# ЛУЧШИЕ ИНТЕЛЛЕКТУАЛЬНЫЕ ИССЛЕДОВАНИЯ

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# STUDY OF STRUCTURE AND WORKING PROCESS OF VACUUM TUBE COLLECTOR

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## Abstract

If the vacuum solar collector is manufactured by hand, galvanized containers for water should be prepared. Its volume can be from 100 to 200 liters. The container should be placed on the roof. If the barrel is installed on the south side of the roof, 100 liters of liquid can occupy up to 60 degrees. The second should be coated with a metallic shiny layer. In this case, the efficiency coefficient is much higher, because the heat exchange area with the air is minimal. It is recommended to use such a simple solar collector in places where ecology is sufficiently preserved, it is better to operate such a system away from polluted places. It should be noted that in the winter months such units are able to produce less heat.

**Key words:** Vacuum tube collector, efficiency, monobloc, thermos, Zmeevik, solar radiation

## Indroduction

A solar water heater is a device that heats, stores and delivers water to the consumer due to absorbed solar radiation energy. The main part of the solar water heater is a solar collector and a tank-accumulator. The main task of solar collectors is to absorb solar radiation as much as possible, collect it as thermal energy and transfer it to a heat-carrying substance (water, antifreeze, etc.) [1-3].

Solar water heating (collector) devices are divided into 2 types: whole and separate constructions.

The whole type of collector (monobloc) consists of vacuum flasks, a tank (thermos) - a hot water reservoir, as well as a system fixed to a single structure with the help of a metal frame with a galvanic coating.

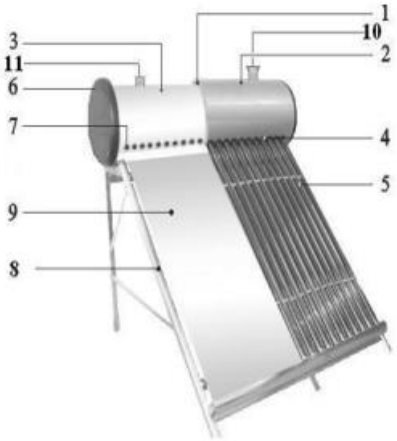


**Figure 1. All kinds of vacuum tube collector.**

1 – Water tank; 2 – the outer layer of the tank; 3 – the inner layer of the tank; 4 – external fastener; 5 – vacuum tubes; 6 – water tank covers; 7 – rubber fastener; 8 - frame under the support, material - steel with galvanic coating or stainless steel; 9 - reflective plate - additional option; 10 – emergency air valve; 11 – controller sensor.

## WORKING PROCESS OF VACUUM TUBE COLLECTOR

The monobloc-collector is mainly installed on the roof of the house or building and provides the necessary hot water pressure to the source of consumption. Circulation in the interior of the tank is carried out due to natural processes. The package also includes a frame-support system, a smart controller, an electromagnetic valve and an electric tank. There are 2 types of tanks to choose from: normal and zmeevik heat exchanger types. The efficiency of the collector provided with the Zmeevik heat exchanger is ~30% higher than the normal one, and the hot water in the tank is also heated due to solar energy [4-6]. Depending on the level of consumption, the amount of water in the tank is 100l, 150l, 200l, 250l, 300l.

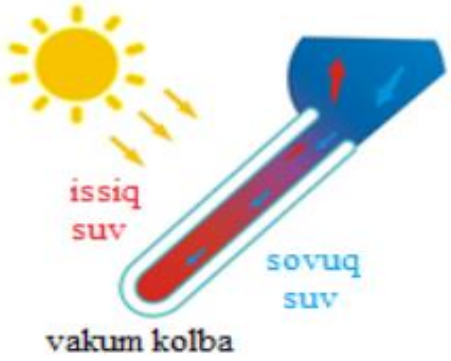


**Figure 2. External view of the vacuum tube collector.**

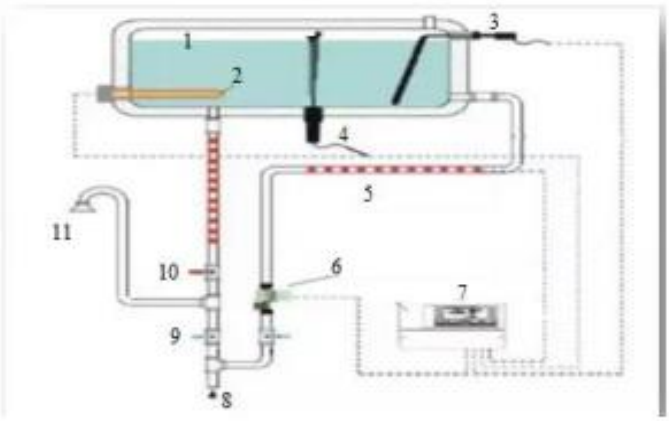


**Figure 3. A schematic diagram of a vacuum tube collector.**

1-Water tank, 2-Electric heater, 3-High level sensor, 4-Low level sensor, 5-Heating cable, 6-Solenoid valve, 7-Smart controller, 8- Cold water inlet, 9- Cold water faucet , 10-Hot water faucet, 11- Consumer.

**Buck battery consists of 3 layers:**

1. The inner part of the tank is made of M-304 stainless steel, which ensures its high safety in hygienic plans, as well as corrosion resistance, durability in long-term practical use.

2. To maintain the temperature of hot water in the middle layer of the tank for a long time

It consists of high-quality polyurethane, 55 mm thick uteplitel with a high accumulation function. In winter, when the ambient temperature is below 0 C, the total heat loss is ~3-60 C. For example, if the water temperature in the collector is 600 C in the evening, then in the morning this temperature will decrease by 50 C, i.e. it will be 550 C [7-8].

3. The outer metal coating of the tank has a special protective paint and provides protection against external influences (sunlight, precipitation, i.e. snow, rain and hail).

The rest of the parts are made of rubber and plastic, taking into account the external effects. Vacuum flasks are made of strong borosilicate glass with a light-absorbing layer, which heats water by converting solar radiation into heat energy. Due to natural circulation, water heated in the tube rises up and accumulates in the tank. The smart-controller controls all working processes of the collector (temperature of water in the tank, level of water in the tank, operating mode of the electromagnetic valve for pouring water into the tank, adding and disconnecting the

1.5 kW heat if necessary). Using this collector, it is possible to save 100% of energy for heating water for 9 months [9-12].


**Figure 4. Components of a vacuum tube collector.**

The efficiency of solar collectors depends on the amount of solar radiation falling on the surface of the collector, the temperature of the environment and the temperature of the heat carrier passing through the collector [13-15].

n our experiments, the efficiency of the vacuum solar collector is equal to the ratio of the useful thermal energy received from the device to the solar radiation power falling on the collector surface unit:

$$\eta_{v.t.k} = \frac{Q_k}{I_T F_k} \quad (1)$$

**Figure 5. A special type of solar vacuum tube collector.**

**Conclusion**

The useful energy obtained from the solar collector can be written as follows, taking into account heat losses and the effect of optical efficiency:

$$Q_k = I_T \cdot (\tau\alpha)F_k - U_k F_k (T_k - T_a) \quad (2)$$

Based on the relationship (1) and (2), the expression for calculating the efficiency of the solar collector can be written in the following form:

$$\eta_{v.t.k} = (\tau\alpha) - \frac{U_k(T_k - T_a)}{I_T} = G \cdot c_p \cdot (T_k - T_{ch}) \quad (3)$$

here is the current density of solar radiation falling on the area of the IT-collector absorber m2; (ta) effective optical FIK of the collector, i.e. t is the light transmission coefficient of the vacuum tube; a - absorption capacity of the absorber; Fk is the area of the collector; Uk is the total coefficient of heat loss in the collector; the temperature of the heat carrier at the time of entry; Ta - ambient temperature; G - heat carrier mass consumption (kg/s), CP - heat carrier heat capacity (J/kgK); Tch is the temperature of the heat carrier at the outlet [16-19].

In several cases, the performance of different types of solar collectors is evaluated by the cumulative coefficients of heat losses. In some literature, Uk ≈ 21 W/(m²·K) for glassless solar collectors, Uk ≈ 4 W/(m²·K) for glass flat solar collectors, and Uk ≈ 1.5 W/(m²·K) for vacuum type solar collectors. is said to be.

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# USE OF GEOTHERMAL ENERGY

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**Abstract:** Renewable energy is undoubtedly the future in the medium to long term, and other forms of energy must be sought to replace the depleting fossil reserves. A combination of different types of interests may be the reason for such a distortion of energy investments today. One of the energies that has attracted the most attention is geothermal energy. However, many people do not know the difference between the use of geothermal energy. Therefore, we dedicate this article to tell you about the main application of geothermal energy, its characteristics and importance.

**Keywords**: Vertical Geothermal, geothermal energy, heat source, electricity, chemically active substances, Horizontal geothermal, Geothermal under the foundation, hydraulic systems .

Renewable energy is undoubtedly the future in the medium to long term, and other forms of energy must be sought to replace the depleting fossil reserves. A combination of different types of interests may be the reason for such a distortion of energy investments today. One of the energies that has attracted the most attention is geothermal energy [1-5]. However, many people do not know what the difference is **in the use of geothermal energy** .

Geothermal energy can also be considered as **an alternative and renewable energy**

**source, if the evaluation is relatively fast.** This is because continued extraction from

geothermal resources may lead to a reassessment of thermal boundaries around the extraction site, which may render the energy source no longer renewable. This exception is local and depends on the very variable development time of the resource depending on the site [6-9].

This type of energy is based on the principle of using geothermal energy or the natural heat of the earth (the word geothermal takes its etymology from the Greek "GE" and "thermos", which literally means "heat of the earth". ). This heat is

naturally released by the nuclear fission of radioactive elements in the Earth's core, mantle, and crust. Some of these elements are uranium, thorium, and potassium, which are actually found in the deepest parts of our planet.

Inside the Earth, the core is a magmatic substance that releases heat from the inside out, so the temperature **rises from 4 to 100 ºC every 2 meters as we go deeper into the Earth [10-13].**

But the interior of the Earth is made up of different layers, reaching a depth sufficient for water to heat up and change its state, turning into water vapor, which rises to the surface under high pressure or form. jets or hot springs.

Geothermal energy production potential (60 mW/m²) is much lower than that of the sun (about 340 W/m²). However, in some places **this potential heat reaches 200 mW/m² and causes heat accumulation in aquifers that can be used industrially.** The extraction rate is always greater than the heat flux contribution, and care must be taken not to overdensify the extraction site, which would take decades or centuries to recover. Drilling costs increase rapidly with depth.

Low-temperature geothermal energy (from 50 to 100 ° C) is mainly used for heating, through heat networks and less often for heating greenhouses or water management [14-16]. In 1995, **global thermal capacity was 4.1 GW.** This can also apply to the use of geothermal heat pumps, which use shallow groundwater or "geothermal probes" drilled 50 to 100 meters to extract enough calories from the ground to heat a room.

With the onset of the oil crisis, global interest in geothermal energy has increased, and **its use as a source of electricity is growing at around 9% per year.**

Geothermal energy is used in many ways because this renewable source of energy allows the production of heat, electricity or hot water. For this, we must always choose the right place to install , using the best conditions that allow us to meet our needs.

The main uses of geothermal energy include domestic and professional use. They are as follows:

- Heating: Using geothermal energy, heat can be extracted from the earth's interior and converted into a room's air conditioning system through emission systems such as underfloor heating.
- Hot water: can also be used for domestic hot water, use a water storage thermos
- Electricity: Electricity can be generated through geothermal energy, using only deposits with temperatures above 150º

In addition to its main use, geothermal energy is also used for other purposes, such as:

- Drying of products, mainly for agricultural enterprises
- Cleaning and feeding various hydraulic systems
- Sterilization of various materials.
- salt mining
- Evaporation and distillation of liquids.
- Fisheries and fisheries
- Cooling, using a concrete environment
- Use of thermal waters for sanitary and medicinal purposes

As one of the renewable sources, it is important to know the energy obtained from

geothermal energy and understand how we can use it without resorting to other artificial sources. and, of course, respect the natural warmth of the earth.

A very effective and increasingly popular method, especially in new construction, is to build houses with underfloor heating, which allows you to walk around the house barefoot, as it dissipates heat. Of course, these floors are not natural , or they are made of a heat-emitting product, but a heat pump is used to distribute the heat to them [17-18].

A heat pump is a pump that connects our home to geothermal energy. With its help, we achieve air or temperature exchange, so that it absorbs the cold on the one hand, and expels the heat from the interior of the earth, from the underground areas. In this way, with the help of the pump and regulating the underground heat management of the whole house, saving heating, because it is based on natural and ecological heat.

Unlike other heat pumps, they are reversible. You can reposition it or turn it off so it stops drawing heat from the ground, as it does in the summer and in areas where it doesn't need as much heat. And this pump does not use the energy it produces to generate more heat, but the energy it uses to distribute it and drive it to where it is needed.

To accommodate the heat pump, during the construction of the house, the floor must be raised, installed, and then the beam floor must be installed. In the case of new construction, it can be installed in three ways:

- Vertical Geothermal: This is a hydraulic system responsible for heat exchange with the underground layer. It's about trying tens of meters of tubing to get to where the depth and heat is.

• Horizontal geothermal: it requires more space, because it is not connected to the electricity network, it is mainly underground, but it must occupy the entire width of the house, so it is cheaper, despite the fact that the house creates an area, requires more space, not too big.

• Geothermal under the foundation: it would be ideal, but it should be planned even before construction, before laying the foundation, so that when the pipes that come into contact with the underground layers are laid, a hydraulic pump will take care of a more optimal distribution of heat. can be installed.

There is no doubt that having geothermal energy at home not only for heating the

home, but also for powering various facilities, saves us a lot of electricity every month . But the only drawback is that its installation is very expensive, especially before placing the foundation, as in the case of installation under the foundation. The initial investment is huge, especially if you are building a home from scratch. At the lowest prices, there is underfloor heating, which gives us the benefits of geothermal, but promises a little less.

I hope that with this information you can learn more about the different uses and properties of geothermal energy.

As with wind and solar energy, geothermal power has minimal operating costs; capital costs dominate. Drilling accounts for over half the costs, and not all wells produce an exploitable resources. For example, a typical well pair (one for extraction and one for injection) in Nevada can produce 4.5 megawatts (MW) and costs about $10 million to drill, with a 20% failure rate, making the average cost of a successful well $50 million [19-21].

A power plant at The Geysers

Drilling geothermal wells is more expensive than drilling oil and gas wells of comparable depth for several reasons:

• Geothermal reservoirs are usually in igneous or metamorphic rock, which is harder to penetrate than the sedimentary rock of typical hydrocarbon reservoirs.

• The rock is often fractured, which causes vibrations that damage bits and other drilling tools.

• The rock is often abrasive, with high quartz content, and sometimes contains highly corrosive fluids.

• The rock is hot, which limits use of downhole electronics.

- Well casing must be cemented from top to bottom, to resist the casing's tendency to expand and contract with temperature changes. Oil and gas wells are usually cemented only at the bottom.
- Well diameters are considerably larger than typical oil and gas wells.

As of 2007 plant construction and well drilling cost about €2–5 million per MW of electrical capacity, while the break-even price was 0.04–0.10 € per kW·h. Enhanced geothermal systems tend to be on the high side of these ranges, with capital costs above $4 million per MW and break-even above $0.054 per kW·h.

Heating systems are much simpler than electric generators and have lower maintenance costs per kW·h, but they consume electricity to run pumps and compressors

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# THE USE OF ENERGY-EFFICIENT LIGHTING IN DINING AREAS

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***Abstract:*** 40% of the energy currently produced in the world and 37% of all energy resources are in housing and public buildings used. The buildings account for a significant share of energy consumption (40-60%). Electricity consumption for lighting reduction two main ways: reducing the nominal power of the lighting: with reducing the time of using the lighting is defined. Quality and quantity (the amount of product from the source) affect our health, comfort (eye calming), safety (both for eyes, skin), the environment (the amount of greenhouse gases) and our economy (price). Many countries are spending a large amount of their electricity budget on the lighting system. To achieve efficient use of electricity, states are switching to energy-efficient lighting, which is the most economical, safe for people and the environment and a reliable way to save energy. In the lighting industry, it is necessary to optimize existing control and lighting equipment and use cost-effective lighting to reduce energy consumption with high light quality.

**Keywords**: Effective lighting**,** dining areas, LED, lighting, Energy saving

## I. INTRODUCTION

**Effective lighting in dining areas:** An important aspect of energy-saving kitchen design is how to brighten up your cooking space. The main thing here is to optimize natural light and connect it with a practical, energy-saving artificial lighting system. Effective LED technology plays here. LED lights revolutionized the lighting of our homes. Compared to conventional incandescent or halogen lamps, LEDs consume significantly less energy, converting about 70% of it into light and wasting only 30% as heat. This is in stark contrast to conventional lamps that change numbers. In addition to saving energy, LED lights are also economical [1]. While initial investment may be slightly higher, LEDs last much longer than traditional ones, saving you replacement costs. The strategic location of LED lighting can also increase the aesthetic appeal and functionality of your kitchen [2].

## II. THEORY

***Natural lighting and lighting tools:*** Natural illumination is a product of light produced from the sun as well as sunlight returning from the Earth and the sky. Natural light has heat and light constants, which are equal to 1317 W/m2 for heat coming from the sun and 137,000 lk for light. The advantages of natural light are that it contains extremely useful ultraviolet and infrared rays, which serve to make the environment healthier, that is, it has the property of killing germs [3]. Natural light is used using three types of devices, i.e. from the roof through the lantern, from the wall through the window, and mixed-state systems [4]. Requirements for naturally lit systems include:

- ensuring that the amount of light is selected depending on the function of the premises, divided in directed or scattered cases;
- ensuring that insulation and lighting are not less than standards.

Lighting lamps are divided into three classes according to the nature of light distribution:

- direct beam propagator;
- light emitter;
- light-repellent lamps.

a) the class of direct light emitting lamps includes lamps that emit about 90% of their own light along the lower semicircle.

b) light-emitting lamps are based on the distribution of their light between the upper and lower circles, spreading the total light along the upper and lower spheres, and giving the opportunity to evenly distribute light, eliminating any shadows. Such lamps are installed in buildings where the ceiling and walls have a light-repellent property.

C) in light-repellent lamps, mostly more than 90% of light is directed to the upper sphere, and lighting is mainly at the expense of returned light. Such luminaires, providing soft and gentle lighting without shadows, are used mainly in museum, theater buildings [9-15].

***Degree of illumination of the dining area.*** In the dining room, 150 lux light level is sufficient. According to the desired ambiance, light level can be reduced to 100 lux or increased to 200 lux. In the dining rooms, it is recommended to use light sources in warm white color, at 2700K color temperature [5].

## III. MAIN PART

We can replace the lighting lights in the dining area with lighting equipment that is energy efficient and modern, or use existing lighting equipment wisely. To reduce electricity consumption in electric lighting networks, it is necessary to correctly select lamps and Luminaires, use them wisely and maintain the voltage at the desired level [6]. Electricity consumption is associated with the accepted lighting norms, types of lighting fixtures and their operating modes [16-24]. The lighting device should provide the required viewing conditions, spending as little electricity and money as possible. The conditions of vision are determined by the plan and distribution of clarity in the field of vision [7]. The calculation and measurement of clarity in practical conditions is associated with a lot of difficulties. Therefore, when normalizing the level of illumination of the surface of the dining table, its coefficient of Return is taken into account. The quality of illumination is not determined only by the degree of illumination [8]

## IV. CONCLUSION

Nowadays, energy conservation is becoming an urgent problem. Energy saving in dining areas by increasing the efficiency of natural light in the use of electric lighting, as well as reducing the number of lighting devices, this leads to a decrease in the total energy consumption of the room and building.

When designing or reconstructing a building – it is necessary to fully implement rooms that are not used or partially used, without windows and walls that do not protrude. In addition, the reduction of lighting devices in areas where direct natural light falls and the application of photosensors leads to an increase in energy efficiency.

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# PHOTOVOLTAIC EFFECTS AND THEIR EFFECTIVE USE

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**Abstract:** This article provides an in-depth study of the photovoltaic effect and its practical applications. The author discusses the basic principles of the photovoltaic effect, including the conversion of light into electricity, as well as its importance in renewable energy production. The article also focuses on the efficient use of photovoltaic technology, its potential to mitigate climate change and reduce dependence on non-renewable energy sources. Overall, this comprehensive and informative piece provides valuable insights into the photovoltaic effect and its role in sustainable energy solutions. With the widespread use of renewable energy, **solar energy systems, which** have become increasingly popular, have begun to be focused on how solar energy systems are produced and how solar energy is converted into electricity. In our content, you can access the information you want to learn about both this subject and the photovoltaic system in detail.

**Key words:** photovoltaic effect, photovoltaic batteries, photovoltaic cables, photovoltaic module, solar energy

Photovoltaics is a method of generating electricity from the sun using solar cells or solar panels. Solar cells convert the sunlight (photon) that falls on them into a direct current. It uses materials known as semiconductors such as gallium, cadmium and arsenide to conduct current [1-5]. When looking at what solar photovoltaics are, we need to look at the details of a solar energy system. Solar cells work based on the effect of creating an electrical voltage at their ends when light hits them, known as the photovoltaic phenomenon or principle. There are two different types of systems in solar energy systems. One of them is On-Grid systems. No need to save in this system. There is a direct exchange with the network. You sell the electricity you generate at the power plant directly to the grid, and if you need more, you supply the electricity you need from the grid. Here, the elimination of charging and battery costs can be considered an advantage. When asked what a photovoltaic panel is, it means a different system, but it actually means the same thing as a solar panel. Photovoltaic panels or solar panels are materials that capture solar energy and convert it into

electricity [6-10]. Panels consist of small cells. These cells are made of semiconductor materials. It can be said that silicone is preferred in their production. If you know what a solar energy system is, that means you have the answer to the question of what a photovoltaic system is. If you want to learn about what a solar energy system is and how it works, check out What is Solar Energy? You can check out our article. However, to give general information, we can say that the systems that collect several solar panels and generate energy from the sun with the help of an inverter and some electronic materials are called photovoltaic systems [11-18].

Photovoltaic batteries are batteries that allow you to store solar energy. In this way, you can use electricity even when there is no sunlight. After answering the question of what is a photovoltaic battery, we can talk about the types of batteries. Battery types can be checked within 4 different technologies. These 4 technologies are called crystal technology, thin film technology, composite technology and nanotechnology. Types of photovoltaic batteries are as follows:

1. Inorganic Batteries
2. Two Layer Inorganic Batteries
3. Single Crystal Silicon Batteries
4. Multi-Crystalline Silicon Batteries
5. Thin Film Batteries
6. Amorphous Silicon Batteries
7. Polycrystalline Thin Film Batteries
8. Thin Film Chalgonite Batteries
9. Cadmium Telluride Batteries (CdTe)
10. Copper Indium Diseleneide Batteries
11. Copper Indium Gallium Diseleneide Batteries (CIGS)
12. Flexible CIGS Batteries
13. Multi-Joint Batteries
14. Nanophotovoltaic Batteries (NanoPV)
15. Quantum Dot Batteries
16. Dye Sensitive Batteries

The process of producing a voltage or electric current within a cell by exposure to sunlight is the answer to the question of what is the photovoltaic effect. Edmond Becquerel first discovered the effect in 1839. In his experiments with wet cells, Becquerel found that the voltage in the cell increased when the silver plates were exposed to sunlight. We can explain the process as follows;

The first, the photovoltaic effect, occurs in solar cells. These solar cells use two semiconductors that are joined together to form a pn junction. (One is p-type and the other is n-type [19-22].

