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ENVIRONMENTAL GAINS OF DHW SYSTEM THROUGH OPTIMUM SLOPE SOLAR COLLECTOR

Abstract: *During the first years of the twenty-first century, extensive efforts have been undertaken to alleviate global warming of the earth caused by emission of CO_2 in atmosphere. The emissions may be mitigated when part of energy needs is satisfied by using non-polluting energy sources such as solar energy, instead of fossil fuels. Also, another important advantage of the usage of solar energy is that it does not pollute the environment with nitrogen oxides and sulfur dioxide.*

In Serbian households, around 70% of electricity is produced by using coal with high greenhouse emission, it is important and the most rewarding to use solar energy for DHW heating instead of electrical energy. In addition it is important to have a high efficiency of conversion of solar energy to heat. Then, the highest amount of avoided primary energy, avoided electrical energy, and decrease in CO_2 emissions may be expected. In this paper, a use of Hooke-Jeeves algorithm is reported to obtain the maximum annual avoided CO_2 emission due to maximum avoided electrical energy use as a function of number of optimum tilt position of the solar collector in SDHWS during year for Belgrade, in Serbia. Also, the difference in annual avoided emission of CO2 of different solar collector system relates to the stationary optimally located solar collector that yearly operates at one tilt.

Keywords: *domestic hot water, slope angle, CO_2 emission, optimization*

1. INTRODUCTION

In Serbian households, the high amount of DHW is used for shower, tap, cloths-washing machines, and dish-washing (machines). It is customary to use electricity for heating of DHW. Accordingly, in Serbia and worldwide, the most rewarding application of solar energy is when it replaces electrical energy for heating of DHW in households [1]. In addition it is important to have a high efficiency of conversion of solar energy to heat. Then, the highest decrease in CO_2 emissions may be expected.

To use SDHWS with the greatest benefit, SDHWS must have adequate design, installation, and operation. During its operation, the applied solar collector has to take the optimal position that will guarantee the highest generation of heat. The solar collector takes the north-south direction and the objective of this paper is to find the optimum solar collector slope. In literature, there is a lot of research with this objective. By using the equations for the global solar radiation by an empirical model, Nijegorodov and Jain calculated optimum slope of a north-south aligned absorber plate from the north to the south poles [4]. By determining the sunshine duration, Chang roughly estimated the optimal tilt angle of a solar collector in the northern hemisphere [3]. Based on the incident angles of the direct solar radiation, Skeiker calculated the optimum tilt angle and orientation for solar collectors in Syria [5]. By taking into account position of the sun at the sky and using the model of ASHRAE, Bari calculated the optimum orientation of domestic solar collectors for the low latitude countries [6]. By using the measured values of the global solar radiation,