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Methods of using ecological sources of clean energy in the cultivation of bell pepper seedlings

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Abstract. Development of ways to use solar energy as a source of clean energy. Development of scientific foundations for the widespread use of solar cells, their new capabilities, development of methods for increasing efficiency. With the development of new innovative technologies, it is necessary to study the operating conditions of autonomous power sources that can be used by consumers, their period of operation, and their in-depth structure. This article describes the role of greenhouses in agricultural production and the structure of autonomous power sources and their principles of operation.

1. Introduction

Extensive measures are being taken to reduce labor and energy consumption in agricultural production, save resources, grow crops on the basis of advanced technologies and develop high-efficiency environmentally natural electrotechnological devices. The Action Strategy for the further development of the Republic of Uzbekistan for 2017-2021, including "... more than doubling the GDP by 2030, ... optimization of arable land for 2017-2020, land and rational use of water resources, introduction of modern intensive agro-technologies" [1, 2]. One of the important issues in the implementation of these tasks, including the development and implementation of electric pulse treatment against nematodes that damage plant roots.

The goal is to obtain efficient electricity by modifying the components of autonomous power sources and to reduce the amount of electricity generated by thermal energy, and to identify renewable energy sources [5].

Today, solar panels are the most important source of solar energy. They are widely used in the power supply of various equipment and devices. In the not-too-distant future, an increase in electricity consumption should lead to a reduction in conventional energy sources (various types of fossil fuels) around the world. Therefore, we need to develop and use alternative energy sources, especially from our only and inexhaustible natural energy source - the Sun [3, 4, 6, 7].

In the future, solar panels will be the main suppliers of solar energy, as they convert solar energy directly into electricity with a high coefficient, low operating costs, not enough constant power and do not pollute the environment. Recently, there has been extensive research on the development of low-cost flat-panel and thin-film solar panels, concentrator systems, and many other ideas. In the future, it can be expected that the cost of a separate solar cell and the large solar panels that build on them will be so low that it will be economically viable to use solar energy on a large scale [2, 5].

Usually, the principle of operation of a solar cell (r-p conductivity of matter) has only one characteristic energy - for example, the band gap [8-11].



2. Methods

When solar energy hits the cell, photons with energies less than E_g do not increase the cell's output power (excluding the absorption of light when the photons are awakened). Each photon with an energy greater than E_g adds an energy equal to E_g to the output power, and the rest of the photon's energy is converted to heat. To determine the energy conversion efficiency (or ideal f.i.k.), we see the energy band diagram of the illuminated r-p conductivity (Figure 1a). Let's assume that the solar cell has an ideal current-voltage characteristic. The corresponding equivalent circuit is shown in Figure 1b, where a parallel DC source I_L is included, showing the movement of unbalanced energy carriers generated during the conversion of solar radiation. Diode saturation current I_s , load resistance R_L . The current-voltage characteristic of such equipment is shown in the following Figure 1.

$$I = I_s(e^{qV/kT} - 1) - I_L \tag{1}$$

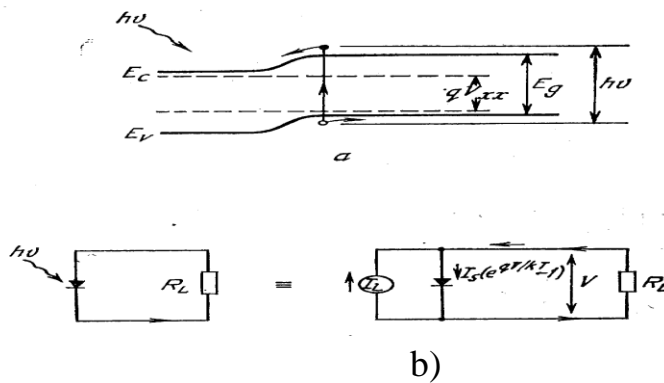


Figure 1. Energy diagram of a conducting solar cell R-p under solar illumination and an idealized equivalent circuit of a solar cell (b)

At a certain peak of load resistance I_kzV_{xx} (I_kz -short circuit, V_{xx} - voltage at no-load of elements) can produce up to 80% of the product. Ideal solar energy substitution efficiency is achieved with optimum material selection when the I_s dimension is at its minimum [12, 13].