When these two different types of semiconductors are combined, the electrons are transferred to the positive (p) side. Holes go to the negative (n) side. In this way, an electric field is created in the connection area.

This field allows negatively charged particles to move in one direction and positively charged particles to move in another direction.

Light is made up of photons, which are small beams of electromagnetic radiation or energy. These photons can be absorbed by cells. When the right amount of light arrives, the cells transfer the energy from the photon to the electrons in the semiconductor material in the pn junction [23-25].

Thus, the electrons move to a higher energy region known as the conduction band. This leaves a gap in the valence band through which the electron can jump. This movement of the electron creates two charge carriers and a pair of electron holes as a result of the added energy.

If the electrons do not move, they hold the semiconductor material together through the bonds they form with the surrounding atoms, and no movement occurs. Electrons in the excited state in the conduction band move freely through the material. Electrons and holes move in opposite directions in the electric field generated by the pn junction. Free electrons try to go to the n side, not the p side. This movement of the electron creates an electric current in the cell [26-28].

As we mentioned earlier, when an electron moves, it leaves a space (hole) behind. It can move in the hole, but this movement is in the opposite direction.

This is the process that creates the current in the cell.

The definition above under the heading "What is a Solar Panel" is "What is a Photovoltaic Module?" It also includes the answer to the question. In other words, a structure consisting of series and/or parallel connected solar cells mounted on two plastic films is called a photovoltaic module. The glass part on the front protects the interior from mechanical damage. In thin-film solar modules, the photoactive layer is placed directly on the glass and then laser-cut into lines and connected in series. It is a building material that provides protection due to its robust structure and enables the production of electricity from solar energy. It can be said that the cost of this material, which is called building-mounted photovoltaic (BIPV) and can be applied to the roof, skylights or facades of certain buildings, is not significantly different when viewed in parallel. building materials. BIPV modules, a rapidly growing part

of solar energy systems that have recently become popular as a result of investment and awareness of renewable energy, can also be applied to older buildings. We can summarize what a photovoltaic window is. Since the principle of operation of solar systems is the same, you can find out how they produce electricity under the Photovoltaic effect or what is a system sections above. Photovoltaic thermal systems, more commonly known as solar thermal systems, use heat from sunlight. Sun rays are absorbed and concentrated through reflectors, and the fluid is heated through a heat exchanger. Water vapor is produced by the heated fluid. This water vapor is used to move turbines and generators, like the system in conventional power plants. It can be said that the definition of power plants that produce energy with water vapor heated by sunlight is the short answer to the question of what photovoltaic thermal systems are.

Photovoltaic cables are cables produced for use in the connections of photovoltaic system elements in all photovoltaic systems and solar panels. They are generally produced technically resistant to UV, ozone or weather conditions. The technical specifications of the cable are determined by the requirements of your system. Even if you have knowledge of what photovoltaic cable is, it will not be possible to have a general idea about which type to use without the necessary technical analysis, without deciding on the structural elements of your solar power system. The suitability of the cable used for the system is an important factor in terms of production efficiency.

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# TYPES OF LIGHTING LAMPS AND THEIR CHARACTERISTICS

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**Abstract:** This article discusses light and its different types, including natural, artificial, and special lighting. The International Lamp Coding System (ILCOS) provides a short form coding system for lamp efficacies and some types of lamps. Today's types of lighting lamps and their characteristics are highlighted. In addition, the article discusses the technical aspects of lighting, such as color temperature, brightness levels, and energy efficiency. Through this comprehensive analysis, the reader will gain a deeper understanding of the role of light in our daily lives and its impact on our well-being.

**Key words:** light output , wattage requirements, International Lamp Coding System (ILCOS), *incandescent lamps*, low-voltage tungsten halogen lamps, tubular fluorescent lamps, compact fluorescent lamps, induction lamps, high-pressure mercury lamps

A lamp is an energy converter. Although it may carry out secondary functions, its prime purpose is the transformation of electrical energy into visible electromagnetic radiation. There are many ways to create light. The standard method for creating general lighting is the conversion of electrical energy into light [1-5].

Although the development of technology has made it possible to produce a variety of lamps, the main factors affecting their development have been foreign market forces. For example, the production of filament lamps used at the beginning of this century was possible only after the availability of good vacuum pumps and tungsten wire drawing. However, it was the large-scale generation and distribution of electricity to meet the demand for electric lighting that determined the growth of the market. Electric lighting has many advantages over gas or oil-based lighting, such as steady light that requires little maintenance, and increased safety by avoiding open flames and local combustion products [6-11]. During the post-World War II recovery, the focus was on productivity. The fluorescent tube lamp became the dominant light source because it allowed factories and offices to be illuminated without shadows and relatively without heat, allowing for maximum use of space.

The light output and power requirements for a typical 1500 mm fluorescent tube lamp are listed in Table 1.

Table 1. Enhanced Light Output and Wattage Requirements for Some Typical 1500mm Fluorescent Tube Lamps

| Rating (W) | Diameter (mm) | Gas fill | Light output (lumens) |
|---|---|---|---|
| 80 | 38 | argon | 4,800 |
| 65 | 38 | argon | 4,900 |
| 58 | 25 | krypton | 5,100 |
| 50 | 25 | argon | 5,100 (high frequency gear) |

By the 1970s oil prices rose and energy costs became a significant part of operating costs. Fluorescent lamps that produce the same amount of light with less electrical consumption were demanded by the market. Lamp design was refined in several ways. As the century closes there is a growing awareness of global environment issues. Better use of declining raw materials, recycling or safe disposal of products and the continuing concern over energy consumption (particularly energy generated from fossil fuels) are impacting on current lamp designs [12-18].

As a general rule the efficiency of a given type of lamp improves as the power rating increases, because most lamps have some fixed loss. However, different types of lamps have marked variation in efficiency. Lamps of the highest efficiency should be used, provided that the criteria of size, colour and lifetime are also met. Energy savings should not be at the expense of the visual comfort or the performance ability of the occupants. Some typical efficacies are given in table 2.

Table 2. Typical lamp efficacies

| Lamp efficacies | |
|---|---|
| 100 W filament lamp | 14 lumens/watt |
| 58 W fluorescent tube | 89 lumens/watt |
| 400 W high-pressure sodium | 125 lumens/watt |
| 131 W low-pressure sodium | 198 lumens/watt |

Main lamp types. Over the years, several nomenclature systems have been developed by national and international standards and registers.

In 1993, the International Electrotechnical Commission (IEC) published a new International Lamp Coding System (ILCOS) intended to replace existing national and regional coding systems. The International Lamp Coding System (ILCOS)

provides a standardized way to categorize different types of lamps based on their efficacy and other technical specifications. This system helps consumers and professionals make informed choices when selecting lighting options [19-22]. A list of some ILCOS short form codes for various lamps is given in table 3.

Table 3. International Lamp Coding System (ILCOS) short form coding system for some lamp types

| Type (code) | Common ratings (watts) | Colour rendering | Colour temperature (K) | Life (hours) |
|---|---|---|---|---|
| Compact fluorescent lamps (FS) | 5–55 | good | 2,700–5,000 | 5,000–10,000 |
| High-pressure mercury lamps (QE) | 80–750 | fair | 3,300–3,800 | 20,000 |
| High-pressure sodium lamps (S-) | 50–1,000 | poor to good | 2,000–2,500 | 6,000–24,000 |
| Incandescent lamps (I) | 5–500 | good | 2,700 | 1,000–3,000 |
| Induction lamps (XF) | 23–85 | good | 3,000–4,000 | 10,000–60,000 |
| Low-pressure sodium lamps (LS) | 26–180 | monochromatic yellow colour | 1,800 | 16,000 |
| Low-voltage tungsten halogen lamps (HS) | 12–100 | good | 3,000 | 2,000–5,000 |
| Metal halide lamps (M-) | 35–2,000 | good to excellent | 3,000–5,000 | 6,000–20,000 |
| Tubular fluorescent lamps (FD) | 4–100 | fair to good | 2,700–6,500 | 10,000–15,000 |
| Tungsten halogen lamps (HS) | 100–2,000 | good | 3,000 | 2,000–4,000 |

*Incandescent lamps.* These lamps use a tungsten filament in an inert gas or vacuum with a glass envelope. The inert gas suppresses tungsten evaporation and lessens the envelope blackening. There is a large variety of lamp shapes, which are largely decorative in appearance. Incandescent lamps are still popular for domestic lighting because of their low cost and compact size. However, for commercial and industrial lighting the low efficacy generates very high operating costs, so discharge

lamps are the normal choice. A 100 W lamp has a typical efficacy of 14 lumens/watt compared with 96 lumens/watt for a 36 W fluorescent lamp. Incandescent lamps are simple to dim by reducing the supply voltage, and are still used where dimming is a desired control feature.The tungsten filament is a compact light source, easily focused by reflectors or lenses. Incandescent lamps are useful for display lighting where directional control is needed [23-24].

Low-voltage tungsten halogen lamps.These were originally designed for slide and film projectors. At 12 V the filament for the same wattage as 230 V becomes smaller and thicker. This can be more efficiently focused, and the larger filament mass allows a higher operating temperature, increasing light output. The thick filament is more robust. These benefits were realized as being useful for the commercial display market, and even though it is necessary to have a step-down transformer, these lamps now dominate shop-window lighting.

Tubular fluorescent lamps. These are low pressure mercury lamps and are available as “hot cathode” and “cold cathode” versions. The former is the conventional fluorescent tube for offices and factories; “hot cathode” relates to the starting of the lamp by pre-heating the electrodes to create sufficient ionization of the gas and mercury vapour to establish the discharge. Cold cathode lamps are mainly used for signage and advertising.

Compact fluorescent lamps. The fluorescent tube is not a practical replacement for the incandescent lamp because of its linear shape. Small, narrow-bore tubes can be configured to approximately the same size as the incandescent lamp, but this imposes a much higher electrical loading on the phosphor material. The use of tri-phosphors is essential to achieve acceptable lamp life.

Induction lamps. Lamps using the principle of induction have recently appeared on the market. They are low-pressure mercury lamps with tri-phosphor coating and as light producers are similar to fluorescent lamps. The energy is transferred to the lamp by high-frequency radiation, at approximately 2.5 MHz from an antenna positioned centrally within the lamp. There is no physical connection between the lamp bulb and the coil. Without electrodes or other wire connections the construction of the discharge vessel is simpler and more durable. Lamp life is mainly determined by the reliability of the electronic components and the lumen maintenance of the phosphor coating.

High-pressure mercury lamps. High-pressure discharges are more compact and have higher electrical loads; therefore, they require quartz arc tubes to withstand the pressure and temperature. The arc tube is contained in an outer glass envelope with

a nitrogen or argon-nitrogen atmosphere to reduce oxidation and arcing. The bulb effectively filters the UV radiation from the arc tube.

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# INFLUENCE OF CURRENT TRANSFORMER ERRORS ON THE CALCULATOR INDICATOR

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**Abstract:** This article describes the principle of operation of the current transformer, the factors that cause measurement errors, the connection diagram, the formula for determining the error that occurred during the operation of the current transformer, and the ways to eliminate the error that occurred.

**Keywords**: current transformer, transformation coefficient, current error, angular error, primary current, secondary current.

As the need for electricity increases, it is necessary to accurately and fully account for its production and consumption.

It is not possible to calculate the electricity produced and consumed with sufficient accuracy by replacing induction meters with meters made on the basis of semiconductor elements with a higher accuracy class [1-5].

If we take into account that the calculation of electricity passing through high-voltage electrical devices is carried out with the help of current transformers and voltage transformers, it is known that errors in them also affect the meter reading.

Current transformers (CA)- are used to isolate measuring devices and protective devices from high-voltage circuit and to supply the protective circuit with current from the network [6-9].

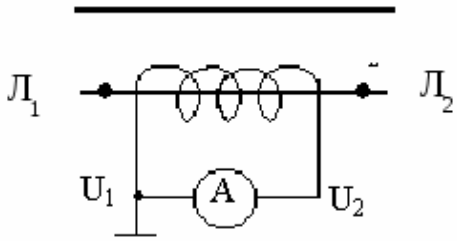


Figure 1. Current transformer connection diagram

Current transformer errors consist of current and angle errors. The causes of these errors are described in the analysis of the operating modes of high-voltage current transformers [10-12].

The origin of current transformer errors depends on the following factors:

1) The load current exceeds the rated current of the current transformer or the rated current decreases by 20%.

2) As a result of the passage of short-circuit currents, the core of the current transformer becomes saturated.

3) Exceeding the specified norm of the load connected to the secondary circuit of the current transformer.

This article analyzes the reasons for the load current exceeding the nominal value and its sharp decrease, as well as the causes of current and angle errors for various characteristic conditions of the load connected to the secondary circuit [13-19].

The primary current of current transformers consists of the current in the secondary circuit and the current used to transform it from the primary circuit to the secondary circuit. In this case, the current error occurring in the current transformer is explained by the following expression;

$$f_{\text{тт}} = \left(\frac{I_2 \times n_{\text{н}}}{I_1} - 1\right) \times 100\%$$

Here:

$I_1$ –is the primary current of the current transformer.

$I_2$ –the secondary current of the current transformer.

$n_{\text{н}}$ – current transformer transformation coefficient.

$f_{\text{тт}}$ –is the current error of the current transformer.

If the secondary current brought to the primary is greater than the value of the primary current, the error on the current is positive, if this value is less than the error, the error is negative.

The angular error in a current transformer represents the angle by which the current in the secondary circuit differs from the current in the primary circuit.

If the current vector in the secondary circuit of the current transformer, turned by 180°, is ahead of the current vector in the primary circuit, then the error has a positive character, otherwise it has a negative character.

The current and angle error increases with increasing secondary circuit load, where the secondary circuit voltage increases and correspondingly the magnetizing current also increases [20-21].

The angle error reaches its maximum value when the primary current is from 0 to 5% of the nominal value of the load current, the angle between the current and voltage in the secondary circuit also reaches its highest value, that is, the current and voltage in the primary and secondary circuits are equal. As a result, the angle between the meters is different, the difference between the electricity measured by the meter and the electricity passing through the primary circuit.

As the primary current of the current transformer increases by 5% of the nominal value of the current of the load, the angular error also decreases, and it is observed that the angular error increases at values exceeding 100% of the nominal value.

It is clear from this that the power consumption of the load connected to the secondary circuit of current transformers does not exceed the value specified in the passport of the current transformer and depends on the nature of the connected load.

1. The measuring current transformer has a small power reserve on the secondary circuit, a small change in the load on the secondary circuit causes the error to deviate from the norm.

2. At a small amount of primary current up to 5%, the error in current and angle increases rapidly.

3. Exceeding the primary current of the current transformer from the rated current leads to an increase in the current and angle error.

4. In order to carry out accurate and complete calculation of the transferred electric energy, the load current and the load of the secondary circuit should not exceed the norm.

5. To reduce the current transformer load, two current transformers can be connected in series, i.e. they are installed in one phase and have the same transformation coefficient $n_T$

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# SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS

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**Abstract:** The article first discusses the various requirements for installing solar panels, including local building codes, permits, site assessment, and equipment selection. It also highlights the importance of evaluating the structural integrity of the roof or ground where the solar panels will be installed. Furthermore, the article delves into the installation process itself, covering key steps such as mounting the panels, connecting them to an inverter, and integrating them with the electrical grid. It also explores safety considerations and best practices for ensuring a successful installation. Overall, this article serves as a valuable resource for individuals and professionals interested in understanding the essential requirements and process involved in installing solar panels. By providing insights into these critical aspects, it aims to facilitate informed decision-making and promote the adoption of solar energy technology.

**Key words:** Solar panel, installation slope, electricity Production capacity, network connection, solar panel size

Dimensions of the panels The first item to consider is the dimensions of the panels themselves. In essence, the greater the capacity on the panels, the larger the size. This relates specifically to the number of cells contained in the panel [1-2]. Thus, more cells mean more surface to capture sunlight and therefore produce more energy. Given this rule of thumb, you can then proceed to figure out the best spot for your panels. As I mentioned earlier, many folks like to mount their panels on their roofs. This is a good idea when you have a Gable roof. In addition, having a sloping roof pitched to one side would certainly be of benefit. Of course, given the dimensions of the panels themselves, they may be too big or too heavy for your roof. This is something that you might want to get a second opinion [3-5]. The last thing you want is to put additional weight on your roof, thus compromising the structure

of your home. Furthermore, roof mounting may not be the best course of action if you have an older roof that's not in the best of shape. However, roof mounting may be your best choice especially if you don't have much land on which to mount your panels. You could have smaller panels though having multiple panels may be more of a hassle than a benefit. Also, if you choose to mount your panels on the ground, make sure that they are in a spot where they can get direct sunlight most of the day. Before actually mounting them, monitor the area in which you would like to mount your panels [6-7]. It could be that shadows set in at a given hour in the afternoon. This could severely limit the overall effectiveness of your solar power system. Tilting panels However, you choose to mount your panels, bear in mind that they need to be at an angle. The reason for this is that when panels are mounted on an angle, they will capture the greatest amount of sunlight for the longest period of time. Tilt your panels at a 45° angle. Now, this is not set in stone as conditions may vary in your part of the world. One interesting calculation is as follows: If your latitude is below 25°, then multiply the latitude by 0.87. This factor represents the ideal angle for your panels, given your geographical location. Due to the curvature of the Earth, sunlight does not hit the surface of the Earth at an even angle. So, you need to compensate for this. So, if you are at a latitude of, say, 23°, you would multiply this by 0.87. Thus, 23 * 0.87 = 20.01. This means that you would have to tilt your panels to a 20° angle. The previous calculation is intended to maximize exposure to sunlight during daylight hours [8-9]. That is why roof mounting may not be your best option, especially if you live around taller structures. Hence, the afternoon shadows may block out your afternoon sunlight. In the event that your latitude is between 25° and 50°, then take the latitude and multiply that by 0.76. Then, add an extra 3.1 degrees to the equation. For example, if your latitude is 45°, then you would have 45 * 0.76 = 34.2. Add in the extra 3.1 degrees, 34.2 + 3.1 = 37.3 degrees. This is the angle at which you should tilt your panel. This will ensure the greatest amount of sunlight given the latitude at which you find yourself. In case you are unsure about what latitude you are located at, don't worry. You can search for your geographical position. With the aid map tools such as Google Maps, you can easily determine your current position. Which way to face A common mistake that newbies make is placing their panel is a random direction. Given the fact that the sun rises in the east and sets in the west, there is a predictable pattern in which sunlight will travel. In addition, the curvature of the Earth will not distribute sunlight evenly. In fact, sunlight will be distributed in a specific direction, given your geographical location [10-11]. For instance, if you live in the northern hemisphere, then your panels should face south.

If you live in the southern hemisphere, then your panels should face north. Unless you are living in the exact equator, you should point your panels in the opposite direction of your hemisphere. If you are unsure about which direction is north and which is south, you can look at a map tool such as Google Maps, or you can use your car's GPS. Those are two very simple ways in which you can determine your north/south position. The reason for tilting in the opposite direction of your hemisphere is related to the way the Earth itself is tilted. The Earth tilted axis is the reason why we have seasons. As such, when it is winter in the northern hemisphere, it is summer in the southern hemisphere and vice-versa. The only part of the world, which gets an equal amount of sunlight throughout the year, is the exact equator [12-14]. So, unless you are living right at the Earth's equator, heed this recommendation. Peak hours Earlier, I mentioned that the peak hours for sunlight were roughly between 10 am and 2 pm. This is when the sun is at its brightest and will deliver the most amount of sunlight. In addition to the tilting of your panels, your system should capture the greatest amount of energy during these peak hours. Now, depending on the part of the world you live in, your days may be longer or shorter. That is why you need to maximize your exposure to sunlight. This is especially important if you live in a part of the world that doesn't get much sunlight. Of course, you might be tempted to place your panels on a flat surface facing straight up. Sure, this will work best when the sun is directly above your position. However, it will not be very efficient once the sun begins to set, and it is at an angle. Furthermore, the north-south facing tilt will ensure that the panel begins to capture sunlight right from sunrise all the way through sunset. This is something that would be virtually impossible if the panels are facing straight up. One good rule of thumb, if you are partially connected to the grid, is to switch to regular electrical power during peak hours. That way, you can give your batteries a good chance to charge up. Once the peak hours have passed, then you can resume using your solar power system. This will help you to charge the batteries faster. The mounting structure for your panels Since the panels will be at an angle, your most immediate option would be to use your roof. The best type of roof to use is a Gable roof since it has the two sides parted down the middle. Since each side is on an angle, then it might be feasible to use your roof. In that case, you can look for the support beams that hold up the roof [15-16]. Next, you will find that the panels have holes where screws, or bolts, can be used to fasten it to the surface that they will be mounted on to. You can use long, 2-inch bolts to drill through the shingle and the support beam. If you decide to drill all the way through the support beam, then make sure you go straight through the middle. This will not comprise the

integrity of the beam. However, if you drill at an angle, then you might weaken the beam at that point. Once you have the hole drilled, you can place the mounting bracket. Bear in mind that you will not place the panels directly on the shingle. Rather, the mounting brackets will support the mounting rail. It is on the rail that you will place the panels on. Then, you can screw the panel onto the support rail. Using the support rail system is a good idea, especially if you have larger panels. If you are using smaller panels, then you could just install the mounting bracket and place the corners of your panel on the bracket. This is doable, especially since the panel won't weigh as much as a larger one. If you are home or structure has steel beams with tin sheet roofing, then mounting will be a lot easier because you can use the same spots where the tin sheets and bolted into the support beams. All you would have to do is remove the bolt, place the mounting bracket, and away you go. The main reason for not mounting panels directly onto the roof is related mainly to rain and snow. If the panels where to be mounted directly on to the surface of the roof, the rainwater would flood the panels. If the panels as slightly raised above the surface of the roof, the water can flow beneath it. The same goes for snow. Concrete roofing Now, let's assume you are mounting panels onto a building with a flat, concrete roof. This job poses a higher degree of difficulty, as most concrete roofs are flat. While they may have an angle in order to allow water to flow, this angle will be inadequate for efficient sunlight capture. So, you will have to fabricate your own mount that takes into account the recommended angle. There are two ways in which you can fabricate your own mount. You can make these mounts out of wood or metal. The mount will look like two triangles joined by straight beams [17-18]. If you are looking for a quick and cost-effective way of making your own mount, you can use regular lumber to make the mount. Depending on the size and weight of the panels, you can use regular 2 x 2 lumber all around. If you use the larger and heavier panels, you might consider using 3 x 3 or 2 x 4 lumber. This will give your panels the support they need. Don't worry about using lumber to mount the panels as the panels will not catch on fire. If anything, it is the batteries that pose a greater fire hazard. Mounting on to wood is a lot easier since the screws that you use will dig into the wood. So, make sure you use wood screws, or at least, cone-shaped screws that have the spiral thread. Try to avoid using the flat-tip screws as you will have to drill into the lumber in order to pass the screw through the wood. Alternatively, you could nail it down with a regular flathead nail. Ideally, you would use a nail gun to do this. You could use good, old-fashioned elbow grease and hammer the nail in. However, you must be very careful not to hammer the surface of the panel. If you do, you may damage

