INVESTIGATION OF THE POWER REDUCTION OF HORIZONTALLY MOUNTED SOLAR MODULE DUE TO SOILING

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Abstract

Soiling of the solar modules can significantly diminish quantity of solar energy which solar modules absorb. This paper presents the results of the influence of calcium carbonate and soil on the power of horizontally mounted solar module. The power of the solar modules upon soiling with 3 g of calcium carbonate ($CaCO_3$) decreased by 12.04% in relation to the clean solar module, and upon soiling with 2.5 g of soil it decreased by 9.13% in relation to the clean solar module. It can be concluded that calcium carbonate exerts a little bit greater influence on reducing the power of horizontal solar module than soil soiling.

Keywords: soiling, solar module, power, $CaCO_3$, soil.

INTRODUCTION

Since the big energy crisis in 1973, renewable energy sources (Sun, wind, geothermal energy, etc.) are being used increasingly. The most significant renewable source of energy is the Sun. For the production of solar generated electricity, photovoltaic (PV) systems are used. PV technology has been widely used over recent years because of its sustainability and cleanliness. The increase of solar modules installation in the world led to an increase in the investigation of the phenomena that may cause adverse effects on the performance of solar modules, such as soiling [1-4].

The performance of the solar modules is influenced by various factors such as the material the module is manufactured of, solar module angle of inclination (angle at which it is set - tilt angle), the intensity of the solar radiation reaching the surface of the module, soiling of the module surface, module temperature, etc. Soiling is a term used to describe the deposition of dust (dirt) on the solar modules, which reduces the amount of solar radiation reaching the solar cells [2, 5-11].

EXPERIMENT

To determine the power of horizontally installed solar module, depending on its soiling by calcium carbonate and soil deposition, solar system shown in Fig. 1. was used. The solar system is located on the roof of the Academy of Sciences and Arts of the Republic of Srpska (ASARS) in Banja Luka, representing a part of the ASARS Solar Energy Laboratory.

Fig. 1. *Solar system composed of five identical solar modules*

For this purpose, horizontally mounted polycrystalline silicon solar module power of 50 Wp (SOLE SL-50P, Germany) was used.

Characteristics of the SOLE SL-50P solar module are given in Table 1.

Table 1. *Characteristics of SOLE SL-50P solar module*

Dimensions (size)	669 x 508 x 35 mm
Weight	5.7 kg
Cell type	Si polycrystalline
Power of solar module	50 Wp
Optimum operating current	2.78 A
Optimum operating voltage	18 V

On 19.02.2020 in the period from 12.00 to 13.00, the influence of different masses of CaCO3 and soil on the power of the horizontal solar module was investigated. On the day of measurement, the horizontal solar module was first cleaned to remove dirt, and the power of the clean module was measured. After that, solar module was soiled with $CaCO_3$ and its power was measured. The solar module was then cleaned, then soiled with soil, and the power measurement of the horizontal solar module soiled with soil was performed.

A stationary PV-KLA device (Ingenieurburo Mencke & Tegtmeyer, Germany) was used to measure the power of the horizontal solar module.

Fig. 2. *PV-KLA device*

The SolarUsbSW switch with accompanying software SolarControlM v0.1.1 (Metering solutions, B&H) was used for automatic control of solar module power measurement and archiving of measured data.

Fig. 3. *SolarUsbSW switch*

RESULTS

Power values of clean, with $CaCO_3$ and soil soiled horizontal solar module, as well as reduction of its power due to soiling on 19.02.2020 are given in Table 2.

Table 2. *Power of clean, with $CaCO_3$ and soil soiled horizontal solar module and reduction of its power due to soiling on 19.02.2020*

Date	Clean	3 g $CaCO_3$		2.5 g soil	
	P (W)	P (W)	ΔP (%)	P (W)	ΔP (%)
19.02.2020	24.32	21.39	12.04	22.10	9.13

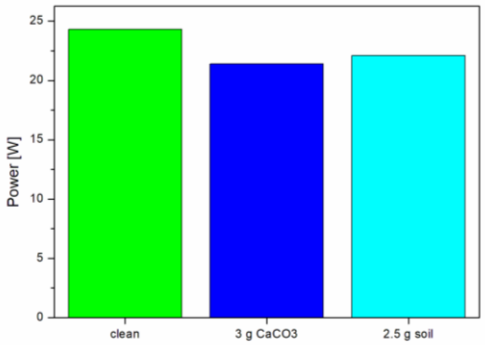

Fig. 4. *Power of clean and soiled horizontal solar module with $CaCO_3$ and soil*

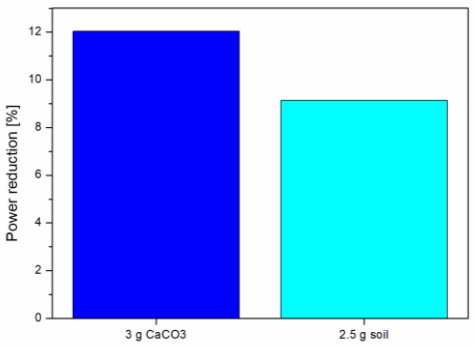

Fig. 5. *Comparison of the impact of $CaCO_3$ and soil on the power reduction of horizontal solar module*

Due to soiling with 3 g of $CaCO_3$, the power of the horizontal solar module decreased by 12.04%. Due to soiling with 2.5 g of soil, the power of the horizontal module decreased by 9.13%.

Based on the data in Tab. 2. and Fig. 5. it can be seen that the power of the horizontal solar module decreases a little bit more due to soiling with $CaCO_3$ than with soil.

CONCLUSION

Solar modules have been widely used over recent years in the world, which led to an increase in the investigation of the phenomena that may cause adverse effects on the performance of solar modules, such as soiling.

The performances of solar modules are influenced by various factors. One of the factors that is increasingly being examined is also soiling of solar modules which reduces the amount of solar radiation reaching the solar cells.

Due to soiling with 3 g of $CaCO_3$, power of horizontal solar module decreased by 12.04%, and due to soiling with 2.5 g of soil by 9.13%.

The obtained results can be used to plan and design installation of solar modules, to conduct their maintenance, and to increase use of solar energy in the Republic of Srpska and worldwide as well.

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