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ANALYSIS AND IMPROVEMENT OF OPERATION OF SOLAR POWER PLANTS

Recently, attention has increased to the search and development of unconventional energy sources, which differ from fossil resources in their enormous reserves, so they are practically inexhaustible or renewed periodically.

One of the best types of renewable energy sources is solar energy. The sun, by human standards, is an inexhaustible source of energy. There are devices that convert solar energy into electrical one. These are solar elements.

Solar panels consist of photovoltaic cells packed in a common frame. Each of them is made of a semiconductor material such as silicon. The semiconductor heats up by absorbing the energy from the sun's rays. The influx of energy is releases negatively charged particles, electrons, inside the semiconductor. The extra energy turns out to be enough to rip electrons off the corresponding atoms. As a result, holes are formed in their place, and the freed electrons begin to wander around the crystal lattice. Under the influence of an electric field, the separation of positively and

negatively charged particles occurs. Thus, a constant voltage appears. Electrons and holes begin to move in a certain direction, an electric current is formed.

To calculate the energy generated by solar panels use the following formula:

$$E = \frac{I \times K_0 \times P_m \times K_l}{U_{\tau}}, \tag{1}$$

where I – the intensity of solar radiation hits the Earth's surface in the horizontal plane by time t ; K_0 – the correction factor for converting the total flow of solar energy from the horizontal plane to the inclined surface of solar panels; P_m – the rated power of the solar panel or solar module circuit; K_l – the coefficient taking into account the losses of the solar battery during the conversion and transmission of electricity; U_{τ} – the intensity of solar radiation at which photovoltaic panels are tested.

The efficiency of solar power plants depends primarily on the material. This diagram (Fig. 1) shows the approximate efficiency of solar power plants for the most common materials. Most of the panels used in Ukrainian home power plants are polycrystalline. Their efficiency ranges from 13% to 17%. For comparison, in mono-crystalline this figure is 18-22%. The huge losses are caused by the fact that most of the light is reflected from the silicon wafers or goes to heating the structure itself. The material of the modules also affects the level of conversion of light energy. So, for cheaper cadmium plates the efficiency is 11%, for photocells consisting of mixtures of gallium, copper, indium and selenium salts (CIGS) - 15%, and for analogs made of organic polymers – from 5%.

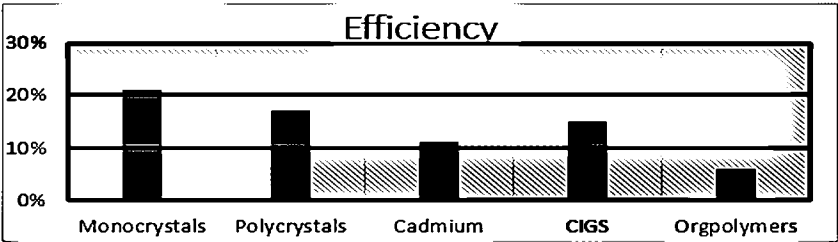


Figure 1 – Efficiency of solar power plants for the most common materials

The slope also affects the efficiency. The fact is that in winter the Sun is low above the horizon and the panel needs to be slightly raised, and in summer, on the contrary, lowered. In this case, it is better that the panels are turned towards the Sun.

The peculiarity of the operation of inverters is such that if some of the panels are in the shade, this will negatively affect the production of all modules, even those that are under the Sun. They will work, as it were, but only half of their real potential.

What to do if the roof is not suitable for solar panels. The solution to this issue will be installation on a support. Unlike roofing, there is nothing to limit the space around the panel, which makes it possible to rotate it.

The effectiveness of the panels depends on the light intensity. The better the illumination, the more power will be generated. Accordingly, weather and climatic conditions are no less significant factor affecting productivity.

Geographic location also affects performance. So, for example, in the northern latitudes in the summer there is a long day, and in the winter there is a short night, which means that in the summer the SES works longer and has more output. In the southern hemisphere, everything is exactly the opposite.

Most of the household solar power plants are installed on the roofs of houses. Over time, the glass surface becomes covered with dust and fallen leaves. And if the wind blows the foliage from time to time, the dust usually remains there until the first rain. To maintain effective performance, a specific maintenance procedure is required for the surface of the panels.

The development of solar energy is promising in view of the inexhaustible source of energy and safety for the environment.