individual cells or the entire panel altogether. Personally, when working with wood, I would prefer to use 1-inch wood screws. They will go a good job of holding the panel in place. If you must nail the panel in, make sure the head of the nail doesn't go through the hole of the panel. Otherwise, it would be as if you hadn't nailed the panel down. Another type of mount that really works very well is a steel frame mount. These can be made by a blacksmith to suit the exact needs of your panels. You can use regular aluminum, such as the frames used in windows, or you can use heavier steel [19-20]. The blacksmith will take the measurements of your panel, and them weld the pieces of metal together. If you wanted to save yourself the hassle of screwing down the panel, you could have the blacksmith weld the frame of the panel onto the mount. This can be done by soldering a few points all around the panel and the mount. The only downside to this is that if you ever need to remove the panel, you will have to work quite a bit to break to weld points. In addition, the blacksmith needs to be very careful not to heat the panel too much. Otherwise, it could blow the whole panel. So, your best option here is to screw the panel down with a nut and a bolt. The blacksmith can drill the holes in for you so that all you have to do is line up the holes, thread the bolt through, and secure it on the other end with a nut. You can then fasten the nut with a wrench. All you need to do is just hand-tighten the nut and bolt in order to securely fasten it to the mount. If you use a gun to tighten the bolt down, the added torque of the gun may crack the frame of the panel. Breaking through the roof Even if your panels are big and heavy, it is always a good idea to secure them to the roof. This is especially true if you live in a windy area, or an area prone to tornadoes and hurricanes. In order to mount your wooden or metal mount, you can break open a small hole into the roof itself. It doesn't have to be very deep. Usually, an inch deep is enough. Don't feel like you need to bust through all the way to the rebar. Now, let's assume you have a wooden mount. Wood and concrete don't mesh very well together. So, you can just set the lumber into the holes in the roof, pour some concrete on it and let it sit there. Of course, you could do that. However, the wood might rot, and you will have to break open the same spot again and remove the rotten mount. So, the solution is to open a small hole, about two inches wide and about an inch deep. Then, you can get large, two-inch bolts. You can set the bolts into the hole and pour concrete around the bolt, thereby filling in the hole [21-22]. What you will have is the bolt protruding from the roof. Next, you can drill a hole all the way through the wood, set the mount over the bolt, and then tighten with a nut over the bolt. You can use four bolts, one for each corner, to fasten your mount to the roof. If you would like added security, you use 6 or 8 bolts. As long as you let

the bolts set into the concrete properly, you should have no trouble with the wind blowing your panels away. If you are using metal mounts, then you can break the holes into the concrete roof just like before, but this time, you can actually set the frame directly into the concrete. Since metal and concrete get along very well, you won't have to worry about your panels blowing away [23-24]. You can set each corner into the roof, and you will be good to go. So, when you get the blacksmith to make your mount, you can ask them to leave a one-inch tip. This is the tip that will go into the roof. When setting metal mounts into a concrete roof, be sure that the spot you choose is the spot that will hold the panels forever. Since metal sets very well into concrete, you will find it nearly impossible to pull the mount out without tearing the roof apart. While you could just hacksaw through the metal tips, removing a metal mount will require additional time and effort. In this regard, wooden mounts are much easier to deal with. Installing panels on the ground If you choose to install your panels on the ground, try to avoid installing them on grass or plain dirt. This is especially important if you get a lot of rain. The reason for this is the ground will get soft, become muddy, and then the panels will sink under their own weight. So, if you have grass or simply dirt, you can pour some concrete down to hold the panels in place. Ideally, you would lay down a concrete slab the size of the panels. This will ensure that your panels will not blow away [25-28]. Now, if you are on a tight budget, you could lay down smaller slabs around each other corners of the mount. You can dig a one to the two-inch hole, pour the concrete in, set the mount, and let dry. Once the concrete is dry, you can lay the panels down. I If you are unsure about how to do this, you can enlist the help of a mason or a foundation expert. They are good at setting solid supports in the ground. The only caveat with installing your panels on the ground is that you need to make sure they have enough open space so that they are not covered by shadows at various points throughout the day. If you have a large backyard of a good piece of land, then you might just get away with it. If you are laying your panels down in a forest, say, for a cabin, then you need to see if the trees around the land may cast a shadow on your panels. Otherwise, mounting panels on the ground provide a good option for you to set them up any way that suits your best.

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# SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS

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**Abstract:** The article first discusses the various requirements for installing solar panels, including local building codes, permits, site assessment, and equipment selection. It also highlights the importance of evaluating the structural integrity of the roof or ground where the solar panels will be installed. Furthermore, the article delves into the installation process itself, covering key steps such as mounting the panels, connecting them to an inverter, and integrating them with the electrical grid. It also explores safety considerations and best practices for ensuring a successful installation. Overall, this article serves as a valuable resource for individuals and professionals interested in understanding the essential requirements and process involved in installing solar panels. By providing insights into these critical aspects, it aims to facilitate informed decision-making and promote the adoption of solar energy technology.

**Key words:** Solar panel, installation slope, electricity Production capacity, network connection, solar panel size

Generally, for a grid tied system, we calculate that we will lose about 23% due to losses in the system, from voltage drop in the wires to bird poo on the panels. Now let's do some math! We take that daily average kwh from earlier, multiply it by 1000 to get watt hours, divide it by your annual average sun hours, to get 11,254W. We divide it by 77% to take into account the system losses, which gives us 14,615 W of solar to provide 100% of our electricity needs. As we said earlier, most grid tied systems don't try to make all of their power, just cut their existing bill. So, for this example, I'm going to cut that in half to provide half of my electricity with solar [1-5]. Therefore, I need a solar array of about 7300 watts. Now let's use this information to pick out the rest of the system. Grid tied inverters are sized based on the size of the solar array they are connected to. There is a certain window of number of panels

in series and in parallel that will work with the inverter. When selecting the inverter, you'll find that most inverter manufacturers these days have an online calculator called a "String Sizer" to help select the right inverter for your panels. You just have to enter the temperatures that the panels will be seeing during daylight hours, and if I'm mounting them on a roof or on the ground [6-11]. This matters because the solar panels' voltage changes pretty dramatically based on temperature, so the string sizer needs to be able to calculate the highest and lowest voltages it will see. You also will have to select the solar panels I'm going to use. I picked Kyocera's 250W panels, they are a terrific panel at a very good price. Since I'm looking at around 7300 watts of solar, I picked the ABB Uno 7.6kW inverter. I can see that depending on how many parallel strings I do, I can use series strings of anywhere from 4 to 14 long in series. However, these may not be the ideal string lengths, if there are any warnings, the string sizer will alert you in a note. I picked 2 sets of 2 strings of 8, for a total of 8000W, the inverter is very happy with that size. It's a little bigger than my 7300W that I calculated that I needed, so it will actually generate more than half my power. So now I've got 32 Kyocera 250W panels, and an ABB Uno 7.6k Transformerless inverter. So how will I mount them? Luckily for those of us doing a lot of designs, IronRidge also has a time saving Design Assistant to help speed up the design work. They've got one for roof mounts, and one for ground mounts. I'll give you an example with the roof mount one. You enter what solar panels you are using, how many, and how they are laid out. For example, 2 rows of 16, flush against the roof. For my area, the building code requires the system be designed to withstand 100mph winds and a snow load of 40psi. For 4' spacing between mounting feet, which lines up with every other rafter, it tells me I can use the IronRidge XR100 rails. Just a few more inputted details, like what color clamps to match the panels and it outputs a bill of material, and the manufacturer's suggested retail price. They do suggest a flashing for an asphalt shingled roof, so if you have a different type of shingle, you may need a different flashing to prevent leaks. The last piece is over current protection, protecting your system in the event something goes wrong. In a grid tied system, there are 2 locations we need to put in over current protection, on the DC side by the solar panels, and on the AC side in the main breaker box. The combiner box I would chose for this example is a disconnecting combiner box. It allows you to turn off the power coming out of the panels right by the panels, in compliance with NEC 2014 Rapid Shutdown requirement. Each string of panels gets its own fuse. The datasheet of the panel usually tells you what size fuses to use, for grid tied panels under 300 watts, it's usually 15A. To calculate it, you take the solar panel's Short Circuit

Current, and multiply it by 1.56. The combiner box wires the strings into parallel, and gives you a place to transition the wire into conduit. It's also a good place to put a lightning arrestor [12-18]. The AC output of the inverter goes into a dual pole breaker in your home's main breaker box. To calculate the size breaker to get, you take the watts of the inverter, in this case 7600 watts, divided by the AC voltage output, 240V, and multiply it by 1.25 to oversize for NEC's requirement for devices being used for more than 3 hours continuous. This gives you a 40 amp dual pole AC breaker. So, what have we got? We have a combiner box with 15A fuses, 32 of the Kyocera 250W panels, wired in 4 strings of 8, an ABB 7.6k Transformerless inverter, and just over 200' of IronRidge XR100 rail, with the and clamps, and mounting feet. You would enter the details for whatever physical layout works for your roof. Then you would get a 40A AC breaker that fits in your main breaker box. There are two types of DC protection devices are essential to guarantee the safe and effective functioning and operation of any PV system: fuses and circuit breakers [19-22].

Fuses are overcurrent protection devices that contain a filament inside that heats up as current flows through it. When a specific current located above the permissible limit passes through the filament, the filament heats up above its thermal capacity and melts. When the wire inside the fuse melts, the circuit gets opened.

An overcurrent can be produced by:

An overload caused by excessive current demand from the electrical loads, above the design limit.

A short-circuit caused by a fault that occurs in the circuit.

A circuit breaker is a thermal protection mechanism is based on a bimetallic contact that heats and expands when an electric current located above the rated value is present. This protects the circuit against overload. A magnetic protection mechanism instantly responds to high fault currents that protect the electrical circuit against short-circuits or over-currents.

Inside the DC breaker, two contacts split when an overcurrent passes through the protection device, automatically switching it to the OFF position.

The DC breaker needs to be put back in the ON position to allow electric current flow again through the circuit. There is no functional difference between fuses or circuit breakers.

If a fault occurs with a fuse, you need to replace it. With a breaker, you flip the switch back in the on position; but fuses are cheaper than circuit

breakers.

Keep in mind that for solar power applications, you must choose circuit breakers that work on DC to protect solar panels and batteries. Circuit breakers that work on AC are used solely to protect the AC loads.

So, which protective device should you use for each applicationI recommend using fuses for parts in your circuits that do not easily trip.

This is the DC part of your solar system.

Circuit breakers can be reused each time that they trip, and they are intended to protect multiple electrical circuits.

You will need to use fuses specifically for protecting the battery bank as higher currents flow through this circuit, and the protection speed of these devices will guarantee that the batteries will not suffer any damage.

Finally, for the main AC panel, it is more common to use circuit breakers to protect loads in residential-sized or off-grid PV systems.

Because of the high current in DC systems, it can get very expensive to use DC circuit breakers. Therefore, fuses are preferred [23-28].

Fuses and circuit breakers can also be classified according to their response speed.

The acting speed is the time it takes for the fuse to open once a fault current or overload passes through the filament. This is dependent mainly on the material used for the fuse element.

Selecting the accurate fuse type also involves selecting the appropriate speed response for the particular application that you are using. Choosing a fuse that acts too fast may not allow normal current operations to run, while choosing a fuse that is too slow may not interrupt faulty currents quickly enough.

There are 3 main types of fuse speeds: ultra-rapid, fast-acting, and slowacting Ultra-rapid fuses are mainly used for semi-conductors' (electronics) protection.

Fast-acting fuses can be used to protect cabling and less sensitive components such as batteries and PV modules.

Finally, slow-acting fuses feature a built-in delay that temporarily allows the flow of inrush electrical currents in electrical motors.

When checking the datasheet of the fuse, you may find some of the following marks, as described in the following table:

The tool is generally built with a high-quality carbon steel material that

ensures a long service life, and that is equipped with an ergonomic grip that is wrapped up with an anti-slip rubber material that makes it comfortable to use. The stripping of the cable to introduce the lug must be done with another tool.

Hammer Lug Crimper

Another option for the same purpose is a hammer lug, which is a manual and more economical solution to crimp the cable lugs for your battery bank. The tool is capable of crimping cable lugs for gauges between #8AWG and 4/0AWG (which covers all possible cable gauges for battery applications). The crimping process with a tool like this is done very simply by adjusting the ram head according to the wire and the terminal sizes. Then, the lug is placed in the jaw of the crimper while it is struck with a hammer (1-2 times is enough) to press the lug against the copper or aluminum.

Crimping Tool

This tool is suitable for crimping individual wires. It integrates a ratcheting mechanism that has an adjustable clamping force useful for precise and repeatable crimps that also adds more crimping power into each squeeze. Its ratcheting mechanism allows you to secure a wire connector even before inserting the stripped wire into the small barrel.

You will be able to crimp wire terminals for gauge sizes between 22 and 10AWG split into three cramping options marked by the colors red, blue, and yellow that will indicate the gauges ranges for each purpose. It has also been designed with an ergonomic material that offers a comfortable and secure grip.

Conduit Cutter

The next tool in our list is the conduit cutter. Conduit is generally used in electrical installations to protect cables or wires from water and/or physical damage.

However, for the conduit to fit your wiring installation, you must be able to cut it to adjust the length properly. For this purpose, a conduit cutter tool is needed.

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# STAGES OF IMPLEMENTATION OF THE E-LEARNING PROCESS IN TECHNICAL EDUCATIONAL

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**Annotation:** The traditional forms of education have been replaced by e-learning elements. The introduction of modern information and communication technologies in the educational process has led to the creation of a new form of teaching - distance learning - in addition to traditional teaching methods. In distance education, the student and the teacher are in constant communication with each other using specially created training courses, forms of control, electronic communication and other technologies of the Internet, separated from each other in space.

**Key words:** e-learning, advanced pedagogical technologies, e-textbooks, multimedia tools, e-learning resources, virtual education, LMS (Learning Management Systems), CMS (Content Management Systems).

E-learning serves to further improve the quality of teaching.

Today, the wide introduction of information and communication and advanced pedagogical technologies, electronic textbooks, multimedia tools into the educational process serves to improve the quality of teaching [1-2]. Our center, established on the basis of the decision of the Cabinet of Ministers of June 7, 2006 "on measures to establish a Center for the development of Multimedia and general education programs under the Ministry of public education of the Republic of Uzbekistan", is also operating on the same purpose.

Here, special attention is paid to the creation, development and popularization of multimedia programs, their effective application to the system.

Electronic copies of multimedia tools, educational literature and manuals for secondary schools are being put into practice in cooperation with CHunonchi, Republican educational center and specialized regional enterprises for the development of software products. The official website of the Ministry of public education (. www.uzedu.uz) updated. As a result, its" education " section provided a list of necessary documents for admission to preschools, schools, music and art,

sports schools, as well as the ability to download electronic views of application forms. For children's music and art schools, sports schools and centers of the “perfect generation”, the Information System “extracurricular education” was launched, which was placed in the unified Information System “E-School” [3-8].

Today, a total of 493 titles of electronic information and educational resources have been put into practice in the public education system. In particular, an electronic textbook with 374 titles, video and audiodars, interactive and animated virtual laboratory work, tests and other additional resources were prepared by the Center for the development of Multimedia general education programs. Methodological manuals and information and educational resources of the ministry www.eduportal.uz it is placed in the “Electronic Library” section of the information and education portal [9-15].

The fact that electronic copies of textbooks and methodical manuals for students of general secondary education schools are posted on the site, which are replaced by a new generation of textbooks every year, also makes it convenient for users. In turn, the organization of seminars and trainings and video sessions with the participation of specialists in the field makes it possible to introduce them to advanced experiments [16-20].

Another innovation is that in order to attract the general public to the activities of educational institutions, to introduce parents to the work carried out, the “best websites in the public education system” review is also being held. This would serve to increase interest in creating their own personal websites between students and teachers, to ensure more efficient use of information technology, to inspire admiration for ICT-related professions in boys and girls, without a doubt [21-24].

Among the many sources of e-learning organization, the following can be indicated:

* Author software products (Authoring tools;

* Virtual learning process management systems LMS • Learning Management Systems;

* Internecontentniparticles CMS (Content Management Systems).

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# IMPROVING ENERGY EFFICIENCY IN BUILDINGS

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**ABSTRACT**

In the course of this research, the building system was analyzed with reference to the improvement of energy efficiency of buildings and international experience. Today, the general condition of the buildings under construction is created according to international experience.

**Keywords:** discomfort, energy consumption, isolation, energy efficiency, passive houses

Increasing the energy efficiency of individual modern residential buildings being built today is becoming a need of the hour, because most of the existing residential buildings in the Republic of Uzbekistan are houses designed and built on the basis of individual individual projects [1-5]. When building such houses, the climate of Central Asia, including Tashkent, is considered hot and sharply continental. In the rooms of the building used in such climatic conditions, the temperature in the summer is 40-450 C, and the temperature of the room exceeds 450 C. This situation creates an uncomfortable microclimate in the room. Analysis of residential buildings being built in the climatic conditions of Uzbekistan from the point of view of increasing energy efficiency, analysis of the constructions of modern residential building projects under construction, energy-efficient roofs, door windows, and the location of the residential building in the area. It is very important to take into account the hot and dry climate of Uzbekistan. An energy-efficient house is a building that consumes very little energy to maintain a comfortable microclimate inside the building [6-12].

Energy saving in such buildings reaches 90%. Annual energy consumption in this type of buildings can be less than 15kWh per 1m2. As an example, most of the private houses being built today (reinforced concrete foundation, "warm floor" system without additional heating, walls 1.5 bricks thick with cement plaster, ordinary plastic windows, roof heat insulation 150 mm and without an air handling device in the ventilation system) the amount of energy used for heating is 110-

130kWh* per year per 1m2. The following houses in the European Union classification is accepted [13-18].

1. **Low-energy houses:**

Houses that use at least 50% less energy than conventional buildings, which meet the requirements of current energy consumption standards.

2. **Ultra-low energy houses:**

Compared to conventional houses

70-90% energy saving. As an example, German Passive House (passive house), French Effinergie, and Swiss Minergie clearly contain the requirements of ultra-low-energy houses. In many foreign countries, a number of administrative and economic regulatory and support measures are implemented to improve the energy efficiency of buildings. 1. Introduction of energy saving standards, strict construction norms and rules, indicators in the framework, which go to heating and lighting the building indicators related to limiting energy consumption. Improving the energy efficiency of residential buildings includes the following measures: building standards for new buildings, construction of passive energy and almost energy-free buildings, retrofitting of existing buildings from the point of view of energy efficiency, and the introduction of construction certification. . According to the final statistics of the International Energy Agency, in 19 of its member countries, the above policy has played a decisive role in the field of energy efficiency, according to which this indicator has been 1.3% since 1990. Today, the modern trend of residential buildings is to build "green buildings". As part of this trend, uniform standards have not been developed in the world, therefore, the approach to determining the ecological level of the building has not been developed in the world experience. Proprietary standards are only available in the UK, France, Germany, Italy, Australia, Japan and China. There are four "green building standards" in the US [19-21].

Some states offer subsidies to owners of buildings certified by the Green Building Council. In many states, building standards are updated annually, with a goal of doubling the energy use of every new building by 2030. A number of cities have legislated a building energy efficiency assessment under the ENERGY STAR program, which includes tables from 1 to 100 and more and suitable for buildings with an area of more than 1000 m2. Providing state support and subsidies for improving the building's energy efficiency. In Great Britain, there is a program called Warm Front (Warm Front), which is aimed at low-income households, according to which thermal insulation and energy efficiency improvement of the heating system

are implemented, the investment is 50 million pounds. This program is also valid in the USA. In Japan, subsidies are provided by the New Energy and Industrial Technology Development Organization (NEDO), which renovates residential buildings in accordance with thermal protection (based on the Energy Efficiency Act), energy-efficient household appliances using renewable energy sources, and efficient equipped with systems. As a result of the subsidies, new-build homes are 15% more energy efficient and retrofitted homes require 25% less energy than when they were built [22-25]. Owners of new and renovated houses must report to NEDO every three years the increase in energy consumption. The level of basic energy demand in new modern buildings being built in Poland, the following technology is useful for different building energy per kW/m2: many buildings with concrete walls 20-30 cm and high-efficiency individual facade insulation total of 20-25 cm, in areas heated by central heating systems, polystyrene at least 20 cm or on slopes, the wooden roof is flat with one layer. Individual houses are insulated 20-25 cm minvata, individual gas boilers in the houses, the wall is 20-30 cm, the thickness of hollow brick walls and polystyrene foam insulation is 15 cm. The volume of high thermal insulation of walls, ceilings and foundations meets high thermal standards, the thickness is about 15 cm. As a result of using modern insulated windows and doors, it is possible to check the efficiency of ventilation systems of buildings, to prevent mold and rot on walls and ceilings due to insufficient ventilation.In conclusion, enough experiments and tests have been carried out in the field of energy efficiency in the world, and it is necessary to consider them in accordance with the climatic conditions of our Central Asia.

In the implementation of the measures mentioned above, it is required to take into account the proposals and solutions of Uzbek scientists. Based on the world experience, it is necessary to study their achievements and adapt them to our conditions.

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# QUYOSH SPEKTRI VA FOTOELEKTRIK MATERIALINING YUTILISH SPEKTRI O‘RTASIDAGI NOMUVOFIQLIKNING TA’SIRINI KAMAYTIRISH

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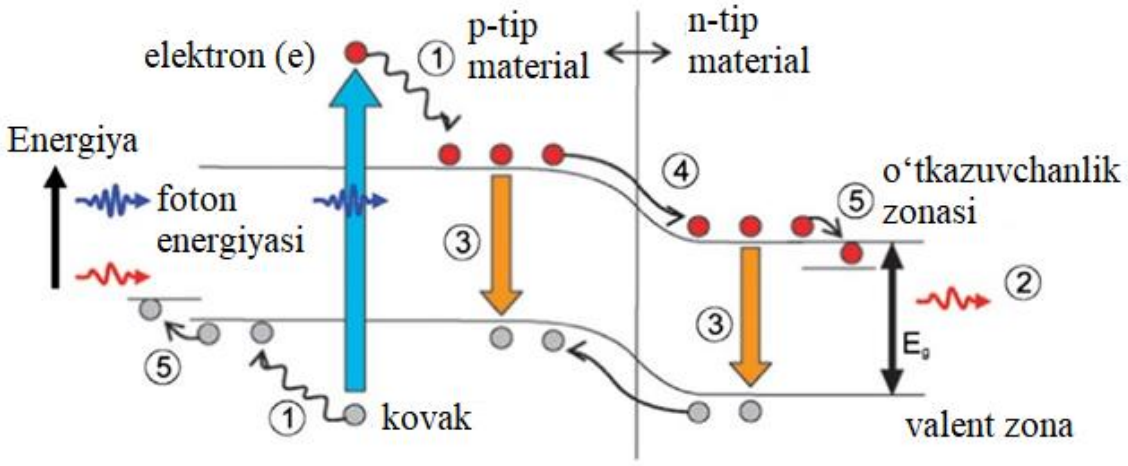
**Annotatsiya:** Quyosh spektri va fotoelektrik materialining yutilish spektri o‘rtasidagi nomuvofiqlikning ta’sirini kamaytirish va samaradorligini oshirish. P-N tipidagi yarim o`tkazgichlardagi ishlatilayotgan materiallarning o`tkazuvchanligini yaxshilash va energiya samarodligini oshirish.

