

METHODS OF CLEANING THE SURFACE OF SOLAR PANELS

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Abstract: The method of cleaning the solar panels is one of the actual requirements of the world. There are special cleaners designed for use on solar panels. They help to effectively remove contaminants and improve surface clarity.

Keywords: solar panels, renewable energy, photovoltaic converters, efficiency, dust, snow, pollutants.

In recent years, Uzbekistan has been actively introducing renewable sources of electrical energy. Solar and wind power plants are being built in the country. The development strategy “Uzbekistan - 2030” sets a goal of bringing renewable energy sources to 25 thousand megawatts and the share in total consumption to 40 percent.

The power generated by solar panels depends on the materials of the solar panel, the surface area receiving the sun's rays, the amount of solar radiation, etc. Uzbekistan is a warm and sunny country in which more than 300 days a year are sunny and clear.

Table 1

Values of average daily radiation in the Tashkent region [2].

Average daily solar radiation, kW·hour/m ²	December	March	June	September
	January	April	July	October
	February	May	August	November
	2,45	5,23	8,08	5,08

The country is actively conducting research in the field of using renewable energy sources in autonomous systems. For example, the use of solar energy in the excitation system of low-power synchronous generators [3].

To increase the efficiency of solar panels, a wide variety of solutions are used: from the installation method to the use of multilayer or double-sided solar modules.

The efficiency of solar panels depends on various factors, including the presence of contaminants on the surface of the solar panel's protective glass.

Over time, dust settles on the surface of solar panels, which prevents the passage of sunlight, other types of pollutants can also appear, and in winter, the front part of the panels can be covered with snow, which reflects most of the sun's rays and reduces the power generation of the panels to zero. Cleaning solar panels, which are usually installed in flat, open areas where there are no obstructions that can create shadows or solar panels installed on the roofs of buildings have some difficulties such as their inconvenient location.

There are the following methods for keeping the surface of a solar panel clean:

- mechanical methods of cleaning pollutants. These include manual cleaning using special brushes and clean water (Fig. 1), as well as using automatic robotic cleaners (Fig. 2).



Fig.1. Special hand brush for cleaning the surface of solar panels.



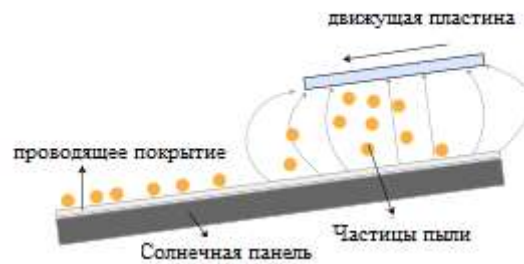
Fig.2. Automatic solar panel cleaning robot.

Mechanical methods can be divided into automatic, mechanized and manual [1].

- chemical methods using protective coatings (hydrophobic, hydrophilic and photocatalytic). Hydrophobic coatings prevent surfaces from becoming wet with water. As a result, raindrops are not wetted with the surface of the glass and slide down, taking with them particles of dust and dirt. Hydrophilic coatings absorb moisture from the air and form a thin film of water that absorbs dust and prevents it from sticking to the surface of the glass. In light rain, the dust is easily washed off with water. Photocatalytic coatings (TiO₂) have the ability to clean the surface of organic contaminants when exposed to sunlight. I would also like to note that you can increase the efficiency of solar panels by cooling them. Using PERC and Half-Cell technologies, which is a gel that can intensively absorb moisture at night and evaporate it during the day. An increase in efficiency by 3-4% occurs due to the cooling of the solar panel as moisture evaporates. The gel is applied to the back of the solar panel.

- electrodynamic methods. The advantage of this method is that it does not require water to clean the surface. However, for effective cleaning it is required that the air humidity be at least 30%. The technology is based on the properties of electrostatic repulsion of charged particles of the same name (Fig. 3). The technology was proposed in 2022 by scientists at the University of Massachusetts. The glass of the solar panel is covered with a conductive transparent material, onto which dust and other pollutants subsequently settle. A high voltage is applied to the conductive layer, which charges the dust particles with the same charge. Then, using

a movable plate, the same charge is used to repel dust particles from the surface of



the solar panel.

Fig.3. Electrostatic cleaning system.

- natural cleaning methods. Based on the use of natural phenomena and forces of nature. Installing solar panels at an angle, which allows snow or dust to naturally roll down. Using the Venturi effect which, by creating a pressure drop, creates a wind that blows dust off the surface of the solar panels. To create the "Venturi effect" you need the appropriate terrain.

The article discussed methods for cleaning the surface of solar panels to increase operating efficiency. Avoid abrasive materials: To avoid damage to coatings and glass panels.

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