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HANWHA SOLAR PANELS. STUDY OF THEIR ELECTROPHYSICAL PARAMETERS

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СОЛНЕЧНЫЕ ПАНЕЛИ HANWHA. ИССЛЕДОВАНИЕ ИХ ЭЛЕКТРОФИЗИЧЕСКИХ ПАРАМЕТРОВ

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ABSTRACT

This article provides information Korean-made solar panels called HANWHA, which were installed at the first photovoltaic station in Uzbekistan. The authors at this station carried out research work, during which they analyzed the real current state of solar panels, carried out measuring work of some electro physical parameters of the panels. For analysis, comparison, as well as obtaining practical conclusions in order to continue the scientific research work the authors manually cleaned the surface of the modules from dust then measured and calculated their parameters. After that authors came to the conclusion that it is necessary to devise a system for cleaning solar panels with the lowest energy consumption for their own needs in order to increase their electro physical parameters.

АННОТАЦИЯ

В данной статье приведены сведения солнечных панелей корейского производства под названием HANWHA, которые были установлены на первой фотоэлектрической станции Узбекистана. Авторами на данной станции были проведены научно-исследовательские работы, в ходе которых проанализированы реальное текущее состояние солнечных панелей, проведены измерительные работы некоторых электрофизических параметров панелей. Для анализа, сравнения, а также получения практических заключений с целью для дальнейшего продолжения научную исследовательскую работу авторами вручную были очищены поверхность модулей от пыли, а потом замерены и рассчитаны их параметры. После этого авторы пришли к выводу, что необходимо разработать систему очистки солнечных панелей с наименьшими затратами энергии на собственные нужды для того чтобы увеличить их электрофизические параметры.

Ключевые слова: возобновляемые источники энергии, фотоэлектрическая станция, солнечная панель HANWHA, мощность, ток короткого замыкания, напряжения холостого хода, стандартные тестовые условия.

Keywords: renewable energy sources, photovoltaic station, solar panel HANWHA, power, short circuit current, open circuit voltage, standard test conditions.

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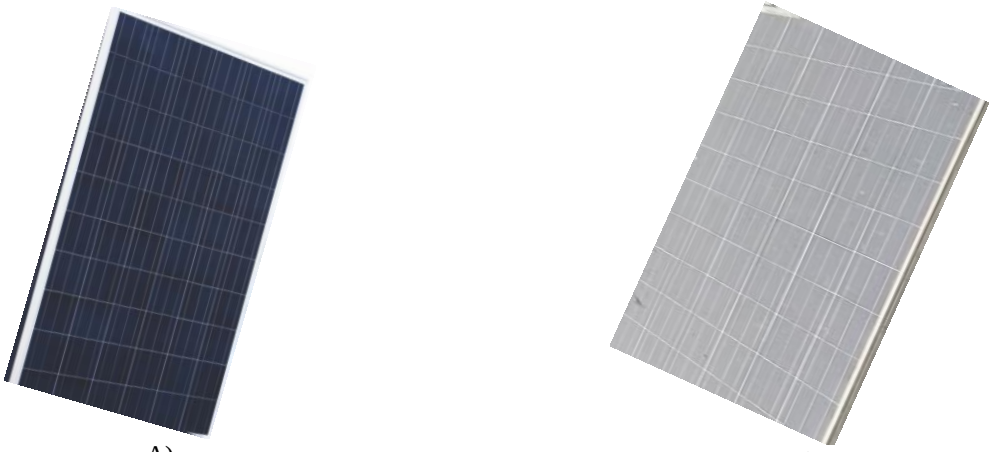
Introduction. The fact that now in many countries of the world there is shortage resources including energy resources. First of all, this is due to the fact that the reserves of fossil energy sources such as gas, coil, fue oil, oil are depleted over time. But, the above sources of energy during long-term use significantly pollute the environment and greatly harm to the ecology due to CO2 emissions into the atmosphere, as a result of which global climate change is observed, unfortunately for the worst side [1, p. 1]. These facts require us to look for new harmless sources of energy that will provide the necessary energy in the future. In this regard renewable energy sources are becoming relevant because they are ecological clean, don't harm the environment and most importantly they are renewable.

Main part. It is known that Uzbekistan is sunny country, where according to forecasts the aggregated solar potential is 9000 billion kWh/year [2, p.3]. To prevent further climate change, reduce dependence on traditional energy sources, as well as achieve carbon neutrality the country has been actively working for almost 10 years. For example, in 2015 the first photovoltaic station with a capacity 126.6 kW (P≈130 kW) was launched in the country in a test mode, which was built at the expense of grant funds from the Korean side. TOP SUN, JSPV, S-ENERGY and HANWHA solar panels were installed in the station by Korean companies that are member of the Korea Photovoltaic Industry Association. Below consider HANWHA solar panel.



A) B)

Figure 1. General view of the solar panel HANWHA. A – Initial state, B- Current state

In Fig.1. shows a general view of the HANWHA solar panel, where you can see that the solar cells are made of polycrystalline silicon (poly - Si) and the surface of the current state of the panel (B) is heavily soiled. Table No. 1 shows the electrical characteristics initial state of the panel, where parameters P_{max}, V_{oc}, I_{sc}, V_{mpp} and I_{mpp} tested at Standard Testing Conditions (STC) defined as irradiance of 1000 W/m^2, at AM 1.5 solar spectrum and a temperature of 25 ± 2^0 C. Module power class have positive power sorting: 0 to + 5W, measurement tolerance: +/- 3% (P_{max}).

Table 1.