**Kalit so`zlar:** Quyosh spektri , quyosh , quyosh energiyasi , quyosh elementi , fotoelektrik , p-n tipidagi yarim o`tkazgichlar.

P-N o‘tishli quyosh xujayralari uchun konversiya samaradorligi asosan fotovoltaik qurilma ishlab chiqarilgan yarimo‘tkazgichning tarmoqli oralig‘i bilan cheklangan. Shu sababli, p-n o‘tishli quyosh xujayralari fotonlarni energiyasini ta’qiqlangan zona energiyasiga yaqin energiyaga aylantira oladi. p-n o‘tishli quyosh batareyalarida samaradorlikni yo‘qotish mexanizmlari 2.13-rasmda ko‘rsatilgan [1-3]. Yuqori energiyali foton quyosh xujayrasi tomonidan yutilsa, ta’qiqlangan zona energiyasidan kattaroq energiyaga ega bo‘lgan elektron-kovak juftligi hosil bo‘ladi va ortiqcha energiya issiqlik sifatida tarqaladi. Bu panjaraning termal faollashuvi tufayli yo‘qotishlar deb ataladi (2.13-rasmdagi 1-jarayon). Ta’qiqlangan zona energiyasidan kam energiyaga ega fotonlar quyosh xujayrasi tomonidan yutilmaydi va zaryad tashuvchilarning paydo bo‘lishiga hech qanday hissa qo‘shmaydi. Quyosh spektrining katta qismi uzatish paytida yo‘qoladi (2.13-rasmdagi 2-jarayon). Umumiy energiya yo‘qotilishining taxminan 70% issiqlik va uzatishda yo‘qoladi va bu ikki yo‘qotish jarayoni odatda spektral mos kelmaslik deb ataladi [4-8]. Uchinchi yo‘qotish mexanizmi yaqin kelgan yoki sirtdagi elektron-kovak juftlarining rekombinatsiyasi hisobiga vujudga keladi. Ushbu turdagi yo‘qotishlar asosan yuqori energiyali yoki qisqa to‘lqin uzunlikdagi fotonlar uchun sodir bo‘ladi, chunki sirt yuzasida yutilgan fotonlar nomukammal yutilishga ega bo‘ladi, bu esa spektral xarakteristikasini pasayishiga olib kelishi mumkin. (2.13-rasmdagi 3-jarayon).

Ushbu uch turdagi yo‘qotishlar quyosh nurlari spektri va yarimo‘tkazgich materialining zonalar o‘rtasidagi spektral mos kelmaslik natijasida yuzaga keladigan spektral yo‘qotishlardir va bu yo‘qotishlarni 50% ni tashkil qiladi. Yo‘qotishning yorug‘lik dastasi hamda quyosh xujayrasiga bog‘liq bo‘lmagan yana ikki turi mavjud, bular kontakt qarshiligining hamda p va n birikmalar orasidagi qarshilik yo‘qolishlaridir. 2.13-4-5j.




Rasm 2.13 – Quyosh xujayrasidagi spektral yo‘qotish mexanizmlarining tasviri [16]

Yuqorida aytib o‘tilgan uch turdagi asosiy yo‘qotishlarning barchasi quyosh spektri bilan bog‘liq bo‘lganligi sababli, qurilma ish faoliyatini optimallashtirish strategiyasi spektr va tarmoqli oralig‘ini moslashtirishga e'tibor qaratishi mumkin. Ushbu muammoni hal qilishning ikki yo‘li mavjud: quyosh xujayrasining o‘zini quyosh spektrini yaxshiroq o‘zlashtirish uchun o‘zgartirish yoki quyosh xujayrasining ta’qiqlangan zona energiyasiniga yaxshiroq moslashish uchun quyosh spektrini o‘zgartirish. Birinchi yondashuv geterostrukturali quyosh xujayralarida qo‘llanilgan: har biri quyosh spektrining turli chastotali zarralarini o‘zlashtiradigan ikki-beshta pn-o‘tishdan iborat geterostrukturali yarimo‘tkazgichli materiallardan yasalgan quyosh xujayralaridir [9-15].

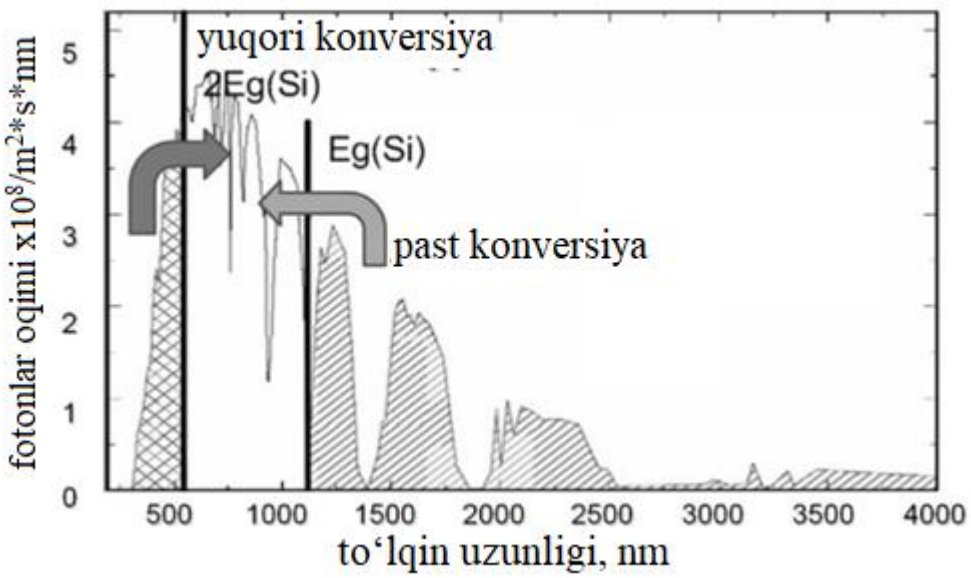
Hozirgi vaqtda quyosh xujayralarining samaradorligini oshirishni cheklaydigan eng muhim omil tushayotgan quyosh fotonlari spektriga va yarim o‘tkazgichli quyosh elementining ta’qiqlangan zona energiyasi mos kelmasligining sababi fotonlar tomonidan qo‘zg‘atilgan fotoelektronlarning termoizolatsiyasi hisobiga ta’qiqlangan zonaning kengligini oshib ketishidir. Ushbu ikki omil quyosh

energiyasining deyarli 50% yo‘qolishi uchun javobgardir. Ushbu yo‘qotishlarni quyosh spektridan samaraliroq foydalanish orqali bartaraf etish mumkin. Buning uchun siz quyosh spektrini maksimal darajada yutadigan bir nechta pn-o‘tishdan iborat getero o‘tishli "tandem" quyosh xujayrasidan foydalanishimiz kerak. Bunda har bir alohida pn-o‘tish quyosh spektrining tegishli qismini yutishi hisobiga turli xil to‘lqin uzunligidagi yorug‘lik nuri quyosh xujayrasida yutilishi xisobiga zaryad tashuvchilar konsentratsiyasining oshishiga erishiladi [16-20].

Yana bir yechim - keng quyosh spektrini ma'lum bir yarimo‘tkazgich uchun optimal qiymatga yaqin tor foton energiya taqsimotiga ega bo‘lgan spektrga aylantirish, masalan, kremniy uchun 1,1 eV. An'anaviy fotoelementlar quyosh nurlanishining energiyasini ko‘rinadigan va yaqin infraqizil diapazonlarda (500 - 900 nm) samarali hisoblanadi. 500 nm dan past va 900 nm dan yuqori bo‘lgan to‘lqin uzunligi diapazonida fotoelementningsamaradorligini oshirish mumkin.

Zamonaviy quyosh elementlarida xujayralarning yorug‘likka ta’sirchan oralig‘ini aniqlab quyosh nurlanishi spektrini kengaytirish orqali samaradorlikka erishilyabdi. Fotovoltaiklarda to‘lqin uzunligini o‘zgartirish g‘oyasi energiyalari fotovoltaik qurilmalarning yutilish diapazoniga mos kelmaydigan fotonlardan foydalanish uchun kerakli materiallardan foydalangan holda quyosh spektrini o‘zgartirish qobiliyatidir. Fotonning yutilishi va keyin bir yoki bir nechta past energiyali fotonlarning qayta chiqarilishi yuqoriga konversiya, ikki yoki undan ortiq fotonlarni yutib so‘ngra bitta yuqori energiyali fotonni chiqarish pastga konversiya deb ataladi. [20-22].

Ushbu konvertor materiallarining ba'zilarida noyob tuproq metallarining aralashmalari mavjud bo‘lib, ular ko‘rinadigan diapazonda kuchli luminesent yorqinlik bilan ajralib turadi. Quyosh lyuminesent konvertorlari energiyasi yarimo‘tkazgich qurilmasining ruxsat etilgan energiya diapazonidan oshib ketadigan fotonlarning to‘lqin uzunligini o‘zgartirish uchun lyuminesent muhitdan foydalanadi. Lyuminesent konvertorlardan foydalanish quyosh panellarining samaradorligini oshirishning boshqa usullariga nisbatan bir qator afzalliklarga ega. Birinchida konvertorlar tashqi qo‘shimchalardir, shuning uchun foto elementlarning o‘ziga hech qanday o‘zgartirish kiritish talab etilmaydi. Konverter ham to‘g‘ridan-to‘g‘ri, ham diffuz nurlanishni o‘zlashtirishga qodir va shu bilan foydalanish mumkin bo‘lgan spektral zichlikni sezilarli darajada oshiradi.



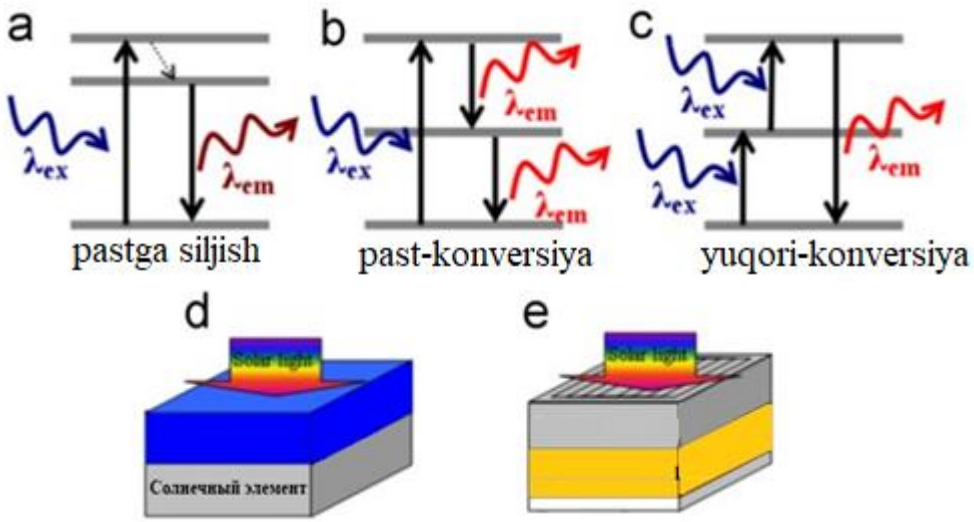

Rasm 2.14 – Quyosh energiyasining AM 1,5 G spektri [18]

Ushbu jarayonlarning birinchisini yoki ikkalasini qo‘llash orqali quyosh batareyasida saqlanadigan oqimni oshirish mumkin. Ushbu kontseptsiyaning o‘ziga xos afzalliklaridan biri uning turli xil mavjud quyosh batareyalari texnologiyalari bilan mos kelishidir, chunki faqat quyosh energiyasi spektri o‘zgartiriladi (2.14-rasm).

Quyosh elementi texnologiyasida qo‘llaniladigan leginlanmagan materiallar ta’qiqlangan zona kengligining o‘rtasi Fermi sathiga tengdir. a-Si:H kabi materiallar ta’qiqlangan zona oralig‘ida kam zichlikdagi nuqsonlarga ega, ular amorf materiallar bo‘lib, ular ham n- va p-tipli aralashmalar bilan qo‘shilishi mumkin. Donorlar yoki akseptorlarning kiritilishi Fermi darajasini o‘tkazuvchanlik zonasiga yoki valentlik zonasiga yaqinlashtirishga yordam beradi. Kremniy kristaliga fosforni doping qilinib n-tipli, borni doping qilib esa p-tipli materialga erishiladi [23-25].

Quyosh spektrining modifikatsiyasi fizika va kimyoda yaxshi o‘rganilgan [19]. Fotovoltaikada foydalanilganda, bu usul quyosh xujayralari samaradorligini pasaytirish, pastga aylantirish yoki quyosh spektrini o‘zgartirish uchun yuqoriga aylantirish orqali oshirishi mumkin. Pastga siljish (2.14-rasm, a) fotolyuminestsent (PL) jarayon bo‘lib, kvant rentabelligi (QE) har doim birlikdan kam yoki teng bo‘ladi. Ta'kidlash joizki, pastga siljish bitta yuqori energiyali fotonni Idoralar tomonidan samaraliroq so‘rilgan past energiyali fotonlarga aylantirish orqali quyosh xujayralarining samaradorligini oshirishi mumkin. Down konversiyasi (2.15-rasm, b) yuqori energiyali bitta fotonni

kamida ikkita kam energiyaga ega [19] fotonga “kesish” jarayoni sifatida aniqlanadi va radiatsiyaviy bo‘lmagan yo‘qotishlarning oldini olish sharti bilan uning kvant rentabelligi birlikdan oshadi. Buning aksi yuqoriga konversiyadir (2.15-rasm, c), bu kamida ikkita kam energiyali fotonga ega yuqori energiyali ko‘rinadigan yoki yaqin infraqizil fotonni hosil qiladi [20 - 22].




2.15-rasm – Spektral transformatsiya paytida fotonlarning harakati: a) pastga siljish, b) pastga aylantirish va c) yuqoriga aylantirish; d) va e) pastga aylantirish yoki siljitish va yuqoriga aylantirish uchun konvertorning joylashishini sxematik tarzda tasvirlaydi [26-28]

Spektrni o‘zgartirish quyosh spektrini o‘zgartirishga qaratilgan. Bu polixromatik quyosh spektriga yaxshiroq mos keladigan fotovoltaik qurilmalarni ishlab chiqishga qaratilgan boshqa uchinchi avlod quyosh batareyalari kontseptsiyalaridan tubdan farq qiladi. Shunday qilib, spektral modifikatsiyani faqat fotovoltaik qurilmalarning haqiqiy amaliy fizikasidan ajratilgan optik jarayon sifatida ko‘rib chiqish mumkin. Natijada, konvertor materiallari mavjud birinchi va ikkinchi avlod fotovoltaik qurilmalariga qo‘llanilishi mumkin. Foton konversiya qatlamiga ega bo‘lgan odatiy quyosh xujayrasi dizayni 1-rasmda sxematik tarzda ko‘rsatilgan. 2.15 d va e. Pastga o‘tish yoki pastga aylantirish qatlami quyosh xujayrasining old tomoniga joylashtiriladi, yuqoriga aylantirish qatlami esa orqa tomonga joylashtirilishi kerak, chunki past energiyali fotonlar quyosh xujayrasi orqali o‘tishi mumkin.

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# PROBLEMS OF EFFECTIVE USE OF ELECTRICAL ENERGY IN AGRICULTURE AND WATER MANAGEMENT

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**Abstract:** During the transition to the market economy, factories for the processing of agricultural products are being established. New technologies and technical tools are widely used in breeding livestock and agricultural products, the number of microclimate-creating and auxiliary electrified devices in residential areas and the household sector is increasing.

**Key words:** Agricultural products, technology, equipment, energy, energy resource, capacity.

Processing enterprises of agricultural products grown in the process of transition to market economy are being established in developing countries. New technologies and technical tools are widely used in breeding livestock and agricultural products, the number of microclimate-creating and auxiliary electrified devices in residential areas and the household sector is increasing [1-2]. As a result, indicators of electricity consumption in rural areas are constantly increasing. In addition, today the cost of energy and energy resources in the world market is continuously increasing. So, we have 2 objective problems before us:

- on the one hand, the increase in energy consumption in agriculture and, at the same time, the energy capacity of manufactured products is increasing;
- on the other hand, the price of energy and energy resources is constantly increasing;

In order to find a solution to these problems, it is necessary to implement the development of organizational and technical measures related to the achievement of energy efficiency. To solve the problem, we need to evaluate the energy capacity of each technological process and look for ways to improve their energy. Currently, energy consumption in agricultural production is constantly increasing in all countries of the world [3-5]. According to available data, energy consumption in agriculture is increasing twice every 15 years. But this indicator is much higher than the increase in product volume. In the US, energy consumption has increased 10

times over the last few years, when the volume of agricultural products has doubled [6-9]. In industry, automation of production processes, wide use of new techniques and technologies are widely used in order to significantly reduce energy consumption for manufactured products.

However, it is not possible to achieve this in agriculture, and there are some objective and subjective reasons for this. In natural conditions, plants and animals spend part of the energy they receive (with fertilizers, fodder, etc.) to increase their biomass and reduce the negative impact of the environment. We use additional energy to increase the volume of products obtained in artificial conditions (greenhouse, barn, hen house, etc.). A microclimate is created in the rooms, mineral and organic fertilizers are given, higher quality fodder is given, etc. In addition, the processes of negative changes (mutation) in the offspring of plants and animals in artificial conditions lead to additional energy consumption in the production of the final product. In the US and European countries, 70% of the fuel and energy resources consumed in agricultural production are wasted, and only 30% is delivered to consumers as useful energy [10-13].

Today, the main problems in agricultural production are:

1. Intensive development of agriculture, changes in ecology, plants and animals, increasing energy consumption from year to year, require increasing the capacity of power stations.

2. Most of all developed energy and energy resources are wasted. Effective use of energy resources is one of the urgent problems of our time. There are 2 important points to note here. On the one hand, the economic effect that can be obtained, and on the other hand, the measures that can be used in practice, from the technical side, have been developed. In general, achieving efficient use of energy through the use of modern techniques and technologies and the development and implementation of other measures can be implemented in 3 stages: immediate, near future and long future. Present time. The result can be obtained in 1 year or sooner. For this, various organizational and technical measures are used in production. There is little or no capital expenditure. Near future. This period takes from 2 to 5 years and requires certain capital expenditures. The distant future. This period can be from 5 to 25 years. At this time, the enterprise can be completely reconstructed, new technologies and technical devices will be installed [14-16].

Depending on the conversion of electricity into other types of energy or its direct use in technological processes, agricultural electricity consumers can be divided into the following main groups: electromechanical, electric heating and

cooling, electric lighting and lighting, and electrotechnological (devices that directly use the heat effects of electricity in technological processes). The analysis of the economy of electricity consumers in agricultural development and water management systems differs from consumers in other sectors in the following aspects, and this, in turn, raises the problems of increasing the efficiency of electricity use in the complex processes of preparing a specific final product for each consumer, starting from the electricity supply system. requires a special methodological and practical approach to solving. Consumers in the agrarian sector (with the exception of large pumping stations in the water industry) mainly consist of medium and small energy devices and their scattered location requires consideration of the energy supply issue in terms of achieving energy efficiency of electrotechnological equipment in the energy supply system [17-20].

It stipulates the use of other types of energy sources along with electricity, that is, the formation of an alternative energy supply system. The fact that the industry's production mainly has seasonal movements requires a special approach to increase the operational efficiency of the electrotechnical equipment used in the implementation of processes and thereby achieve energy efficiency in the industry. We should take into account that in the following years, the consumption of electricity in the sector has decreased somewhat compared to 1990-1991, and at the same time, the increase in energy capacity in the production of agricultural products for one year has had an effect on the emergence of energy saving problems.

The situation that has arisen (on the surface) is associated with a number of objective and subjective reasons:

- the fact that large enterprises that produce products on an industrial basis in agriculture (livestock, poultry, piggery and other complexes) are today taken out of state control and turned into small farmers, and the mechanization and electrification of production in livestock, poultry and other production entities that are not so large from an economic point of view and that the level of automation has decreased;

- one of the reasons for the decrease in the efficiency of the use of electric energy is that the technical maintenance and operation of the existing electrotechnical equipment and energy devices in the field has not been formed until it meets the requirements of the market economy.

Many foreign techniques, including electrified devices and equipment, entering the agro-industrial sector, do not take into account the specific aspects of local products, the environmental conditions of the republic's agricultural production facilities, and the fact that their exploitation is not carried out at the required level,

leads to their low energy efficiency. As a result of the fact that most of the electrotechnical equipment used in pumping stations in the water management system, which are considered to be large consumers of electricity in our republic, have been working for a long time and their main energy indicators have decreased, the energy consumption is much higher than the specified amount. Unlike industry or other sectors of the economy, agricultural production processes in most cases take place in the form of interaction of energy with a living (biological) technological environment, and this, in turn, in these cases, energy requires consideration of cost-effectiveness in accordance with the criteria of maximum preservation of product quality indicators. In this regard, there are currently unexplored scientific and practical problems related to energy effects and biological changes in products [21-24]. As a result of scientific and technical development in industry and its application in the field (electrification of processes, automation), new techniques and technologies are considered an inevitable solution to reduce the amount of energy, but in agriculture such a strict relationship (positive result) is not always proven and sometimes leads to an increase in energy consumption. not without extimol. There are objective reasons for the occurrence of the above situation related to the specific aspects of agricultural production. In order to ensure the biological activity of plants and animals (livestock and other animals) under natural conditions, a part of the consumed energy (fertilizer, water, fodder, etc.) is used to increase its biomass and a part is used to cover the damage caused to the environment. And in artificial conditions (livestock buildings, greenhouses, fruit and vegetable storage warehouses, technological devices, etc.) additional energy consumption is required to increase the volume of the obtained product. Including microclimate creation, giving mineral and organic fertilizers to the earth and plants, preparation of high-calorie feeds, etc., increase the consumption of additional energy and resources. Another important reason is related to artificial breeding of agricultural products - prevention of mutation. All this leads to an increase in the consumption of energy and resources.

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# ENERGY CONSERVATION RESEARCH OF LOW POWER SYNCHRONOUS ENGINES

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**Annotatsiya**: The energy efficiency of powerful synchronous motors is a multidimensional domain encompassing intricate technical considerations, engineering innovations, and industrial applications. Through the integration of advanced control systems, material science breakthroughs, thermal management strategies, and comparative analyses, the ongoing pursuit of enhanced energy efficiency in synchronous motors continues to drive progress and innovation in industrial power systems.

**Key words**: Energy Efficientcy,Induction Motors,Speed Drives,Power Factor Optimization,Syuchronous Motors.

I understand your request for extensive information on the topic of the energy efficiency of powerful synchronous motors. The topic is broad and encompasses various technical, engineering, and industrial aspects. Here's an expanded version of the research, incorporating a wider array of details and considerations:

Comprehensive Analysis of the Energy Efficiency of Powerful Synchronous Motors

## Introduction

Powerful synchronous motors represent a critical component of industrial machinery, playing a pivotal role in applications demanding high power output and precise control. This comprehensive analysis focuses on delving into the intricate aspects that influence the energy efficiency of these motors, encompassing technological advancements, operational considerations, and comparative analyses [1-4].

