

MAXIMIZING PERFORMANCES OF A SOLAR DOMESTIC HOT WATER SYSTEM THROUGH OPTIMUM SOLAR COLLECTOR SLOPE AND AZIMUTH ANGLES USING THE HOOKE JEEVES ALGORITHM

OPTIMIZACIJA PERFORMANSI SOLARNIH PRIJEMNIKA KORIŠĆENJEM SOFTVERA ENERGYPLUS I ALGORITMA HOOKE JEEVES

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In Serbia, it is customary to use electrical energy for heating of domestic hot water (DHW). As around 70% of electrical energy is produced by using coal with high greenhouse emission, it is beneficial to environment to use solar energy for heating of DHW in solar DHW system (SDHWS). It is very important to maximize the value of solar fraction during a SDHWS operation. In this paper, a use of Hooke-Jeeves algorithm is reported to obtain the optimum slope and surface azimuth angles for solar collectors that is a part of the SDHWS that give the maximum value of solar fraction for the SDHWS. Different values of optimum slope and azimuth angles of solar collectors due to south and the collected solar energy are calculated for each month during entire year that enable the maximum amount of the solar energy and the solar fraction for SDHWS.

Keywords: Optimization, SDHWS, Solar Fraction, Simulation, Solar collector

U Srbiji je uobičajeno da se za grejanje sanitarne tople vode koristi električna energija. S obzirom da se 70% električne energije proizvodi korišćenjem uglja pri čemu dolazi velikih emisija gasova staklene bašte, za životnu sredinu je korisnija upotreba solarne energije za zagrevanje vode koja se koristi u domaćinstvu. Veoma je važno postići maksimalnu vrednost solarnog udela u toku rada sistema za grejanje sanitarne tople vode (STV). U ovom radu, korišćenjem Hooke algoritma dati su optimalni uglovi (nagiba i azimuta) za solarni prijemnik koji je deo solarnog sistema za grejanje sanitarne tople vode pri čemu dobijamo maksimalne vrednosti solarnog udela za taj sistem. Različite vrednosti optimalnog ugla (nagiba i azimuta) solarnog prijemnika usmerenog ka jugu i prikupljene solarne energije izračunavane su za svaki mesec u toku godine pri čemu dobijamo maksimalne vrednosti solarnog udela za solarni sistem za grejanje sanitarne tople vode.

Ključne reči: Optimizacija, STV, Solarni udeo, Simulacija, Solarni prijemnik

1. INTRODUCTION

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 CO₂ in atmosphere. These emissions are generated by intensive burning of fossil fuels to satisfy the growing energy needs of humanity. 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, 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. As 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. 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 amount of avoided primary energy, avoided electrical energy, avoided exergy, and decrease in CO₂ emissions may be expected.