Electrical parameters of HANWHA solar panel

Power class	250 W
Maximum power (P_{max})	250 W
Open Circuit Voltage (V_{oc})	37.7 V
Short Circuit Current (I_{sc})	8.79 A
Voltage at Maximum Power (V_{mpp})	30.4 V
Current at Maximum Power (I_{mpp})	8.23 A
MODULE EFFICIENCY **(**H**)**	15.5 %

From practice it is known that solar panel operate outdoors, experiencing various natural phenomena such as rain, snow, hail, wind, dust, abnormal heat and frost which contributes to a change in their characteristics and parameters. To identify these changes, we carried out research work at the above station (Fig.2.) and the values obtained by measuring during the research are shown in table No. 2.

Figure 2. Scientific research process

Table 2.

Electrical parameters of the current state of HANWHA solar panel

t, time	E, W/m^2	I_{shc}, A	V_{oc}, V
9:15	131.8	1.29	34.14
10:15	593	5.36	33.91
11:15	652	6.04	33.66
12:15	656	5.92	33.28
13:15	574	4.62	33.24
14:15	478	3.33	33.09
15:15	243	1.74	33.48
16:15	157	0.89	33.15
17:00	27.6	0.12	31.37
17:15	15.6	0.02	30.30

From the values shown in the table you can see that compared to the passport data these parameters differ significantly. This is due to the fact that the level of dust content in the territory of the station is above the norm, there is no system for cleaning panels from dust and dirty. Therefore, for comparison we manually cleaned the HANWHA solar panel during the research (Fig. No. 3) and by measurement the value of the parameters of the cleaned panel was obtained.

Figure 3. Solar panel manual cleaning process

Table No. 3 shows the obtained parameters of the HANWHA solar panel after manual cleaning, where it is assumed that the solar radiation flux density E (W/m^2) before and after cleaning is the same value.

Table 3.

Electrical parameters of HANWHA solar panel after cleaning

t, time	E, W/m^2	I_{shc}, A	V_{oc}, V
9:15	131.8	1.42	34.15
10:15	593	5.49	34.44
11:15	652	7.54	33.48
12:15	656	7.33	33.34
13:15	574	6.70	33.33
14:15	478	5.13	33.62
15:15	243	3.02	33.79
16:15	157	1.49	33.46
17:00	27.6	1.41	32.11
17:15	15.6	0.06	31.17

Table No. 3 shows that the parameters of the solar panel after cleaning have increased significantly. It follows thence to increase energy efficiency it is necessary to always clean the surface of the modules from dust and dirty. From the well-known formula (1), we also calculated the value of the power generated before and after cleaning this solar panel and construct a graph for their comparison. The empirical formula for calculating the power of solar panels is as follows:

$$P = I_{sc} * V_{oc} * \xi, \quad (1)$$

where, I_{sc} – short circuit current (Amper); V_{oc} - open circuit voltage (volt); ξ – fill coefficient which we accept provisionally equal to 0.754 for all calculations.

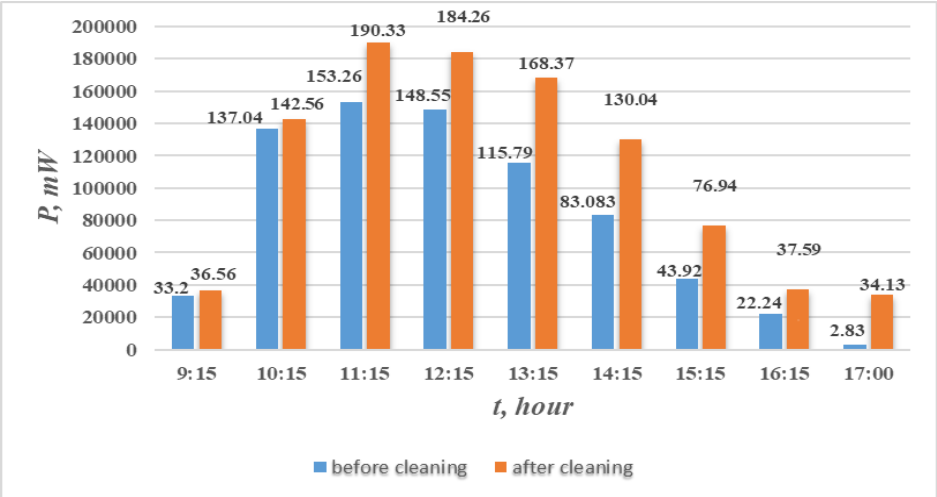


Figure 4. Power comparison graph

As can be seen from graph above, the generated power after manual cleaning is significantly higher than the power before cleaning. For example, at 11:15 o'clock, when the radiation was the highest, the generated power after cleaning was equal 190.33 W and the power before cleaning was 153.26 W, which is 24% less. At 17:00 o'clock, the power before cleaning is 2.83 W, after cleaning it is 34.13 W, which is 11% more. This indicates that should always clean the surface of the solar panels from dust and dirty in order to get more energy.

Conclusion. And so it can be concluded that:

1. The share of solar energy in the energy sector of our country will increase significantly in the near future due to its widespread introduction, also solar energy will play a key role in achieving carbon neutrality.

2. The electrophysical parameters of the HANWHA solar panels of the photovoltaic power plant have significantly decreased in recent years due to the high level of dust in the plant area.

4. After manual cleaning of the HANWHA solar panel its electrophysical parameters increased, since dust and dirt accumulated on the surface of the panel prevent the passage of sunlight resulting in a decrease in the energy efficiency of the solar panel.

5. In order to prevent a further decrease in the electrophysical parameters of the solar panels of the station the authors propose to devise a new, unique, low energy-intensive and most importantly automatic cleaning system, because participation of personnel in the cleaning process is very unacceptable and to some extent leads to an untimely increase in energy efficiency.

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