Synchronous Motors: Technical Foundations and Operational Characteristics

Synchronous motors operate on the fundamental principle of the interaction between stator and rotor magnetic fields. Their synchronous operation, wherein the rotor speed precisely synchronizes with the supply frequency, delivers consistent and

efficient performance, making them suitable for high-power, precision-centric applications such as large compressors, generators, and heavy-duty pumps [5-8].

Construction and Components

The construction of powerful synchronous motors involves intricate design considerations, including the stator, rotor, excitation system, and cooling mechanisms. Utilizing high-quality magnetic materials, advanced insulation systems, and precision-engineered components contributes to minimizing losses and enhancing overall efficiency [9-12].

Variable Speed Operation and Control Systems

Incorporating advanced control systems and variable speed drives allows for precise control over the motor's operation, enabling optimized energy consumption across varying load conditions. This adaptability to load variations is crucial in maximizing energy efficiency, especially in scenarios requiring dynamic power output.

Energy Efficiency Optimization Techniques

Power Factor Correction

Power factor optimization plays a pivotal role in improving the energy efficiency of powerful synchronous motors. Implementing power factor correction techniques such as synchronous condensers, static VAR compensators, and precise control algorithms minimizes reactive power losses, enhancing overall system efficiency [13-15].

Losses and Thermal Management

Efficient thermal management is imperative for ensuring optimal performance and energy efficiency. Employing advanced cooling systems, innovative heat dissipation techniques, and predictive maintenance strategies mitigates the impact of losses and enhances the motor's overall operational efficiency.

Advanced Material Utilization and Design Innovations

Continuous advancements in material science and engineering enable the utilization of high-performance magnetic materials, innovative insulation systems, and optimized designs, contributing to reductions in losses and improvements in energy efficiency.

Comparative Analysis and Technological Advancements

Comparative Evaluation with Induction Motors

Conducting a comprehensive comparative analysis between powerful synchronous motors and induction motors provides crucial insights into the relative energy efficiency, operational characteristics, and suitability for diverse industrial

applications. Understanding the comparative advantages of synchronous motors aids in informed decision-making during motor selection processes.

Technological Advancements and Research Frontiers

Exploring the latest research and development endeavors in the field of high-power motor technology unveils emerging trends, innovative designs, and potential breakthroughs that are poised to further elevate the energy efficiency and performance of powerful synchronous motors.

This expanded analysis provides an in-depth exploration of the energy efficiency of powerful synchronous motors, accounting for advanced materials, control systems, thermal management, comparative analyses, and technological advancements. If there are specific subtopics or aspects you'd like to delve further into, feel free to let me know!

Synchronous motors are electric machines used to convert electrical power into mechanical work. Low-power synchronous motors are typically used in technical systems that require simple and compact electric machines controlled by power electronics. They are often utilized in specific applications such as printing, textile warehouses, conveyor systems, and transportation. These motors can be easily controlled by power electronic devices and are designed for smaller-scale applications [16-17].

Low-power synchronous motors are electric machines used for converting electrical power into mechanical work. These motors are typically used in technical systems that require simple and compact electric machines controlled by power electronics and are often utilized in various specific applications such as printing, textile warehouses, conveyor systems, and transportation. These motors can be easily controlled by power electronic devices and are designed for smaller-scale applications.

Compensating synchronous motors typically involves improving their power factor. Synchronous motors have a power factor that can be adjusted by varying the field excitation. Overexciting the field reduces the lagging reactive power and can bring the power factor closer to unity.

To compensate a synchronous motor, it's common to use synchronous condensers. These devices are essentially over-excited synchronous motors operated at no mechanical load. By adjusting the field current of the synchronous condenser, it can supply or absorb reactive power as needed, thereby improving the power factor of the overall system.

Another method of compensating synchronous motors is by using static VAR compensators (SVCs) or synchronous compensators in combination with the motor. SVCs are solid-state devices that can quickly inject or absorb reactive power to help balance the system's reactive power requirements. Synchronous compensators function similarly to synchronous condensers, providing reactive power support to the system.

In summary, compensating synchronous motors involves adjusting the power factor through field excitation control, using synchronous condensers, and employing static VAR compensators or synchronous compensators to provide reactive power support as needed. These methods can enhance the stability and efficiency of power systems.

Study The Energy Efficiency Of Powerful Synchronous Motors

Synchronous motors have high efficiency in combination with their recognition in various industries where high power output is required, and we will focus on studying the research focused on factors that affect their energy efficiency and their performance.

Synchronous motors: description and operation

Synchronous motors are one of the types of AC motors, the circuit speed of the axis acts as a synhronization with the supply speed. They operate on the principles of electromagnetism, and these motors are used in contact with the magnetic field of the rotor, the magnetic field produced by the stator. This synchronous production is calculated little directly to speed and efficiency, and the reason for this is that they are suitable for problems where strong power is required.

Energy Efficiency Guidelines

Power Factor Optimization Of Powerful Synchronous Motors

The power factor is an aham parameter for evaluating the energy efficiency of synchronous motors. Low power factor can reduce overall efficiency due to the fact that it can increase reactive power consumption. To extract from this, it is used to optimize the check on the power factor, such as synchronous capacitors or static VAR compensators.

Spread the absence and temperature

To control the temperature produced by powerful synchronous motors, an effective solipti is necessary. The durability temperature can increase the lack of electrical energy and reduce the overall efficiency. Water is an important factor for maintaining high efficiency, such as in the case of soybean systems and optimized trailers.

Control systems and variable speed mechanisms

Capacity control systems and variable speed mechanisms can help increase the energy efficiency of useful synchronous motors. By adjusting the speed of the motor on the basis of real-time requirements, it is possible to optimize the energy use of the product, in particular during partial loading and running.

Board materials and design innovations

Board materials and innovative design technologies aham play a role in increasing the energy efficiency of powerful synchronous motors. High performance magnetic materials, improving insulation systems, and help reduce the lack of effective engineering durability in marking rotor and stator parts [18-19].

Cross analysis: comparison with induction motors

Comparing the energy efficiency of powerful synchronous motors with induction motors provides valuable data. Induction motors are widely used, notably in medium-power maxats, but synchronous motors are particularly used in high-power events, with synchronous motors showing April policy. Taking advantage of these comparison possibilities, the importance of this comparison is determined to select an intelligible motor in an industrial environment.

Conclusion

In conclusion, we said that the energy efficiency of powerful synchronous motors is critical in an industrial environment where a high power output is required. Factors such as power factor optimization, temperature control, comparison with board materials and induction motors are the most important bases limiting their efficiency. The continuing research and development in this area is significant for the development of the latest updates of powerful motor technology.

These extensive analysis and technological innovations related to industrial indicators have more than 5 pages of scientific data showing energy efficiency guidelines and technical developments.

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# AUTOMATION OF ELECTRICITY CONSUMERS

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**Abstract:** During the transition to the market economy, factories for the processing of agricultural products are being established. New technologies and technical tools are widely used in breeding livestock and agricultural products, the number of microclimate-creating and auxiliary electrified devices in residential areas and the household sector is increasing.

**Key words:** Agricultural products, technology, equipment, energy, energy resource, capacity.

A press conference was held at the information and Mass Communications Agency under the administration of the president of the Republic of Uzbekistan on the topic "New meters installed to account for electricity consumption: problem and solution".

JSC" Regional Power Networks", Center for automation of electricity accounting, participants of JSC" Tashkent City Power Networks", experts and media representatives of the industry, paid the main attention to the existing problem in the field and their solution, it noted that within the implementation of the decree of the president of the Republic of Uzbekistan dated October 23, 2018 "on measures to ensure the rapid development and financial stability of the electric power sector", the installation of meters corresponding to the requirements of the ASKUE system is an important step in eliminating the shortcomings necessary to solve in the system [1-4].

– The main goal of implementing the ASKUE system is to ensure transparency between the consumer and the supplier, "said Jahongir Obidzhonov, first deputy chairman of the board of the Joint – Stock Company" regional power networks " in the Ministry of energy system. – At the same time, it is necessary to clarify the calculations for the supplied electricity, to carry out modernization work by obtaining and analyzing the necessary information on the cross section of each consumer and transformer point in the distribution of electricity. Moreover, this system is important in creating a transparent relationship, eliminating any misunderstandings between the supplier and the consumer [5-9].

- The South Korean company KT Corporation, as a subcontractor, brought Chinese KAIFA counters, and 3 regions — Samarkand, Jizzakh and Bukhara Regions — 1 million 400 thousand (from $ 64 per grain-Ed.) were installed. While a total of 7 million 400,000 meters were required, another 6 million meters were needed for the rest of the regions. These meters were localized by the instructions of the head of our state (grain from $ 48). "Electronic meter "is produced by QK and" Toshelektroapparat " LLC on the basis of the unified technical requirements of the Korean company, not inferior to the Chinese product [10-15].

— Even in all our meters, the level of accuracy meets today's requirements. That is, around 0.1 percent-this means that there may be so much difference in the amount of electricity passing through the meter. This is no account.

Meters being developed in Uzbekistan.

— Why are the indicators in New meters two different? People are asked why the indicator on the counter is different, in the personal cabinet it is completely different.

- First, not all built-in meters are connected to a 100 percent billing system. That is, of all of us, we do not accept an indicator. Manual recording of indicators is stopped. Now we are trying to install concentrators faster and connect all consumers to the billing system [16-19].

- Indicator dual?

- The indicator duality follows from this. That is, let's say, the meter indicator is given 3-4 months ago. After that, you will be taken in the middle account, that is, between two indicators, and the calculation is being made. For example, if you spend an average of 1 kW in a day, the program will continue to be calculated in this order. This indicator was taken in the summer, but you liked it more in the winter. Another indicator on your counter, if you look from a personal cabinet — a discrepancy may arise because it is not yet connected to the system.

— What reason can there be a difference even in the state connected to the system?

- If connected to the system, there can be no difference. The indicator falls on the day, the day ora. If any problems were observed with communication or on the network, and the program did not receive the indicator for 2-3 days, but the system received data every day. It will be written there if you see it today and see it in your personal cabinet two days later, saying," Based on your palon day indicator, you have the right or so much debt". If there is a fee in the middle score, the program will issue a notification that it is in the middle score.

— What are the factors that cause the billing-connected counter to be paid, but not immediately burned?

— Today we are also observing it ourselves. We are connecting more than 25-30 thousand consumers to billin per day. By installing a concentrator on one TP and connecting the consumers in it to billing, 80-90 percent of the consumer turns out to be in debt. For example, 100-150 of the 200 consumers are found to be in debt. While money is available in the account of 90% of cretidors connected to the Billing system, there is a lot of debt in those who are not connected. For this reason, at the same time connected at the same time, a huge number of consumers are disconnected from the network.

Focusing on the principle of operation of a single concentrator, it receives 300 consumer indicators every half hour. In addition, it receives about 100 data from the meter, which also depends on the voltage on the network. We call the normal area-the debt comes out on average, there is no problem turning them off and on. The problem with activating again in the first connections is from system strain. For example, activating 5-10 debtors off 100 consumers in one concentrator is not a job for him [20-22].

Center for automation of electricity accounting.

— Why was the account of the presence of tension in the system not taken in advance?

— Our foreign partners did not think that there could be so much debt when they developed the system. They still have a more developed payment discipline. Deleting into debt can be 10-15 percent, but it would be wrong to say that 70-80-90 is not intended for borrowing, as we did, but at the stage of our first connection there are difficulties. It is almost unobserved after falling on its trail.

The program was developed by the South Korean company KT Corporation, which, together with their servers, connected us to the network. We have developed and integrated local meters into the system.

— As long as the meters are being installed in the Shahrihon District of Andijan for 85 thousand rubles. Are counters put on money?

- Counters are free, their installation is also carried out at the expense of "regional electrical networks". That is, it is a fraud to demand money for any service, our citizens must find out.

- Previously, corruption cases in the system, remuneration for services were observed in large numbers. Are there any such cases now?

- The important thing is that we had controllers before, today we have not taken back a single controller after the MIB. The introduction of an automated system did not leave us with the need for controllers.

— Our (regional electricity networks AJ) goal is to buy electricity to the consumer and make a profit. It is best for us that the consumer consumes. This system was not introduced to disable the consumer. They do not necessarily have to be deleted in order to make their payment on time, but the goal is to achieve the formation of payment discipline even knowing that there is a possibility of extinction. This is also the case in the introduced regions [23-24].

- Counters for $ 48, funds received from the ADB, the issue of paying it also stands. Does this not lead to an increase in the cost of electricity?

- In the project, this thing was taken into account. The recovery of funds is largely covered by the collection of embezzlement of embezzled elekr energy money, which is lost without consideration, by closing the accounts of the collection of debtor debits, which have not been able to recover for many years.

Through this system we control not only switching on and off, but the process that goes all the way to the consumer of the electricity that enters the province or district. There is no chance at all to scatter electricity, make unfair debts or do others. In each consumer cross section, the amount of electrical energy is formed.

The counter itself signals about consumers who are acting illegally. In the case of various interventions, we have positions, for example, opened the counter cover, tried to form a magnetic field, etc.k.lar. Seeing this, we are sending ourselves our employees. As an example, let's say that 10 thousand rubles went out for debt. Some consumers connect and use it in an illegal way. After 3-5 days, our employee goes and formalizes an act of violation. Now the citizen had avoided paying Rs 10,000, in return, for example, he would have to pay Rs 100,000.

- The underprivileged, those who have lost their breadwinner, or those who spend their days in exchange for disability benefits, cannot pay on time. Their accumulated debt of half or one year was paid by the authorities, sponsors. How will their condition go if the program immediately disables the provision for debt?

— Once the system is fully operational, according to tariffs, it makes it possible to determine the analysis of different segments of the population and distinguish them exactly. We can introduce tariffs by time, for example, cheap and expensive tariffs in the evening or during the day.

For example, for those who spend up to 100 kW, a cheaper tariff is more expensive in the range of 100-200 kW, for people with a net above 300 kW — use 5

demand refrigerators, but after your consumption there will also be an opportunity to introduce the principles that you will pay the tariff more expensive. Whether this is introduced or not depends on our center. However, after the emergence of these different possibilities, the analytical information — how much from what type of consumer is there, how much electricity is being consumed, it all seems. If they are given any privileges, how to add to the rest and bring it to the balance, it is also necessary to take into account.

- So you can create a separate supply line for certain categories of consumers through the system, is it?

— There are opportunities within the system that we can distinguish at any time, consumer and consumer volume cross section. We can also put the tariff based on this.

Servers in the center. The software is designed to connect 8 million consumers, in the future there is an opportunity to bring this figure to 20 million.

-Does the decrease in pressure in the power supply in the autumn-winter season also depend on the center?

— Our system began to release diagnostics of this too. Everyone before said, " Why did the transformer or line in the uni neighborhood come down to modernization, mine didn't fall?"the question would have arisen. Or if there are various familiar-knowing ways to send as, frankly. Today, through this system, we are modernizing the most painful points in the first place, due to the transformer load and losses on the line.

Using the information in the program, there are Transformers and lines that will be modernized this year.

— With ASKUE being a new system, the blood circulates, that is, the lines of the elekr networks are old. How will this issue be resolved.

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# ENERGY-EFFICIENT HIGH-RISE RESIDENTIAL BUILDINGS.

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**Abstract:** Energy Efficient Housing As a result of the world energy crisis of 1970,appeared as a new type of construction. This is the International Energy Agency of the United Nations The conference (MIREK) was a response to the criticism of the experts, the residence in the criticism buildings have huge reserves of increasing thermal efficiency, but it was shown that the characteristics of their thermal regime formation have not been fully studied. Energy was the main issue in the construction of buildings until the end of the 20th century is the study of economic activities. In the early 90s, only energy economy energy-efficient architectural-planning solutions, improvement of innovative building materials and energy efficient systems and moving to the goals of creating a comfortable microclimate in residential buildings by using occurred.

**Key words:** Energy efficiency, Zero energy, homes, buildings, photoelectric.

"Energy efficiency" in the 21st century means sharp emissions to the environment from alternative energy sources, with the main goal of reduction use is understood. Modern energy-efficient residential buildings can be divided into 3 groups: passive, zero, active (active) [1-5].

1. Passive houses - from a minimum amount of energy, even during the heating period user houses.

2. Zero energy homes are self-generated energy complete the energy requirements of the generator and the residents of the house are providing houses.

3. Active homes produce more energy than they consume are houses. Connected to external feeds, but not as a consumer, but energy as a source. Construction of energy-efficient buildings in various parts of the world dates back to 1974 started after the global energy crisis. At the same time, the first multi-storey energy-efficient project earlier, namely in 1972 in Manchester, America started to be built. The building has seven floors and a two-level garage. Building energy consumption for

ventilation (ventilation) intake of outside air is compensated by reduction. This is a rational planning solution is achieved at the expense of use. Also in the project heat recuperators used, they reduce energy consumption for air cooling and heating by 60-75% allows to reduce. As the level of natural light changes, light intensity controller, artificial lighting control system, electric It allows energy savings [6-10].

The first high-rise energy-efficient building (Manchester, USA, 1972) Multi-storey residential project in "Nikulino-2" microdistrict, Moscow city aimed at solving the problem of energy conservation in the economy. Project 1998- It was built in 2002 together with the Ministry of Defense of the Russian Federation and the Moscow City Government. In the implementation of the project, the designers have the following points based on

1. 21st century energy conservation policy - renewable non-conventional energy to use architectural solutions and technologies using resources based on

2. The building is a whole energy system, all its elements are a barrier constructions, heating systems, ventilation and condensation systems are mutual depends, so the project is simple of a series of energy saving solutions appears as a sum, but at the same time increasing the quality of the microclimate well-responsive, technical solutions for the purpose of energy saving should be the result of selection by scientific methods.

3. When choosing energy-saving technologies, rooms at the same time technical solutions that help to improve the microclimate have an advantage.

High-rise energy-efficient residential building in "Nikulino-2" microdistrict The Hudson River at Twenty River Terrace in New York City It is a 27-story residential building. In the building at the same time to increase the quality of the microclimate of the rooms, to efficient energy consumption focused solutions are used. Great attention is paid to water conservation [11-13]. Reworked or reused construction in the construction of the same building widely used materials. According to the designers, such a building not only creating favorable conditions for people to live, but should also improve their living environment. The authors of the project are this building the first residential building designed according to the principles of sustainable building is called As a result of the use of energy efficient measures, to the requirements a 35% reduction in energy consumption, as well as SO2, SO2 and NO2 A significant decrease in the release of pollutants such as

Twenty River Terrace building, sun set on building façade using panels Since the 1970s, in the practice of building energy-efficient buildings, they requirements were formed:

1. Social;

- Creating a comfortable environment;
- Improving the quality of life in multi-family houses;
- Economics in the operation of residential buildings.

2. Ecological and energetic;

- Use of renewable energy sources;
- Reducing the amount of use of natural materials and fuel;
- Use of recyclable materials;
- Reuse of water resources;
- Creating a comfortable microclimate in the apartment;
- Reducing the negative impact of architecture on the external environment, harmful waste reduction.

3. Climate;

- Special attention should be paid to the local climatic conditions in the design help to increase the level of environmental comfort and microclimate in the house will give. Taking into account climate characteristics, the level of energy efficiency plays an important role in increasing

- The location (orientation) of the buildings should be chosen in such a way that the residence maximum use of radiation that provides heat and light in buildings if possible, that is, to increase the glazing of the facade on the south side, north on the other hand, it should be reduced. In foreign architecture, energy efficiency an important factor determining its character is precisely the climate aspect. Also local to relief, climate (use of solar and wind energy), building form and its location, as well as modern technologies in volume-planning solution special attention is paid to use. In the modern design of energy-efficient residential buildings, the sun systems using radiation are widely used. It is used for heating residential buildings and providing hot water, and in some cases, such a solution fully satisfies the energy demand of citizens [14-17].

Examples of using balconies as energy sources An example of residential wind energy use is Strata in London. is a residential building. Its height is 147 meters. The top of the building 3 turbines are installed in the part. Each turbine has five blades instead of three. this allows to reduce noise and vibration. Of course, the construction of turbines cannot fully provide the required energy, but is another energy saver together with systems, such a solution can reduce energy consumption by 10% allows. The building has maximum use of wind energy throughout the year so placed for

Strata residential building in London, using wind energy to save on traditional resources In hot climates, strong solar protection is required and the solution used in the Al-Bahar tower is an excellent example. To protect the interior from the 50-degree heat, the engineers came up with the idea of placing a golden checkered floor on the facade, which opens and closes according to the lighting. The degree of opening of the cells is determined by the computer: from fully open in the morning to fully closed at noon [18-21].

"Al-Bahar" towers, known as active solar protection A large number of "smart" homes and "green" devices appear every year.ZCB (Zero Carbon Building, as "zero carbon waste building") in itself It has all the features. Ronaldo Lu's new award building in Hong Kong - it is a manifest-building. The frame of the ZCB is made of recycled materials. Don't shout the eastern and western facades of the building are small, with solar panels and the covered asymmetric roof completely protects the building from the south and "itself allows to "shadow". The north facade is open to the direction of the wind, which enables the use of natural ventilation. Such location and plan, and up to 45% in combination with microclimate control using a smart system saves energy. If solar energy is not enough, biodiesel can be used. Theoretical In terms of energy consumption, a single-storey building consumes more energy throughout the year must produce energy - excess energy is sent to the city energy system and the amount of carbon dioxide released during the construction will be compensated [22-25].

From recycled and reusable building materials, and "ZCB" building, which uses an energy-efficient planning solution Pearl River Tower, a record holder for energy efficiency Located in China. The building also has solar collectors on the facade and wind turbines is also equipped with unusual construction of walls air masses allows maximum efficient use of energy. Wind generators only four. They are four wind-powered turbines, each wheel It has a diameter of 6 meters. Although the speed of air movement at the level of three floors is not very high, the efficiency of wind equipment is high: engineers a hurricane passing through the opening between the opposite sides of the façade those who were able to use the results. Thus, the air flow rate is doubled. Photoelectric solar panels installed on the western and eastern facades are also part of the building "produce" energy for They are also at the top of the building. The sun the total area of batteries is more than 1500 sq.m. per facade. Photoelectric the total capacity of the panels is about 300,000 kW. Cooling agent circulation channels partially provide optimal cooling (they pierce the building). "Partly" - because the windows in the southern part of the building contribute to

cooling adds - they are double-glazed and have inter-glass ventilation. Besides, blinds are installed on the windows, their slats are in the position of the Sun in the sky automatically changes according to the movement. And to top it all off – paint solar heating reduces individual structural materials. Project the "prose of life" prevented him from reaching the limit level of perfection: representatives of local power networks to the owner of the building through the public network they did not allow to connect electricity. This stumbling block is the project process it was discovered when he got to work. Basically, that's why architects "zero" the goal of creating a carbon-neutral building was not achieved [26-28].