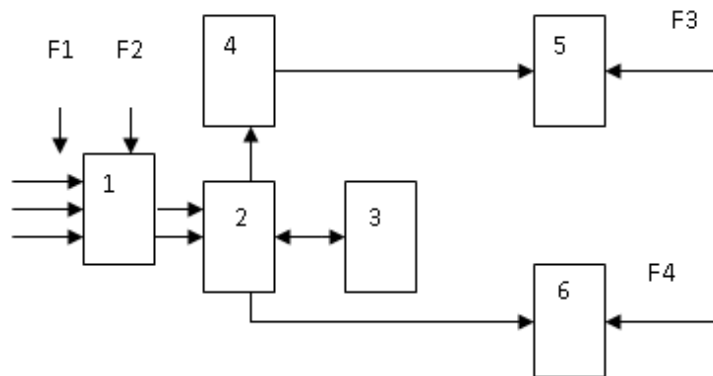


Figure 2. Power supply system: 1- photoelectric converter battery; 2- switch; 3-rechargeable battery; 4- inverter; 5 consumers of alternating current electricity; 6 consumers of alternating current electricity; F is negative.

Solar cells in Q-junctions (QE). Let's look at r-p silicon solar cells first, as they are used as reference equipment for all solar cells. The main problem in this is the transformation of the energy of the element and its reliability, because under the influence of particles of high energy. The characteristics of an element in outer orbits decrease with time. In addition to using flat solar panels in terrestrial conditions, it is also possible to use a solar array concentrator system. In addition to improving cell reliability and

energy conversion efficiency, there are also problems with cost reduction as ground-based solar panel systems must be able to compete with other energy sources [7,9].

The power supply system (ESE) based on a solar power plant can be broadly represented by a diagram (Figure 2).

Here the relationship between the energy source and consumers is taken into account in the form of a negative effect: the actual intensity of solar radiation, which depends on the seasons and F1 days; Powered by the F2 photoelectric converter battery; F3, F4 - power of randomly changing and constant current load.

To apply the methods of systematic analysis, we establish a relationship and a statistical indicator that describes the laws of change in negation.

Solar power plants are commonly used to power small remote areas such as farms, mobile pastures, etc. Requirements for objects are defined as negations of F1 and F3, taking into account the shape of the load curves [6, 9].

3. Results

To obtain the results of laboratory examination and observation of the daily and monthly energy consumption of 36 solar panels installed on the roof of the laboratory building in December 2020 and January and February 2021, the following data were obtained (see Table 1 and 2, and Figure 3 respectively):

Table 1. Monthly electricity collection schedule of solar panels

№	Daily energy; kWh	№	Daily energy; kWh
1	54.7	15	61.9
2	62.3	16	96.5
3	67.8	17	98.8
4	71.9	18	62.9
5	78.3	19	6.2
6	88.1	20	17.4
7	79.0	21	25.2
8	42.1	22	67.2
9	13.5	23	12.6
10	26.3	24	4.5
11	18.9	25	26.0
12	38.9	26	105.6
13	58.6	27	76.1
14	90.9	28	115

Table 2. Daily electricity collection schedule of solar panels

№	voltage, V	Current, A	power, W	Transmitted energy, kW * h
8:00				0.12
9:00				0.83
10:00	547.6	3.4	1861.8	2.22
11:00	538.6	3.6	1982.3	4.62
12:00	546.2	3.7	1851.3	7.94
13:00	547.3	4.8	2648	5.74
14:00	553.6	4.9	2771	5.68
15:00	536	3.2	1715.3	1.94
16:00	529.7	2.9	1536.2	0.73
17:00	512	1.8	921.8	0.12
Total				35.68

The purity of the produce grown in greenhouses is very important. Therefore, in order to ensure the early germination of vegetables and melons, including seedlings of bell peppers, our farmers grow seedlings in

separate nurseries. The seedlings are grown in special containers on an area of 20 m² for planting bell peppers in a 1 ha greenhouse. If we place the seedlings in these nurseries in two tiers and illuminate them with additional modern LED infrared and ultraviolet lamps, we can accelerate the germination of the seedlings.

