM) for a selective solar absorber in a single glazed flat plate water heater. We first show that the efficiency of a collector with an absorber with absorptance  $\alpha$  and emittance  $\epsilon$ , *relative* to the maximum efficiency for an ideal absorber, can be expressed as  $\eta_R = \alpha - A\epsilon - B$ . The effectiveness of the absorber can then be written as a figure of merit,  $FM = \alpha - A\epsilon$ . The larger the value of FM, the better the solar absorber performs in the collector. This is shown to give quite different results from the coating selectivity,  $\alpha/\epsilon$ .  $A$  is a function of many heater parameters as well as the orientation and geographical location of the heater but, to a good degree of approximation, can be simplified sufficiently to be expressed as a linear function of the inlet water temperature only:  $A_{av} = 0.0073 T_{in}$ . For typical average water temperatures between 30°C and 60°C,  $A_{av}$  ranges from 0.22 to 0.44 so the emittance is relatively less important than the absorptance. In the latter case, for example, the figure of merit is a very simple expression which can be used by developers of solar absorbers without any knowledge of the parameters or location of the HWH:  $FM = \alpha - 0.44\epsilon$ .

### Keywords:

Selective solar absorber; Efficiency; Figure of merit; FM; Flat plate solar heater.