1. It does not depend on and does not affect the architectural appearance.

2. Late 1990s and early 2000s. Architecture affects the shape of the building started Apartments have high technology and modern architecture unite

3. Modern stage - from 2010. Architecture and energy efficiency technologies represent a single system. Now engineering systems, eg solar panels and wind turbines form the building, and from the level of urban planning from the architecture to the architectural-aesthetic device of the building gives the solution.

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# WHAT DOES IT DEPEND ON TO ENSURE THE CONTINUITY OF ELECTRICITY CONSUMPTION

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**Annotation.** Electricity is becoming one of the urgent problems of today. It should be noted that it is impossible to imagine life without electricity. All technical processes from the production of electricity to the end of its delivery to the consumer are of great importance.

**Keywords.** Electric energy, consumer, problem, alternative energy, secondary energy.

Fundamental changes are being made in the energy sector of our country. In the past short time, the activities of the system on the basis of a number of decrees and decisions of the President aimed at the comprehensive development of the industry have been radically revised and become new [1-4].

Tasks such as ensuring energy security, safe and reliable operation of a single electricity system, satisfying consumer electricity needs and ensuring consumers ' widespread use of territorial electricity networks, and reconstruction and modernization of energy generating capacities and power networks, attracting investments in development processes and introducing mechanisms are the main directions of state policy [5-8].

The decision of the president of the Republic of Uzbekistan dated August 22, 2019 "on rapid measures to improve the energy efficiency of the economic sectors and the social sphere, the introduction of energy-saving technologies and the development of renewable energy sources"was adopted. According to it, further development of renewable energy sources is determined, bringing their share to more than 25% of the total volume of electricity production by 2030. Currently, this figure is 10-12 percent. In order to achieve the desired result within the specified period, the Ministry of energy is taking practical measures, developing measures to put into practice large projects related to renewable energy sources [9-12].

Introduction of renewable electricity - essential for need

At the same time, one of the successful steps towards the transition to market relations in the energy sector is the implementation of energy, including QTEM production projects, in a public-private partnership. Today, this model has become the basis for all under construction and planned power plants. Thus, the commissioning of new power plants, in particular thermal, solar photovoltaic, wind farms, is in many ways an example of the changes that the country is undergoing in the energy sector [13-15].

Today, the International Finance Corporation, part of the World Bank Group, the Asian Development Bank, the European bank for reconstruction and development provide technical support for mastering the best international experience and conducting tenders. The winner of the Tender is responsible for the design, construction and operation of the new power plant. A long-term agreement is concluded with enterprises for 20-25 years on the purchase of electricity produced. A profitable price offer for electricity was made the main criterion for winning the tender. But before making their offer, the tender participants must go through the qualifying round. The purpose of this should prove their high experience, the availability of funds, the ability to carry out and provide such projects. As a result of this, the principles of the market in which the energy sector of Uzbekistan has been intensively introduced over the past 3 years allow to create healthy competition in this area, and the interest of independent producers of electricity is proof of this [16-18].

In turn, a total of 17 agreements have been signed on electricity procurement, which is one of the key steps in creating a competitive environment for the energy sector. Independent producers of electricity include TOTAL EREN CA (France), ABU DHABI FUTURE Energy COMPANY (UAE), ACWA POWER (Saudi Arabia).

In accordance with the decree of the president of the Republic of Uzbekistan dated March 27, 2019 “on the strategy for the further development and reform of the electric power sector in the Republic of Uzbekistan”, a project center was established under the Ministry of energy and it also works with international financial organizations. The center has attracted international experts who have gained a lot of experience in reforming the energy sectors of different countries. The issue of improving energy efficiency in the socio-economic sphere is the most pressing issue today. Currently, about 23% of energy consumption in the world falls on the housing sector, while in the Republic of Uzbekistan these figures are 40%. In particular, while

the energy consumption per 1 square meter in Europe is 120, 150 kilowatt hours per year, in Uzbekistan this figure exceeds 390 kilowatt hours. In the process of carrying out work on improving energy efficiency, in 2020, in exchange for the implementation of organizational and technical measures in the sectors of the economy, 1,352.4 million were received. cubic meters of natural gas, 917.5 million kilowatt-hours of electricity savings were achieved [19-21].

By 2025, it is envisaged to bring the power of the energy system to 25.6 gvt. In it, thermal power plants provide 18.8 GW, hydroelectric power plants – 2.5 GW, and solar and wind power plants reach 4.3 GW. Outdated devices are planned to be decommissioned one by one. The total production capacity as of 2030 is 29,200 MW. This is 2 times more than today's figures. As a result, the volume of electricity production in 2030 is 120.1 billion kilowatt hours. As a result of the work in this direction, by 2025 the task of bringing the capacity of the country's energy system to 25,600 MW, and in 2030-to 29,200 MW was determined. Renewable energy projects in Uzbekistan contribute to the implementation of the tasks set before the country's energy sector.

Why are power outages often observed?

There are several problems with the continuous supply of electricity consumption. In particular, the main cause of interruptions in electricity supply is caused by a sharp increase in electricity consumption as a result of cooling air temperature. At the same time, short-term interruptions make it possible to prevent large accidents in the system. This is because in any energy system, it is important that the energy balance between consumption and production is ensured at any time for its stable operation. This process is very important in terms of reliable and uninterrupted supply of electricity to consumers and ensuring the smooth operation of the energy system.

Providing an energy balance between consumption and production remains a daunting task, even in developed countries, when there is a sharp increase in the need for electricity (in cold weather in the hot summer season or in the harsh winter season). In doing so, it will force the introduction of restrictions on the supply of electricity to prevent major accidents and the disconnection of consumers from the supply of electricity throughout the country. When the process of balancing the energy system by the dispatch center does not provide in time, the “strain” on the system causes various large accidents, which leads to the fact that large-large areas do not have electricity for a long time. In cases where it is impossible to ensure the balance of energy, the dispatch department of enterprises of regional power networks

will be forced to impose restrictions on part of the consumers in accordance with the schedule of the plan. These graphs, as a rule, include low-voltage (0.4 kv, 6-10 kv) distribution electrical networks. These actions are aimed at preventing major accidents that can occur in the country's energy system. This allows for regular monitoring of electricity Day and night and timely response of dispatcher control [22].

An electric power system is a complex structure that includes thermal power plants that generate electricity, transportation of generated electricity through high voltage main power networks, electricity distribution networks, and consumers. The difference in electricity production from other industries and directions, as well as its peculiarity, is that the production, transmission, distribution and consumption of electricity is the only technological process that must be carried out at the same time, and at every moment it is an extremely important task to establish equality, balance between them [23-24].

We can also see that accidents occur as a result of situations such as a type character nonlinear connection in an electrical energy system, as well as large voltages to Transformers. In relation to this, the legislation defines the issue of liability. Article 169 (D) and (e) of the Criminal Code of the Republic of Uzbekistan shall be liable under Articles 1852, 2782 and articles 61, 100, 101 and 102 of the Code of administrative responsibility of the Republic of Uzbekistan.

To prevent serious systemic accidents in such cases, it is necessary to develop an energy system, increase its energy efficiency and improve the conditions for providing the system with energy resources.

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# PPLICATION OF PHOTOVOLTAIC EFFECTS TO ENERGY-SAVING MATERIALS COMPONENTS OF THE STRUCTURE AND SOLAR CELLS

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**Abstract:** This paper explores the use of photovoltaic effects in the design and development of energy efficient materials and storage cell components. The authors explore how photovoltaic technology can be incorporated into building materials and energy storage devices to improve their efficiency and sustainability. The article discusses the various applications of photovoltaic effects, including generating electricity from sunlight, capturing and storing energy, and contributing to the overall reduction of energy consumption. The conclusions presented in this paper provide valuable insights into the practical application of photovoltaic technology in the construction and energy storage industries, which have important implications for environmental protection and sustainable development.

**Key words:** photovoltaic, potential, photoelectric, nanomaterials, utility power system, distributed generation

Currently, more than 75% of electricity is generated by burning mineral and organic fuels. However, the energy industry is already faced with a situation of depletion of its traditional raw material base. One of the reasons for this was the limited availability of fossil energy resources. In addition, oil, gas and coal are also the most valuable raw materials for the intensively developing chemical industry. Maintain high The pace of energy development through the use of only traditional fossil energy sources is becoming increasingly difficult [1-5].

In addition, the combustion of fuel in thermal power plants, as well as in residential heating systems (boiler installations) leads to significant environmental pollution. When burning solid and liquid fuels or natural gas, sulfuric anhydride, nitrogen oxides, and fluoride compounds enter the atmosphere. required energy sources**.**

When it comes to energy based on renewable energy sources (alternative energy), the first thing that comes to mind is solar energy. This is not surprising: the integral flux of solar radiation entering the Earth's atmosphere is about 2.1017 W.

While the total installed capacity of all power plants in the world does not exceed 3.10 12W, i.e. almost 100 thousand less [6-9].

Th present article is devoted to the study of solar elements properties of the most reliable and fi nancially beneficial converting process of solar energy into electric energy based on semiconductor silicon. Silicon is the biggest longitude diffusion than CaAs, so it is shown that current carriers are generated more by sunlight.

During the exploitation of this solar elements defects lessen the the life of secondary carries of electric energy and as a result of it it disseminates the optical sensitivity of solar centers in amount of products [10-13].

The sun is a huge, inexhaustible, absolutely safe source of energy, equally owned by everyone and accessible to everyone. The bet on solar energy should be considered not only as a win-win, but in the long term and as a non-alternative choice for humanity. The transformation of solar energy into electrical energy is carried out using semiconductor photocells. These devices appear today to be fully mature in scientific and technological terms in order to be considered as the technical basis for large-scale solar power of the future.

However, the widespread introduction of solar energy is possible only with a significant reduction in the cost of electricity obtained by converting the energy of solar radiation. For the economic efficiency of photoconversion using solar modules in ground conditions, cheap devices that provide light collection and energy converters with a high efficiency [14].

For the successful production of highly efficient solar cells, along with the use of modern manufacturing methods, a deep understanding of the processes occurring in the cells is necessary. By establishing a correspondence between the characteristics of the elements and the main structural, electronic and optical properties of the semiconductor layers, it is possible to accurately determine the influence of each of them on the parameters of the p-n junction and identify ways to increase the efficiency of the device. generation of solar energy. Application of photovoltaic effects to energy-saving materialscomponents of the structure and solar cells [15-17].

The photovoltvoltaik effect is the generation of voltage and electric current in a material upon exposure to light. It is a physical phenomenon.

The photovoltaic effect is closely related to the photoelectric effect. For both phenomena, light is absorbed, causing excitation of an electron or other charge carrier to a higher-energy state. The main distinction is that the term photoelectric

effect is now usually used when the electron is ejected out of the material (usually into a vacuum) and photovoltaic effect used when the excited charge carrier is still contained within the material. In either case, an electric potential (or voltage) is produced by the separation of charges, and the light has to have a sufficient energy to overcome the potential barrier for excitation. The physical essence of the difference is usually that photoelectric emission separates the charges by ballistic conduction and photovoltaic emission separates them by diffusion, but some "hot carrier" photovoltaic devices concepts blur this distinction [18-19].

The photovoltaic effect occurs in solar cells. These solar cells are composed of two different types of semiconductors - a p-type and an n-type - that are joined together to create a p-n junction. To read the background on what these semiconductors are and what the junction is, click here . By joining these two types of semiconductors, an electric filed is formed in the region of the junction as electrons move to the positive p-side and holes move to the negative n-side. This field causes negatively charged particles to move in one direction and positively charged particles in the other direction.

Light is composed of photons , which are simply small bundles of electromagnetic radiation or energy. These photons can be absorbed by a photovoltaic cell - the type of cell that composes solar panels. When light of a suitable wavelength is incident on these cells, energy from the photon is transferred to an atom of the semiconducting material in the p-n junction. Specifically, the energy is transferred to the electrons in the material. This causes the electrons to jump to a higher energy state known as the conduction band . This leaves behind a "hole" in the valence band that the electron jumped up from. This movement of the electron as a result of added energy creates two charge carriers, an electron-hole pair [20-22].

Environmental concerns and climate change have put pressure on utility power system managers to look for alternative sources of energy. Recent research advances and developments in exploiting renewable energy sources for improving power system operations have seen encouraging results. Distributed generation (DG) is a method of generating electricity from multiple renewable energy sources that are very near to load demands. DGs interconnected to utility power systems have multiple advantages such as increased system reliability, reduced peak power requirement, improved power quality, requisite supply of reactive power, and environmentally clean energy. The renewable energy resources used for generation

of electricity are solar, thermal, photovoltaic (PV), wind farms, hydro, biofuels, wave, tidal, ocean, and geothermal sources. However, PV systems have been considered a better renewable energy source for electricity generation, because of the abundant long-time availability of free solar energy at the earth's crust. PV generation is based on the PV effect, which is a process with PV cells that uses solar light photons to strike on the doped semiconductor silicon to produce electricity.

The photovoltaic effect is a process of converting light, i.e., photons, into electricity. Solar cells or photovoltaic (PV) cells are electronic devices where sunlight is directly converted into electricity due to the photovoltaic effect. A photovoltaic system is an array of solar modules that comprise a number of solar cells that generate electrical power. Multiple modules, as shown in the photovoltaic hierarchy in Fig. 5.1, are wired together to form an array to obtain more electricity [23-25].

Photovoltaic (PV) effect is a process by which PV cell converts the absorbed sunlight energy into electricity. PV system operates with zero carbon-dioxide emissions which has benefits for environmental safety. The photon energy absorbed by nanomaterials is transferred to the electrons in the atoms. Fig. 41.1.1 shows the pictorial representation of the working of a PV cell. When two differing p–n semiconductor layer are brought into contact, an electric potential is created between n- and p-type semiconductor layers. Electrons wander across the junction and jump to the p-type semiconductor leaving behind a static positive charge. Simultaneously the holes wander across the junction leaving behind a static negative charge. These free electrons and holes join up and disappear. At a certain level, a depletion zone is created at the p–n junction where there are no more chances of any charge carrier migration [26-28].

These separated static positive and negative charges create an electric field across the depletion zone. This built in electric field provides the force or voltage needed to drive the current through an external circuit. When the photon energy from the sun is absorbed by the semiconductor layer it is transferred to the electrons of the material. The electrons get sufficient energy to move to the conduction band which in-turn leaves a “hole” in the valence band. Valence electrons escape from the normal positions in the atoms of semiconductor material and become a part of electric flow or current. This voltage causes electrons to move toward the negative end and holes toward the positive direction. When there is a sufficient amount of sun energy, i.e., when the absorbed photon energy is greater than the bandgap energy of the materials

used in the PV cell, the atoms collide and free electrons start to migrate, creating the current of electricity.

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# LIGHTING IN PRODUCTION AND ITS STANDARDS. NATURAL AND ARTIFICIAL LIGHTING

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**Annotation:** The article discusses the importance of lighting in buildings, its impact on human health, lighting standards and requirements, as well as methods of lighting buildings: natural, artificial and mixed lighting. At the same time, when and where to use these types of lighting, their advantages and disadvantages will be discussed.

**Key words:** energy efficiency, energy saving, full lighting, general lighting, local lighting, mixed lighting, natural lighting.

Lighting requirements

In order for the lighting in production conditions not to harm the health of workers, it is required that it does not strain the eyes and is evenly distributed in all parts of the building during work. The light should not dazzle the eyes, in other words, the light rays should not fall directly into the eyes [1-2].

The spectral composition of light should be selected in such a way that, as a result, a person correctly perceives the colors of the surrounding objects. There should be sharp shadows in the workplaces and the illumination of the surrounding environment should not be too different, otherwise, as a result of a person frequently changing his eyes from one situation to another, the accommodation properties of his eyes will be disturbed and vision will be impaired. the state of exhaustion of organs occurs.

Lighting and their main types

In practice, three types of lighting are used in workplace lighting, that is, they natural, artificial and mixed.

Natural lighting

1. Rooms where people are always present, as a rule, must have natural lighting. It is allowed to design rooms that do not have natural lighting, as well as rooms that are allowed to be placed in the basement and basement floors of buildings, which are

approved in the established order, as specified in the construction standards and regulatory documents for the design of buildings and structures [3-8].

2. Natural lighting is divided into side, top and mixed (top and side) types. In small rooms with one-sided natural lighting from the side, small values of TEK are measured at the point located at the intersection of the conditional working surface at a distance of 1 m from the wall and the characteristic wall of the room, far from the place of light, and at the point between the room in the case of two-sided side lighting. In one-way side lighting of residential and public buildings, the measured amount of TEK (natural illumination coefficient) should be provided as follows:

a) in the living rooms of residential buildings, at the point of calculation located at the intersection of the vertical plane and the floor plane, taken at a distance of 1 m from the wall farthest from the windows (in one room of apartments with 1,2 and 3 rooms and in 2 rooms of apartments with 4 or more rooms ); In other living rooms and kitchens of multi-room apartments, the standard amount of TEK in the case of side lighting should be provided at the reference point located in the center of the building at the floor level;

b) in the hotel rooms of dormitories, hotels - at the point of intersection of the vertical plane of the characteristic wall of the building and the plane of the floor in the center of the building;

c) in groups and playrooms of pre-school educational institutions, rooms for sick children and medical isolation - at the point of calculation at the intersection of the vertical plane of the building's characteristic roof and the plane of the floor, taken at a distance of 1 m from the wall farthest from the windows;

g) the vertical plane of the characteristic wall of the building with a conditional working surface located at a distance of 1.2 m from the wall farthest from the windows in the classrooms and training rooms of general education institutions, boarding schools, vocational education institutions at the point of calculation at the intersection;

d) in other rooms of residential and public buildings at the counter located on the working surface in the center of the building;

Mixed lighting

In industrial buildings, mixed lighting is used in the following cases:

a) for production rooms where discharge works are performed;

b) for production and other rooms, when: technology, organization of production or climatic conditions require spatial planning solutions at the construction site, in cases that do not allow to ensure the standard values of TEK

(one-story buildings with a large width, spaces with a large width (intervals), one-story multi-span buildings, etc.), as well as the feasibility of mixed lighting from a technical and economic point of view, when compared with natural lighting, is confirmed by appropriate calculations in scores;

c) in accordance with the regulatory documents on the design of buildings and structures of certain industrial networks, approved in the established order should be kept. Mixed lighting of rooms of residential, public and administrative- household buildings, rooms and kitchens of residential buildings, educational and training rooms of schools and educational institutions, rooms for children's residence, sanatoriums and rest houses, from dormitories of sanatoriums and rest houses external, in cases where it is required by the conditions for the selection of rational volume-planning solutions allowed to hold [9-12].

General (regardless of adopted lighting systems) artificial lighting of production rooms where people are always present must be provided with discharge light sources. The selection of sources of maturity should be carried out in accordance with the requirements of section 4 of this standard. The use of incandescent lamps is allowed in some cases, when there is no possibility to use discharge light sources or it is not suitable for the purpose, according to the technology, conditions or the requirements of the interior decoration of the house [13-15].

Artificial lighting

1. Artificial lighting is divided into types of working, emergency, safety and duty lighting. The normative description of indoor and outdoor lighting is ensured by the use of working lighting lights together with emergency lighting lights. Normative illumination and the relative power providing it are indicated in the working drawings of the buildings. Emergency lighting is divided into emergency lighting and evacuation route lighting [16-20].

2. Artificial lighting can be divided into two systems: general lighting and mixed lighting.

3. Work lighting should be provided for all rooms of the buildings, as well as for open space sections intended for workers' work, passage and traffic. For rooms with zones with different conditions of natural lighting and different working procedures, it is necessary to consider lighting with separate control of such zones. For general and local lighting of buildings, light sources with a color temperature of 2400 to 6800 K should be used. The activity of ultraviolet radiation in the wavelength range of 320-400 nm should not exceed 0.03 W/m. It is not allowed to have wavelengths less than 320 nm in the radiation spectrum. Energy efficient light

sources should be used for artificial lighting [21-25]. If the power of the light sources is equal, it is recommended to take into account those with a longer shelf life, taking into account the requirements of high light output and color differentiation. The use of common incandescent lamps for lighting is limited. Also, it is not allowed to use general incandescent lamps with a power of 100 W or more for lighting. If necessary, part of the working or emergency lighting can be used for duty lighting. The standardized description of lighting outside buildings and rooms can be provided by working lighting, as well as by the combined use of security lighting and lighting of escape routes.

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# WISE USE OF ENERGY IN ADMINISTRATIVE BUILDINGS OF INDUSTRIAL ENTERPRISES

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## ABSTRACT

This article analyzes data, indicators and experience on the topic of rational use of energy for administrative buildings of industrial enterprises. The article shows the important issues of energy technologies, energy efficiency and energy security. This article will be important for those who study scientific and practical issues related to increasing the efficiency of industrial enterprises, optimizing production processes and ensuring energy security.

**Key words.** Industrial enterprises, administrative buildings, electricity, resources, residential buildings, energy, alternative energy, solar, solar energy, rational use of energy, habits, economical devices, raw materials, enterprises.

Today, for most developed and developing countries in the world, the issue of effective use of all kinds of resources, especially energy, raw materials and materials, is urgent. Uzbekistan, as a country rich in natural resources, is interested in the development and wide implementation of energy-saving technologies, and the use of innovative approaches to the efficient use of energy resources. able to increase competitiveness in the domestic and world markets, which in turn will certainly help the growth of the economy [1-5]. Within the framework of the project, more than 30 industrial enterprises have preferential loans allocated at the expense of the International Development Association and commercial banks of Uzbekistan. These enterprises are using a number of conveniences, such as reducing the consumption of electricity and natural gas. 82 sub-projects on increasing total energy efficiency are being implemented in our country. According to estimates, as a result of the successful implementation of these projects, 500 million kWh of electricity and 187.7 million cubic meters of natural gas will be saved annually in our country. special attention is paid to the application of sources. In particular, within the scope of this project, the effective management system of industrial enterprises is being

improved, which helps to ensure competitiveness in production. That is, costs are reduced and product quality is improving. In this regard, innovation projects aimed at rational use of fuel and energy resources are widely used. We should be able to use the most optimal options or optimal solutions for the use of any type of energy in the administrative buildings of industrial enterprises [6-9].

