

# Mathematical model for determining the irradiated area of the lower absorber surface of the double exposure flat-plate water solar collector

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## Abstract:

The term double exposure, flat-plate water solar collector is related to the solar collector which has the ability to absorb solar irradiation from the upper and lower surface of its own absorber. Absorption of solar irradiation, from its lower absorber surface is accomplished using reflecting surface placed below the collector. In comparison with conventional flat-plate solar collector, at analyzed collector, insulation mounted in the lower part of the collector box is replaced by glazing. Because of the exclusion of the insulation, therefore reducing overall collector heat losses, absorber of the same has to be coated with selective coating on both sides. Described collector is analyzed in order to determine the possibilities of improving its efficiency, in comparison with conventional collector, which among other things depends on size of the irradiated area of the lower absorber surface. This paper presents the mathematical model for determining the irradiated area of the lower absorber surface of the mentioned analyzed collector-reflector system for different possible positions and dimensions of the reflector relative to the collector. The model can be used for numerical optimization of the positions and dimensions of the reflective surface (reflector) relative to the collector. The basis and reason for the future conducting of the numerical analysis, relies on the fact that it is possible, using reflector, to increase the collector absorbed solar irradiation, specifically for examined case for 6.52% (10:00 h), 12.53% (12:00 h) and 30.11% (14:00 h).

## Keywords:

Double exposure flat-plate collector, mathematical model, absorbed irradiation.

## 1. Introduction

The need for the increasing usage of the renewable energy sources, specifically in this case, solar energy, requires conducting a different researchs in order to improve the efficiency of the solar systems. The most common systems for absorbing solar energy are flat-plate solar water collectors which by upper surface of its own absorber absorb solar irradiation. This paper points the possible increase of the amount of energy absorbed by the modified collector system called double exposure flat-plate water collector. The term double exposure, flat-plate water solar collector is related to the solar collector which has the ability to absorb solar irradiation from the upper and lower surface of its own absorber. Absorption of solar irradiation, from its lower absorber surface is accomplished using reflecting surface placed below the collector. In comparison with conventional flat-plate solar collector, at analyzed collector, insulation mounted in the lower part of the collector box is replaced by glazing. Because of the exclusion of the insulation, therefore reducing overall collector heat losses, absorber of the same has to be coated with selective coating on both sides. There are several studies[1,2,3] relative to this modified collector-reflective system. Within them optimization of the tilt angle of the collector and reflector, without taking into consideration the impact of the position and dimension of the reflector relative to the collector on the system efficiency, is executed. This paper presents the mathematical model for determining the irradiated area of the lower absorber surface of the mentioned analyzed collector-reflector system, for different possible positions and dimensions of the reflector relative to the collector, which can be lately used for numerical optimization of the positions and dimensions of the reflector relative to the collector.