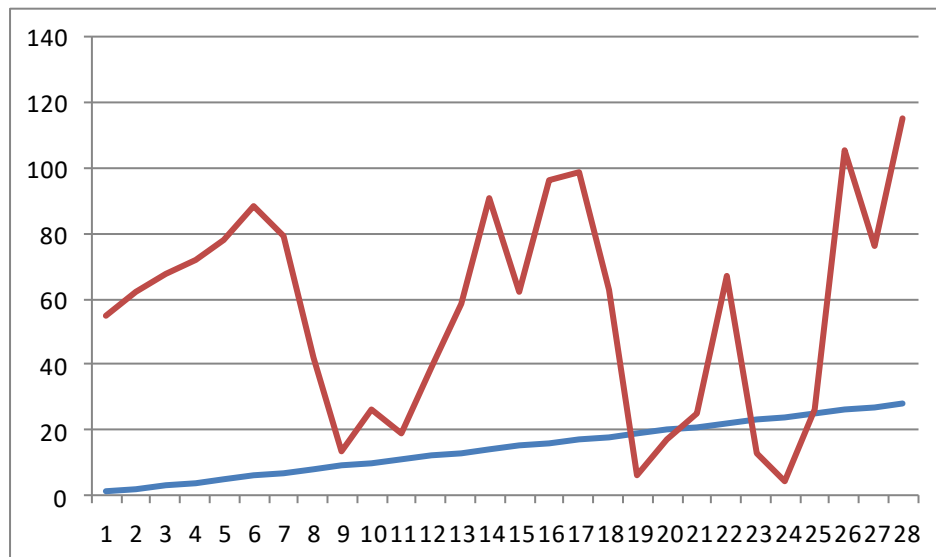


Figure 3. Solar panels monthly electric energy harvesting growth chart

We calculate the illumination of a desktop designed for growing 2-storey nursery seedlings using the relative power method. Room dimensions (AxBxh) respectively (4x3x1.3) m³.

As a source of illumination, we take lamps with incandescent lamps PPD. We get the safety factor $k = 1.3$.

Payment. Considering that the light distribution in the PPD lamp is cosine, we assume that the optimal relative distance between the lamps is $\lambda = 1.6$.

Suppose that the suspension height of the luminaires is the same = 0.3 m. At the level of the working surface $h_{p.p} = 0$, the calculated height is $h_x = 1.3 - 0.3 = 1\text{m}$.

We calculate the distance between the lamps:

$$L = 1 * 1.6 = 1.6 \text{ m}$$

For simplicity of calculation, we obtain this value $L = 1.5\text{m}$.

$$\text{Number of rows of luminaires } n_3 = 3 / 1.5 = 2$$

$$\text{Number of lamps in a row } n_4 = 4 / 1.5 \approx 2.66 = 3$$

$$\text{The total number of lamps in the room } N = n_3 * n_4 = 2 * 3 = 6$$

The distance between the lamps is 1m, the distance from the lamps to the edge of the desktop is 0.5m.

$$\text{Normalized lighting in the room } EH = 100\text{lx}$$

From Table 5-31 (2) we find the power density for PPD lighting:

$$P_{ud} = 37.5 \text{ W / m}^2$$

Estimated electrical power of all lighting fixtures:

$$P = P_{ud} * S = 37.5 * 10 = 375\text{W}$$

Power of one lamp:

$$PL = 375 / 6 = 62.5 \text{ W.}$$

From Appendix 5 (2), select the closest standard luminaire, for example B220-230-60, from which its power is calculated:

$$\Delta P = (60 - 62.5) * 60 / 62.5 = -2.4\%$$

which does not exceed the permissible limit (from -10% to + 20%).

It would be advisable to use modern energy saving LED bulbs instead of incandescent bulbs. The power of the LED lamps corresponding to the light distribution current is $P_{LED} = 5 \text{ W}$.

Total power of the entire device:

$P = 5 * 6 = 30 \text{ W}$ for 10 m² and $P = 60 \text{ W}$ for 20 m².

The daily energy consumption of this device is:

$W = 60 * 24 = 1440 \text{ W} * \text{h} = 1.44 \text{ kW} * \text{h}$

4. Conclusions

In short, the study of the results of scientific and analytical work on the creation of solar cell materials for the storage and use of solar energy in batteries when supplying power to consumers. Solar battery, battery is an important thing to consider. At the same time, with the transition to a market economy, it is important to use new energy-saving innovative projects. Based on the data obtained, it is necessary to conduct special studies of unconventional energy sources.

According to the proposed project, an autonomous power plant with 36 m² of solar panels will collect at least 35-38 kWh of electricity in winter, 8.5 kWh in summer or on sunny days, and provide the electricity needed to light and operate a water pump at night. Solar panels allow you to heat greenhouses away from the centralized power grid through the correct use of energy.

Construction of new greenhouses in unused areas in mountainous and foothill areas where water supply and water supply are problematic will increase agricultural and food production opportunities.

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