For example, after determining how an industrial enterprise uses energy in its administrative building, a solution is sought. If the building is old, its energy consumption is higher than required, it is necessary to completely reconstruct the energy consumption of this building or it is preferable to replace it with new energy-saving devices (consumers). In accordance with the rules and regulations of urban planning in the commissioning of multi-apartment and multi-story buildings, multi-story buildings without the installation of small solar photoelectric plants, solar solar equipment, and other electrical and thermal energy-saving devices are not allowed to be put into use without the agreement of the Ministry of Energy. that buildings meet the requirements of energy efficiency and equipment with measuring devices for the energy resources used by choosing optimal architectural, functional technological, structural, technical-engineering solutions, they are correctly implemented during construction, reconstruction and perfect repair increase and ensure regular updating of catalogs of standards, technical design solutionsrequirements for individual elements, constructions of buildings and structures, equipment and technologies used in them, requirements that allow eliminating wastage of energy resources during construction, reconstruction, perfect repair and operation, are implemented and included in project documents organization; compensation of 25 percent of the energy resources used by enterprises and organizations for buildings and structures from renewable energy sources and establishing the services of energy service companies in improving the energy efficiency of facilities [10-13].The Ministry of Housing and Communal Services, the Council of Ministers of Karakalpakstan, regional and Tashkent city hokimities for housing owners' associations and owners of public buildings and structures. In order to optimize the operation of centralized heating systems, heat supply implementation of comprehensive measures to improve heat protection in networks and buildings and structures (use of energy-efficient and energy-saving construction materials in newly constructed buildings and structures, implementation of measures to improve heat protection in existing buildings). in the introduction of energy-saving technologies and renewable energy sources, taking into account the geographical

location of buildings, social spheres and residential facilities, as well as energy consumption, takes measures to implement effective systems for ensuring the implementation of programs aimed at increasing energy efficiency. It helps to use energy rationally in administrative buildings of industrial enterprises, reduce energy costs and solve environmental problems. This is done through optimization of energy consumption, energy financing and automation. In addition, energy efficiency services for heat, healthcare and appliances will be introduced. Measures such as installation of energy kits, use of light energy sources (sun, wind) and renewal of heating and cooling systems are carried out in administrative buildings [14-18]. Such actions are necessary to see the true benefits of energy resources and create opportunities for industrial enterprises to reduce environmental problems. The rational use of energy in industrial enterprises is very important for the efficient use of energy resources, comfort and speed. It is also a common theme in this system to improve energy saving and consumption processes, reduce energy waste and support technical solutions. It is necessary to improve the quality of energy with the help of new technologies and innovations in industrial enterprises, to reduce energy costs and reforms, and to pay attention to social problems. These processes increase the production efficiency of industrial enterprises and reduce environmental problems. Industrial enterprises, administrative buildings constantly struggle with energy efficiency problems. This problem arises in the production processes of the building and in reducing or ensuring the amount of energy needed to heat it. Enterprise managers support various methods to improve energy efficiency. For example, energy efficiency can be improved through measures such as monitoring energy consumption, using new technologies, strengthening insulation and installing automated systems. An additional goal of such actions is to improve various indicators by reducing energy costs. This can increase the efficiency of the enterprises and develop the business more qualitatively and faster. Energy savings in office buildings is a very important topic for industrial enterprises, and there are several important ways to implement these processes. For example, technical solutions such as energy perspectives, energy efficiency improvement, automation systems and optimization of energy savings in production processes can be used. In addition, it is important to build new energy stores and implement energy storage facilities in the company's administrative buildings. With the use of these types of warehouses, business administration buildings can improve energy costs and efficiency for consumers. Issues related to strategic planning and attracting investments or ensuring energy security are also important for industrial enterprises.

It is necessary to work with professional consultants in these processes. Industrial enterprises, administrative buildings and energy sector need to carry out complex technical and initiative work to use external or internal saving aspect. It will also be related to the problems of improving energy efficiency, obtaining economic benefits and protecting the environment from the aspect of energy saving [19-21]. For administrative buildings and industrial enterprises, it is necessary to have energy-saving aspects, building materials (for example, insulation materials), heating and cooling systems, separating means (for example, closed systems) and other technical features. In these cases, new technologies and energy-storage methods can be used to increase the efficiency of energy saving. Using the energy saving aspect also helps to protect the environment. For example, with the production of heating systems through an automatic control system, consumers with heating and cooling equipment will soon become one of the most important parameters for consumer rooms. Attention is paid to the fact that the environment can become hotter when using such equipment. Such products are also very important for industrial enterprises. In these cases, energy efficiency can be converted into efficiency through energy saving and reduce investment costs. The goal is not to affect previous performance, but to conserve energy by turning it into efficiency.

**Summary:**

Within the framework of the project, 82 sub-projects on improving energy efficiency are being implemented in our country. According to estimates, as a result of the successful implementation of these projects, 500 million kWh of electricity and 187.7 million cubic meters of natural gas will be saved annually in our country. Energy efficiency in administrative buildings is of great importance in industrial enterprises. Energy efficiency requires the application of new technologies for the enterprise, the study of the possibilities of automation of production processes and reduction of energy consumption. Energy efficiency in administrative buildings can be implemented by working with light energy sources, separating the heating and cooling systems of closed verandas, automating lighting systems and monitoring the amount of energy consumption. These methods lower energy costs for industrial enterprises, reduce environmental impact and do not affect continuous operational characteristics. The implementation of such actions and the use of technological solutions that increase energy efficiency in administrative buildings can change the economy and environmental condition of enterprises. In industrial enterprises, it helps to use energy wisely, reduce energy consumption, return more often, and

improve quality. The rational use of energy can be determined by the following conclusions:

1. Efficient use of energy: Industrial enterprises should use technologies that can use energy efficiently through rational use.

2. Smart energy consumption: The most important guide for industrial enterprises is to support temporary technical means (techniques) that increase energy consumption through smart use.

3. Improve the quality of technical processes: As energy consumption is optimized and the quality of processes is improved, energy will be reduced and industrial enterprises will be more efficient.

4. Use of information technology (IT): Industrial enterprises can effectively use information technology (IT) to reduce energy consumption through monitoring and other automated methods.

Rational use of energy is one of the most important tasks of industrial enterprises. Through these methods, industrial enterprises can implement a strong and effective energy policy and increase its level.

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# СРАВНЕНИЕ ПОТЕРЬ ПРИ ПЕРЕДАЧЕ И ПАДЕНИЯ НАПРЯЖЕНИЯ ЛЭЭИ И ВОЗДУШНЫЕ ЛИНИИ ЭЛЕКТРОПЕРЕДАЧИ

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**Аннотация:** В энергосистеме нагрузки подключаются к электростанций через линии электропередачи. Передача линии – воздушные и подземные. За последние сорок лет новая технология включена в подземный кабель линия электропередачи с элегазовой изоляцией (ЛЭЭИ). ЛЭЭИ имеет множество преимуществ при использовании подземных и воздушных кабелей. линии передачи, такие как низкие потери при передаче, менее емкостные нагрузка, надежность, персональный безопасность, та же операция, что и накладные расходы линий и с незначительным электрическим старением. ЛЭЭИ может справиться со многим больше мощности, чем воздушные линии связи, из-за большой площади проводника. ЛЭЭИ лучше всего подходит для высоких напряжений. ЛЭЭИ может стать нашей будущей линией, особенно в больших городах из-за увеличения населения и размеров крупных городов. В в этой статье потери и падения напряжения при одном и том же номинальном напряжении накладные расходы линии являются в сравнении к ГИЛ линии. Моделирование в PSCAD выполнен с использованием параметров ВЛ и ГИЛ линий. одинаковых номинальных напряжений (200 КВ, 350 кВ, 600 кВ, 630 кВ, 1000 кВ). Длина из линия является взятый как 120 км в оба случаи. приведены сравнительные графики процентных потерь и падений напряжения. построенный с использованием МАТЛАБ.

**Ключевые слова:** ЛЭЭИ **(**линия электропередачи с элегазовой изоляцией**),** ВЛ (воздушные линии)

## I. ВВЕДЕНИЕ

ЛЭЭИ является лучшим вариантом для высоких напряжений из-за высокой мощности. рейтинг. Должный к большой область это может проходить много из текущий чем накладные расходы линии область является обратно пропорциональный к тот сопротивление. Таким образом, сопротивление ЛЭЭИ намного больше. ниже, чем у ВЛ. Диаметр ГИЛ 600 кВ

находится на о 450 мм, и 1000КВ ГИЛ имеет диаметр 600 мм [1-4]. С другой стороны в ВЛ Проводник с четырьмя слоями имеет диаметр около 17,4 мм. а у сокола с тремя слоями — 15,9 мм [5-6]. мощность ГИЛ номинал значительно выше, чем у воздушных линий. Передача потери ГИЛ значительно ниже, чем при воздушной передаче линии. К строить а высокий Напряжение линия является а трудный задача должный к общественные препятствия и право проезда. В будущем линии ЛЭЭИ могут быть устанавливается на большие расстояния. ЛЭЭИ в Японии составляет 3,25 км. является тот самый длинный ГИЛ линия [7-8]. Должный к высокий монтаж расходы ГИЛ является нет использовано более тот длинный расстояния [9-10].

## II. РАСЧЕТ ИЗ ПОТЕРИ

### *A.* Расчет потерь в воздушных линиях электропередачи.

Моделирование выполнено в PSCAD. Берется трехфазная цепь имеющие измерения мощности с обеих сторон. Параметры взято из ниже Таблица 1.

Табл.1. Параметры воздушных линий передачи

| **Напряжения уровень** | **Линия параметры за км** | | |
|---|---|---|---|
| | **Сопротивление за км** | **Индуктивность за км** | **Сопротивление на км** |
| 200кв | 0,050 | 0,488 | 3.371 |
| 350кв | 0,037 | 0,367 | 4.518 |
| 600кв | 0,028 | 0,325 | 5.2 |
| 630кв | 0,012 | 0,329 | 4,978 |
| 1000кв | 0,005 | 0,292 | 5.544 |

Напряжение источник, линия параметры и нагрузка являются смоделировано. Конденсаторы подключены с обеих сторон, потому что передача инфекции линия является взятый как середина 100 км линия. мультиметры подключены для измерения мощности на передающей стороне и получение конец. параметры для 100 км линии являются взятый для каждый из Напряжение уровни. результат полученный от тот моделирование следуют [11-13].

Таблица II. Результаты моделирования воздушной трансмиссии линии

| Напряжение уровень | Власть в МВт | | Потери ( %) | Напряжение капли ( кв ) |
|---|---|---|---|---|
| | Отправка завершена мощность(МВт) | Получающая сторона мощность(МВт) | | |
| 200кв | 94,97 | 93,94 | 1.10 | 11.4 |
| 350кв | 153,5 | 152,2 | 0,53 | 6,8 |
| 600кв | 255 | 254,2 | 0,315 | 5.4 |
| 630кв | 361,9 | 361,6 | 0,3147 | 1.3 |
| 1000кв | 521,2 | 521 | 0,115 | -2 |

*B.* Расчет из потери из ГИЛ

Власть умение обращаться способность ГИЛ является много выше чем воздушные линии. Но здесь для сравнения одинаковые номинальные строки взяты одинаковые напряжения и номинальные мощности линий, сравниваются в оба случая. Работа воздушных линий аналогична ЛЭЭИ. Та же модель моделируется для ЛЭЭИ в качестве воздушных линий. параметры ГИЛ применительно к разным номинальным напряжениям являются данный в таблица 3 [14-16].

Таблица III. Линия параметры из гил

| Напряжение уровень | Линия параметры за фаза за метр | | |
|---|---|---|---|
| | Сопротивление за фаза на метр (мкОм) | Индуктивность за фаза на метр (мкГн) | Емкость за фаза на метр (пФ) |
| 140/175кВ | 18 | 0,187 | 59 |
| 220/330кВ | 16 | 0,211 | 52 |
| 380 кв | 13 | 0,210 | 53 |
| 420/550кВ | 11 | 0,205 | 54 |
| 800кв | 10 | 0,247 | 45 |
| 1200кв | 8 | 0,208 | 42 |

После моделирования ЛЭЭИ в PSCAD как 100-километровая линия Пи. модель, принимающая сторона и посылая конечные полномочия для каждого линия следуют.

Таблица IV. Моделирование полученные результаты из гил

| Напряжения уровень( кв ) | Полномочия в МВт | | Потери( %) | Напряжение капли ( кв ) |
|---|---|---|---|---|
| | Отправка завершена мощность( МВт) | Получающая сторона мощность( МВт) | | |
| 200кв | 160,1 | 159,3 | 1.13 | 2.2 |
| 350кв | 159 | 158,7 | 0,19 | 0,1 |
| 600кв | 260,7 | 254,2 | 0,15 | -0,6 |
| 630кв | 365,6 | 365,2 | 0,11 | -2 |
| 1000кв | 523,1 | 522,5 | 0,114 | -4 |

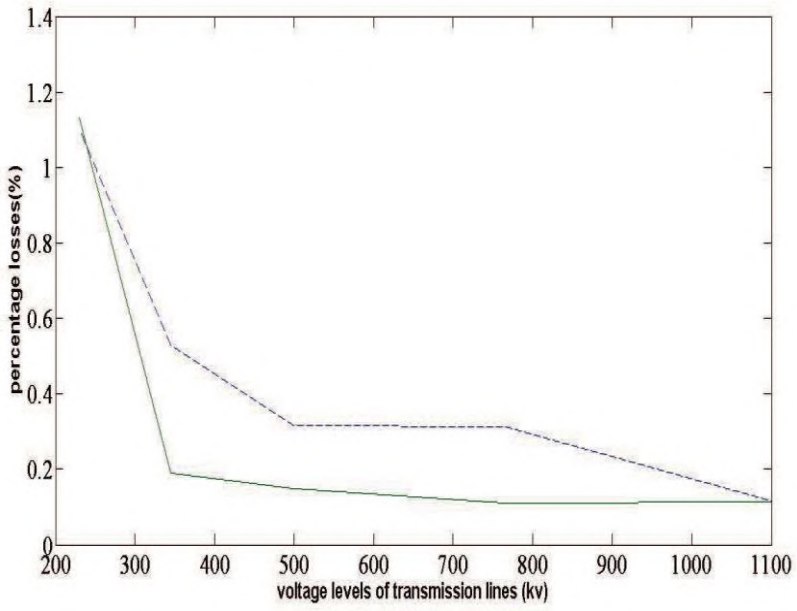


Рис. 1. Процентная передача потери сравнение из ГИЛ и накладные расходы передача инфекции линии, пунктирный линия шоу накладные расходы линии потери.

## III. Сравнение

Процентные потери, полученные от воздушных линий, приведены в

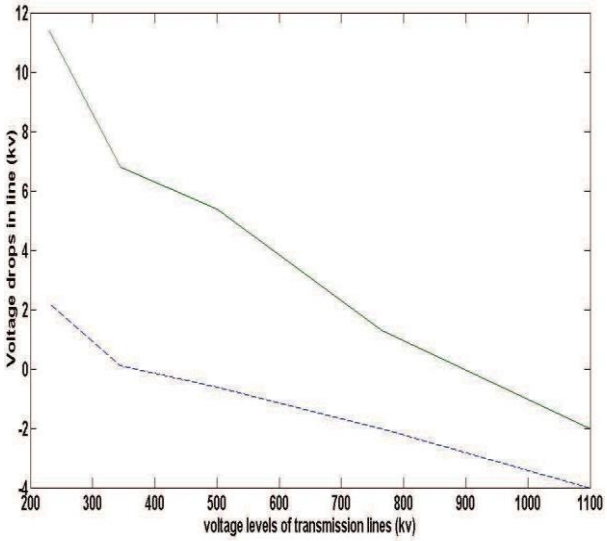


Таблица 2. Сравнивая процентные потери как ЛЭЭИ, так и накладные расходы линии график является полученный в МАТЛАБ [17-19]. На Икс ось напряжения указаны в кВ, а по оси у потери указаны в процент на рис. 1, тогда как на рис. 2 падение напряжения в сравнении. Синяя линия на графике на рис. 2 представляет ЛЭЭИ. а зеленая линия представляет ЛЭЭИ на рис.1. Это можно увидеть Из рис. 2 следует, что снижение потерь ГИЛ происходит гораздо быстрее, чем воздушные линии связи от повышения напряжений передачи. ЛЭЭИ - этолучший кандидат для сверхвысокого напряжения. На рис. 2 пунктир линия показывает уменьшение падения напряжения с увеличением уровень напряжения ЛЭЭИ, а полная линия указывает на падение OHL. Для ГИЛ тот линия компенсация является нет нужный пока на воздушных линиях компенсация необходима для поддержания уровень напряжения [20-24]. Это означает, что профиль напряжения ЛЭЭИ значительно лучше чем воздушные линии [8-10].

Рис. 2. Напряжение капли сравнение график из ГИЛ и накладные расходы линии электропередачи пунктирная линия указывает тот напряжение капли в ГИЛ.

## IV. Расходы фактор

Первоначальная стоимость ЛЭЭИ намного выше накладных расходов. линий почти в 6 или 7 раз больше, чем воздушные линии, ноон может окупить свою стоимость через несколько лет из-за низкой эксплуатационные расходы. Просматривая профиль напряжения в случае ЛЭЭИ не требует установки

больших компенсаций при получении конец. ЛЭЭИ сам по себе также является компенсатором, таким образом, реактивная компенсация мощности стоимость может также уменьшенный.

## V. Заключение

Должный к увеличивать в тот столичный города и области. Накладные расходы передача инфекции является нет возможный. Для что причина мы придется перейти на подземную передачу. Для этого у нас есть кабели и ГИЛ. ЛЭЭИ — лучший кандидат без каких-либо специальностей. неисправности и эксплуатировались как воздушные линии. Из-за меньшей передачи потери и меньшие падения напряжения, он имеет дополнительные преимущества, т.е. низкоеэксплуатационные расходы и линия без компенсации. Итак, ГИЛ может заменить воздушные линии, а энергосистема может быть стал более надежным с меньшими потерями и меньшим количеством неисправностей без тревожный экологический красота.

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# RESEARCH ON THE ENERGY EFFICIENCY OF HIGH-POWER SYNCHRONOUS MOTORS

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**Key words:** Energy Efficientcy, Induction Motors,Speed Drives,Power Factor Optimization Syuchronous Motors.

A synchronous generator is a special device that can convert any energy into electricity. Such devices are mobile stations, thermal or solar batteries and special equipment [1-2]. Depending on the type of generator, shipping from it, so what device is worth the help.

Creation history

At the beginning of the 19th century, the Robert Bosch company first developed something similar to a generator. The device was powered by an engine. The tests revealed that the car was not suitable for fast driving, but the developers were able to improve the hardware.

In 1890, the company became famous and switched to the production of these devices. In 1902, Bosch's student created a high-voltage ignition. The device was able to create a spark between the two electrodes of the candle, which made the system versatile [3-5].

The beginning of the 60s of the 20th century was the period of distribution of generators throughout the world. If it was only in demand in the automotive industry, now such units can provide electricity to entire houses.

Device and purpose

The design of such units includes only two main elements:

Rotor;

Stator

In this case, the rotor shaft has additional elements. These can be magnetic or field windings. Magnets have a toothed shape, the direction of making and transmitting the current is adopted.

The operation of the generator converts energy into electricity. With its help, the dependent equipment can be supplied with the necessary current, after which it will be possible to load them [6-7].

High-power synchronous motors are known for their efficiency in converting electrical energy into mechanical power. They are commonly used in various industrial applications where precise control and high efficiency are crucial.

Key points on the energy efficiency of high-power synchronous motors include:

1. Synchronous Operation: These motors operate in sync with the frequency of the power supply, resulting in a constant speed of rotation. This synchronous operation enhances efficiency and stability.
2. High Efficiency: Compared to induction motors, synchronous motors often exhibit higher efficiency, especially at high power levels. This makes them suitable for applications where energy savings are a priority
3. Power Factor Improvement: Synchronous motors can improve the power factor of the electrical system. By adjusting the excitation, they can operate at leading power factor, reducing reactive power and improving overall system efficiency.
4. Variable Speed Operation: Some high-power synchronous motors are designed for variable speed operation, allowing for better control and adaptability to different load conditions. This can contribute to energy savings in applications with varying power requirements.
5. Maintenance Considerations: Proper maintenance is essential to ensure continued high efficiency. Regular checks on the rotor field winding, bearings, and other components help optimize performance and prevent energy losses.
6. Application Specifics: The energy efficiency of synchronous motors can vary based on the specific application, load profile, and operating conditions. Consulting manufacturer specifications and guidelines for a particular motor model is crucial for accurate information.
7. Advancements in Design: Ongoing advancements in motor design, materials, and control systems contribute to improved energy efficiency in high-power synchronous motors. Keeping abreast of these developments can aid in selecting the most efficient motors for specific applications.

When evaluating the energy efficiency of high-power synchronous motors, it’s essential to consider factors such as the motor design, load characteristics, and the efficiency standards and regulations applicable in the region [8-10].

Synchronous motors are known for their high efficiency and power factor, making them a popular choice for high-power applications where precision and consistency are crucial. When it comes to energy efficiency, synchronous motors excel due to their ability to operate at a consistent speed regardless of the load. This characteristic, along with the design and construction of the motor, helps minimize energy losses and maximize overall efficiency [11-14].

One of the key contributors to the energy efficiency of high-power synchronous motors is their synchronous operation. Unlike induction motors, which rely on slip to generate torque, synchronous motors run at a constant speed that remains synchronized with the frequency of the power supply. This synchronous speed stability helps optimize the motor's performance and efficiency, particularly in applications where precise speed control is critical, such as in industrial machinery, compressors, pumps, and other high-power equipment [15-16].

The design and construction of high-power synchronous motors also play a significant role in their energy efficiency. These motors are often engineered with high-quality materials, advanced insulation, and optimized magnetic circuits to reduce losses and improve efficiency. Additionally, the use of efficient cooling systems, such as forced air or liquid cooling, helps maintain optimal operating temperatures and further enhances overall efficiency.

Moreover, advancements in motor control technology have further improved the energy efficiency of high-power synchronous motors. Variable frequency drives (VFDs) and other advanced control systems enable precise speed and torque control, allowing the motor to operate at optimal efficiency across a wide range of load conditions. This level of control not only enhances energy efficiency but also extends the motor's lifespan and reduces maintenance requirements.

Efforts to improve energy efficiency in high-power synchronous motors have also led to the development of specialized motor designs, such as permanent magnet synchronous motors (PMSM). PMSMs leverage permanent magnets to create a stronger magnetic field, resulting in improved power density and efficiency compared to traditional synchronous motors. These advancements have made PMSMs particularly attractive for applications where maximizing efficiency and power output in a compact design is essential, such as in electric vehicles, wind turbines, and robotics [17-19].

In summary, the energy efficiency of high-power synchronous motors can be attributed to their synchronous operation, high-quality construction, advanced cooling systems, and the integration of modern control technologies. These factors

collectively contribute to the superior efficiency, reliability, and performance of synchronous motors in a wide range of high-power applications.

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# SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS

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**Abstract:**The article first discusses the various requirements for installing solar panels, including local building codes, permits, site assessment, and equipment selection. It also highlights the importance of evaluating the structural integrity of the roof or ground where the solar panels will be installed. Furthermore, the article delves into the installation process itself, covering key steps such as mounting the panels, connecting them to an inverter, and integrating them with the electrical grid. It also explores safety considerations and best practices for ensuring a successful installation. Overall, this article serves as a valuable resource for individuals and professionals interested in understanding the essential requirements and process involved in installing solar panels. By providing insights into these critical aspects, it aims to facilitate informed decision-making and promote the adoption of solar energy technology.

**Key words:**Solar panel, installation slope, electricity Production capacity, network connection, solar panel size

As you can see, in the example we have two 12V solar panels. They are wired in parallel, so that makes the plusses together and the minuses together. And that keeps it at 12V. Let’s go to the combiner box: a Midnite PV3 combiner box.The plus and minus from solar panel 1 come in to, the plus goes into its own breaker. And the minus goes into the negative bus bar. Then the plus and minus from solar panel 2, the plus goes into a separate breaker, and the negative goes to the negative bus bar. The output of the breakers is combined with this included positive finger bus bar. So, it slides into the top of the breakers and that combines the positives. The negative bus bar combines the negatives. And that gives you your parallel wiring. There is also a lightning arrestor that will protect us from any lightning strikes. And notice

the ground going to the grounding bus bar, the positive going to the positive bus bar, and the negative going to the negative bus bar [1-4].

The ground comes from the racking going into the grounding bus bar. So, the rails are grounded through this, and then the grounded mid-clamp from IronRidge takes that ground, across the rail, up to the edges, the frame of the solar panels.

This setup gives a nice bonded connection through all of it. I would then go off to a grounding rod, and that would give me my nice earth ground connection. Because this example is a portable system, I've transitioned to "invisible conduit". But know that this is going to be conduit all the way into the house [5-9].

Let's transition into the house to our DC Load Center.

The DC Load Center is really just a fancy way of saying breaker box. The combined negative, positive, and ground, all come into our DC Load Center. We have it going into a breaker. It's coming out of the breaker, into the PV In to the charge controller. My negative is also coming in, and it's actually just transitioning right on out. It's just going in there as a nice place to land the negative. But it's going in and then it's coming right back out and it's going to the negative PV In of my charge controller. Then the battery is out from the charge controller. I've got the plus and minus going into the DC Load Center. The plus is going to a breaker, and it's going to be coming out, and going to my positive bus bar. The positive bus bar is going to be going to my battery. So, I've got the negative coming out of the charge controller, going to the negative bus bar. And that negative is also going to be going to my battery. So, that’s going from the charge controller, to the battery [11-16].

Basically, what the busbars do, is give a nice easy way to connect everything to the battery. So, you only have one connection to the battery, because it’s just connecting into the busbars. So, anything you need to connect to the battery, you can just connect to the busbar, through a breaker. So I have going from the positive and the negative, I'm actually going to a cigarette outlet.

Now you have the DC load. From the positive bus bar, to another breaker, and out to the DC input of my inverter. And here comes the 12V inverter. The negative is coming from the negative bus bar, which is just acting like the battery, going to the negative of the inverter. The inverter turns that into 120V 60Hz pure sinewave, because I'm in North America. If I was someplace that used 230V 50Hz, I would just use a different inverter for that [17-18].

The inverter creates the AC power for me and goes to an AC breaker box. For the example I imagined a Midnite Baby Box, but if you've got a lot of AC loads, you would have a bigger AC breaker box.

Through my breaker, out to an AC outlet, let there be lights! You are totally wired! Then we just write those down in a triangle with V at the top and we draw a line to separate the letters. Now, all we do when we need to use a formula is cover up the letter we need. So, if we want to find the voltage, then we write V = and then we cover up the V in the triangle. That leaves us with I and R, so we write I multiplied by R, which means voltage equals current multiplied by resistance. You can write a little multiplication symbol in the triangle between the two letters if it helps you. Now, I know what you're thinking. Why is current represented with a letter I and not a C for current? Or even a letter A for the unit of Ampere. Well the unit of current is the Ampere or the Amp and this is named after Andre Ampere, a French physicist. A couple of hundred years ago, he undertook lots of experiments, many involved varying the amount of electrical current. So, he called this intensité du courant or the intensity of current. So, when he published his work, they took the letter I and it became standard until this day. Now, you might also come across formulas where the letter E is used instead of V. The letter E stands for EMF, or Electromotive Force, but don't worry about that, just stick to using V and substitute V for E if you see it used in Ohm's Law's questions. Anyway, so by covering V, we get voltage equals current multiplied by resistance. If we want to find current then we write down I = and then we cover up the letter I in the triangle. That gives us V and R, so as V is above the R like a fraction we can write V divided by R. Therefore, current is equal to voltage divided by resistance. If we want to find resistance, then we write down R = and then we cover up R in the triangle. That leaves us with V and I. So, we write V divided by I, which gives us resistance equals the voltage divided by current. Let's say we have a simple electrical circuit with a battery and a resistor. We don't know what the voltage of the battery is though. The resistor is 3 Ohms and when we connect a multi meter into the circuit, we see that we get a reading of two Amps of current [19]. We want to find the voltage. So, using Ohm's triangle, we can cover up the V and that gives us V equals I multiplied by R. We know the current is two Amps so we can write that in and we know the resistance is three Ohms, so we can write that in also. Therefore, two Amps multiplied by three Ohms, gives us six volts. The battery is therefore six volts [20]. If we now double the voltage by connecting two six volt batteries in a series, we get 12 volts. If we now connect this to the same circuit, the current also doubles from two Amps to four Amps. If we double the voltage again to 24 volts, the current will also double to eight Amps. So, what's the relationship here? We can see that current is therefore directly proportional to voltage. If we double the voltage, we double the current. Remember, voltage is

like pressure, it's the pushing force in the circuit. It pushes the electrons around the wires and we place things like lamps in the way of these electrons so that they have to flow through these and that causes the lamp to light up. By doubling the voltage, we see that the current also doubles, meaning that more electrons are flowing and this occurs as we apply more pressure or more voltage [21-23]. This is just like if we were to use a bigger water pump then more water will flow. What about finding current? Let's say we now have a three Amp lamp connected to a six volt power supply. To find the current, we cover up I in the triangle. That gives us V divided by R, so current equals voltage divided by resistance. We know the voltage is six volts and the resistance is at three Ohms, so the current is therefore two Amps and that's what we see on the multi-meter. If we double the resistance to six Ohms, by placing another three Ohm lamp into the circuit, the current halves are just one Amp. If we double the resistance again to 12 Ohms, the current will half again to .05 Amps. We can visually see this because the lamps will become less bright as the current reduces from the increase in resistance. So, what's the relationship here? We can see that the current is inversely proportional to the resistance. When we double the resistance, the current will decrease by half. If we half the resistance the current will double. Current is the flow of electrons or the flow of free electrons. For us to make this lamp shine, we need to push electrons through it. How do we do that? We apply a voltage across the two ends [24-25]. The voltage will push the electrons. The atoms inside the copper wire have free electrons in their valance shell, which means they can very easily move to other copper atoms. They will naturally move to other atoms by themselves, but this will be in random directions, which is of no use to us. For the lamp to turn on, we need lots of electrons to flow in the same direction. When we connect a voltage source, we use the pressure of a battery to push the electrons through the circuit all in the same direction. For example, to power a 1.5 Ohm resistive lamp, with a 1.5-volt battery, requires one Amp of current. This is equal to six quintillion, two hundred and forty-two quadrillion electrons passing from the battery and through the lamp every second. And if you can achieve this, then the lamp will stay at full brightness. If the voltage or current reduces or the resistance of the circuit increases, then the lamp will become dimmer. Finally, let’s tackle the resistance. Let’s imagine a resistive lamp connected to a 12-volt power supply, we don't know how much resistance is adding to the circuit, but we measure the current at 0.5 Amps. To find the resistance, we write down R = and then we cover up the R in the triangle. We're left with V and I, so resistance equals voltage divided by current. We know the voltage is 12 volts and the current is 0.5 Amps, so 12 divided

by 0.5 gives us 24 Ohms of resistance. Resistance is the opposition to the flow of electrons. It tries to prevent electrons from flowing. That's why we use resistance in circuits to reduce the current and protect components such as an LED. If we tried to connect an LED directly to a nine-volt battery, it would blow out because the voltage and the current are too high. But, when we add a resistor into the circuit, then these are reduced, so the LED is protected and will shine brightly. So, given the circuit, we can increase the current by increasing the voltage [26-28]. Or we can also increase the current by reducing the resistance. We can also reduce the current by increasing the resistance. It's time for you to test your skills. Can you solve these problems? Problem one : Let's say we have this lamp which has a resistance of 240 Ohms. If we plug this into an outlet in the US, which uses 120 volts, what will the current be? Problem two : If I plug the same 240 Ohm resistive lamp into an outlet in the UK, we get a current of 0.958 Amps. So, what is the voltage being applied here? Solution one: I = V ÷ R I = 120V ÷ 240 Ω I = 0.5A Solution two: V = I x R V = 0.958A x 240Ω V = 229.9V (~230V)

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# A GUIDE TO SELECTING INVERTERS AND CONTROLLERS FOR SOLAR ENERGY DEVICES

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## Introduction:

Solar energy has emerged as a sustainable and renewable source of power, with solar devices becoming increasingly popular for both residential and commercial use. When it comes to harnessing solar energy efficiently, the selection of inverters and controllers plays a crucial role. In this article, we will explore the significance of inverters and controllers in solar energy systems and provide valuable insights into making informed choices.

**Keywords.** String inverters, microinverters, power optimizers, hybrid inverters, grid-tied inverters, off-grid inverters

Understanding Inverters:

An inverter is an electronic device that converts the direct current (DC) generated by solar panels into usable alternating current (AC) electricity. This conversion is essential because most household appliances and electrical grids operate on AC power. Inverters are responsible for ensuring the compatibility between the DC power generated by solar panels and the AC power required for consumption or feeding back into the grid [1-2].

Types of Inverters:

String Inverters: String inverters are the most common type of inverters used in solar energy systems. They are cost-effective and suitable for small to medium-sized installations. A string inverter connects multiple solar panels in series, forming a string, and converts the combined DC power into AC power.

Microinverters: Microinverters are installed on each individual solar panel, allowing for independent power conversion. They offer better performance in shaded or partially shaded conditions and provide module-level monitoring. However, they tend to be more expensive compared to string inverters [3-4].

Power Optimizers: Power optimizers are similar to microinverters in that they are attached to each solar panel. They optimize the DC power output of the panels and send it to a central inverter for conversion to AC power. Power optimizers are a compromise between string inverters and microinverters, offering increased efficiency and flexibility while being more cost-effective than microinverters.

Choosing the Right Inverter:

Several factors should be considered when selecting an inverter for solar energy devices:

System size and design: The number of solar panels and their configuration affects the choice of inverter. String inverters are suitable for standard installations, while microinverters or power optimizers may be preferred for complex or shaded systems [5].

Efficiency and performance: Inverter efficiency impacts the overall energy conversion process. Higher efficiency translates to more electricity production and better system performance. It's crucial to compare efficiency ratings before making a decision.

Monitoring and data analysis: Some inverters offer advanced monitoring capabilities, allowing users to track the system's performance in real-time. Monitoring features can be valuable in identifying issues, optimizing energy production, and ensuring the system operates at its full potential.

Understanding Controllers:

Solar controllers, also known as charge controllers or regulators, are responsible for managing the charging process of batteries in off-grid solar systems. They regulate the flow of electricity from the solar panels to the batteries, preventing overcharging and damage to the batteries [6-7].

Types of Controllers:

PWM Controllers: Pulse Width Modulation (PWM) controllers are the traditional type of solar controllers. They regulate the charging process by periodically interrupting the current flow to maintain the battery voltage at the optimal level. PWM controllers are cost-effective and suitable for small-scale systems.

MPPT Controllers: Maximum Power Point Tracking (MPPT) controllers are more advanced and efficient. They dynamically adjust the voltage and current to extract the maximum power from the solar panels, even in varying weather conditions. MPPT controllers are ideal for larger systems and installations with higher voltage panels.

Choosing the Right Controller:

Consider the following factors when selecting a solar controller:

System voltage and capacity: Controllers should be compatible with the system voltage and battery capacity. Ensure that the controller's specifications match the requirements of your system [8-10].

Efficiency: MPPT controllers are generally more efficient than PWM controllers, especially in situations where the solar panels operate at a higher voltage than the battery bank. Higher efficiency results in better energy utilization and faster charging.

Load handling and additional features: Controllers may offer additional features like load control, temperature compensation, and advanced battery protection. Evaluate the specific requirements of your solar system to determine the necessary features.

Inverter Technologies:

While we discussed string inverters, microinverters, and power optimizers in the previous section, it's worth noting that there are other specialized types of inverters as well:

Hybrid Inverters: These inverters are designed for hybrid solar systems that combine solar panels with energy storage, such as batteries. Hybrid inverters can manage both solar power generation and battery storage, allowing for greater self-consumption of solar energy and backup power during grid outages [11-13].

Grid-Tied Inverters: Grid-tied inverters are specifically designed for solar systems that are connected to the utility grid. They enable the system to feed excess solar energy back into the grid, earning credits or compensation through net metering or feed-in tariff programs. Grid-tied inverters do not provide backup power during grid outages.

Off-Grid Inverters: Off-grid inverters are used in standalone solar systems that are not connected to the utility grid. These inverters are responsible for converting DC power from solar panels into AC power for direct use or for charging batteries. Off-grid inverters often include additional features such as battery charging control and system monitoring [14-15].

Controller Technologies:

Apart from PWM and MPPT controllers, there are other specialized controllers available for specific applications:

Diversion Load Controllers: These controllers are used in systems with excess energy that cannot be stored in batteries. Instead of overcharging the batteries,

diversion load controllers divert the surplus energy to alternative loads such as water heaters or space heaters, effectively utilizing the excess power [16-17].

Lighting Controllers: Designed for solar lighting systems, these controllers control the operation of solar-powered lights. They manage the charging and discharging of batteries, control lighting schedules, and may include features like motion sensors or dimming capabilities [18-23].

Wind/Solar Hybrid Controllers: In hybrid systems that combine both solar and wind power generation, these controllers manage the charging process of batteries from both energy sources. They regulate the power flow and ensure efficient utilization of both solar and wind energy.

System Monitoring and Smart Features:

Many modern inverters and controllers come equipped with advanced monitoring capabilities and smart features, enhancing the overall performance and convenience of solar energy systems. These features may include:

Real-time monitoring: Inverters and controllers with monitoring capabilities provide detailed information on energy production, consumption, and system performance. Users can access this data through online portals or mobile apps, enabling them to track and optimize their energy usage [24-25].

Remote control and management: Some inverters and controllers allow users to remotely access and control their solar systems. This feature enables system owners to adjust settings, monitor performance, and receive notifications or alerts remotely.

Integration with smart home technologies: Inverters and controllers can integrate with smart home systems, allowing homeowners to monitor and control their solar systems alongside other connected devices. This integration enables seamless energy management and automation for increased efficiency [26-28].

Data logging and analysis: Advanced inverters and controllers store historical data on energy production and system performance. This data can be used for analysis, identifying patterns, optimizing energy usage, and diagnosing any issues or inefficiencies.

## Conclusion

In conclusion, inverters and controllers play vital roles in solar energy systems, ensuring efficient power conversion, battery management, and system control. There are various types of inverters available, including string inverters, microinverters, and power optimizers, each offering different benefits and suitability for specific applications. Controllers, such as PWM and MPPT charge controllers, regulate the

charging and discharging of batteries, optimizing energy flow and maximizing system performance.

Advanced features and integration capabilities, such as real-time monitoring, remote control, and smart home integration, enhance the functionality and convenience of solar systems. These features allow users to monitor energy production, adjust settings, and optimize energy consumption. Communication interfaces and integration with energy management systems enable seamless integration with other technologies and grid support functions.

When selecting inverters and controllers, it's important to consider factors such as system size, compatibility, efficiency ratings, and warranty and support. By choosing the right equipment and leveraging advanced features, solar system owners can maximize energy production, optimize self-consumption, reduce reliance on the grid, and contribute to a greener and more sustainable future.

Overall, inverters and controllers are crucial components that enable the effective utilization of solar energy, making solar systems more efficient, reliable, and cost-effective. With continual advancements in technology, the capabilities and possibilities of inverters and controllers continue to expand, driving the growth and adoption of solar energy worldwide.

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# CHOOSING INVERTORS AND CONTROLLERS FOR SOLAR CELL

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## Abstract

In this article we are going touch on some of the topics about solar cells, invertors , controllers as well as in what they are more beneficial and at their best sufficiency. Also we are going do discuss what are the advantages and disadvantages of installing solar cells and how much does one need to wait until those cells to pay off.

**Key words:** AC, DC efficiency, monobloc, thermos, solar cells, solar radiation

## Introduction

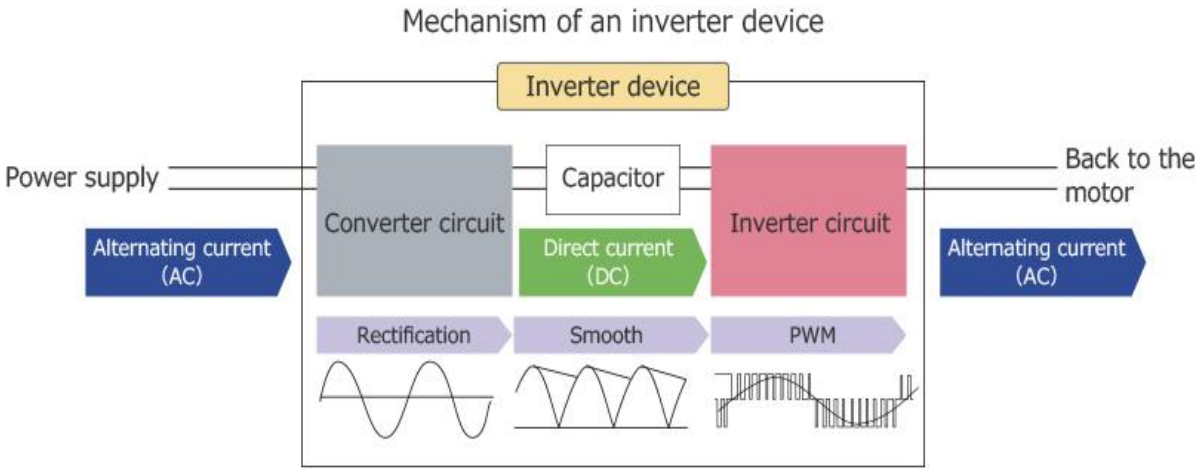
Solar cells can be arranged into large groupings called arrays. These arrays, composed of many thousands of individual cells, can function as central electric power stations, converting sunlight into electrical energy for distribution to industrial, commercial, and residential users. Solar cells in much smaller configurations, commonly referred to as solar cell panels or simply solar panels, have been installed by homeowners on their rooftops to replace or augment their conventional electric supply [1] . Solar cell panels also are used to provide electric power in many remote terrestrial locations where conventional electric power sources are either unavailable or prohibitively expensive to install. Because they have no moving parts that could need maintenance or fuels that would require replenishment, solar cells provide power for most space installations, from communications and weather satellites to space stations. (Solar power is insufficient for space probes sent to the outer planets of the solar system or into interestler space, however, because of the diffusion of radiant energy with distance from the sun) [2] .

## How does an invertor work

The inverter device's role is to control the voltage and frequency of the power supply and seamlessly change the rotation speed of motors used in home appliances and industrial machineries [3-9] .

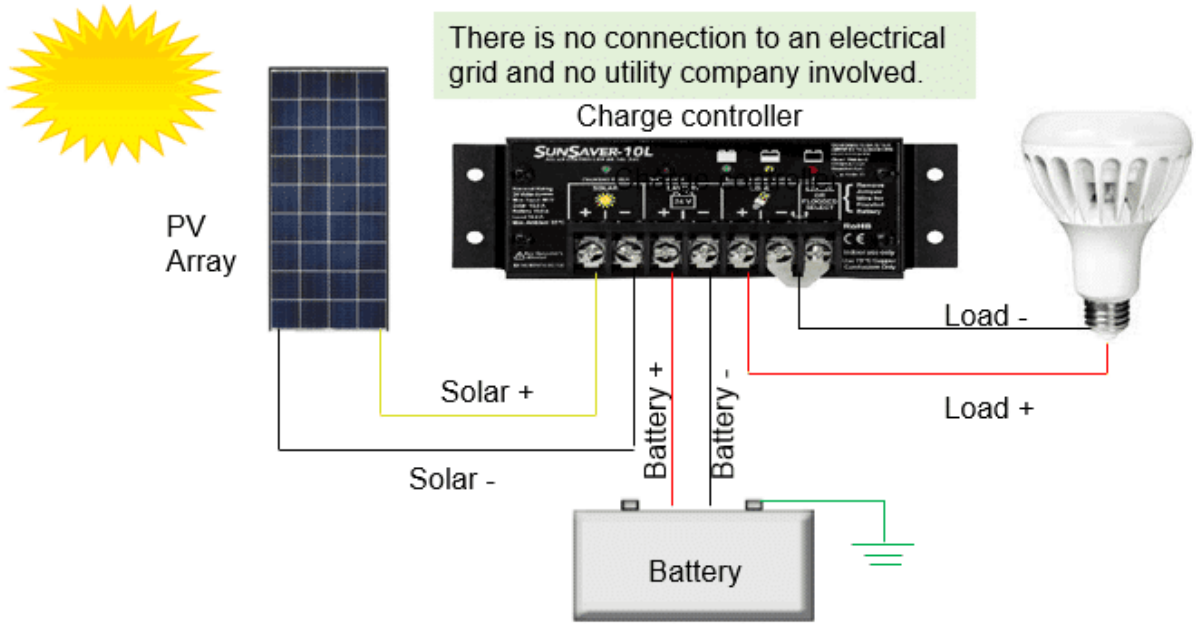
The first thing to keep in mind when it comes to enriching your understanding of the internal structure of an inverter device, is that the converter circuit converts alternating current (AC) coming from the power source into direct current (DC), and the inverter circuit changes the converted direct current (DC) back into alternating

current (AC). They work as a set. The diagram below shows the role they both play and the way they work [9-13] .




**The working process of controller**

The first solar charge controller schematic below (Figure 1) illustrates how a solar charge controller is connected to power a direct current (DC) load, and the second one (Figure 2) pertains to an alternating current (AC) load [14-17] .




When installing a solar charge controller, it is recommended that you connect and disconnect in the following order:

Battery to the controller first

PV array to the controller

Electrical load to the controller

When disconnecting, you reverse that order. The battery provides power to the controller so always make sure that solar and loads are disconnected before

connecting or disconnecting the battery from the controller. Connections between the battery, load, PV array, and the controller should have disconnect switches to enhance safety and facilitate ease of installation and breakdown [15-20] .

## Conclusion

Solar energy is a renewable energy source, meaning you don't ever use it up. Solar energy is clean. It creates no carbon emissions or other heat-trapping "greenhouse" gases. It avoids the environmental damage associated with mining or drilling for fossil fuels. Furthermore, solar energy also uses little to no water, unlike power plants that generate electricity using steam turbines.

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# CADASTRING THE RENEWABLE ENERGY SOURCES IN UZBEKISTAN

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## ABSTRACT

In this article, we will consider the cadastre of solar energy, which is considered a renewable energy source in Uzbekistan

**Key words:** alternative energy, solar cadastre, energy object.

## INDRODUCTION

It is necessary to train competitive specialists with in-depth knowledge to carry out research, design, construction, operation, repair and reconstruction of energy facilities built on non-traditional and renewable energy sources. Taking this into account, we will consider the solar cadastre of solar energy, which is considered one of the renewable energy sources.

## MAIN PART:

Information on the flow of solar radiation and the amount of transported energy is a solar cadastre. Information on the solar cadastre is collected based on the following indicators:

- monthly and annual totals of solar radiation falling on the horizontal plane;
- rays of the sun falling on the horizontal plane in a normal-experimental position;
- the time of the sun's rays.

In general, data on the total amount of solar radiation and incident energy can be obtained in the following ways:

- by calculating data at a specific geographical point - by analytical method;
- in a short period of time at a specific geographical point, with direct information obtained by measuring with tools and equipment;
- by obtaining information from the reference books where the data of the meteorological stations that have carried out long-term measurements with the only accepted method have been collected [1-5].

When calculating the use of solar energy, the amount of energy provided by

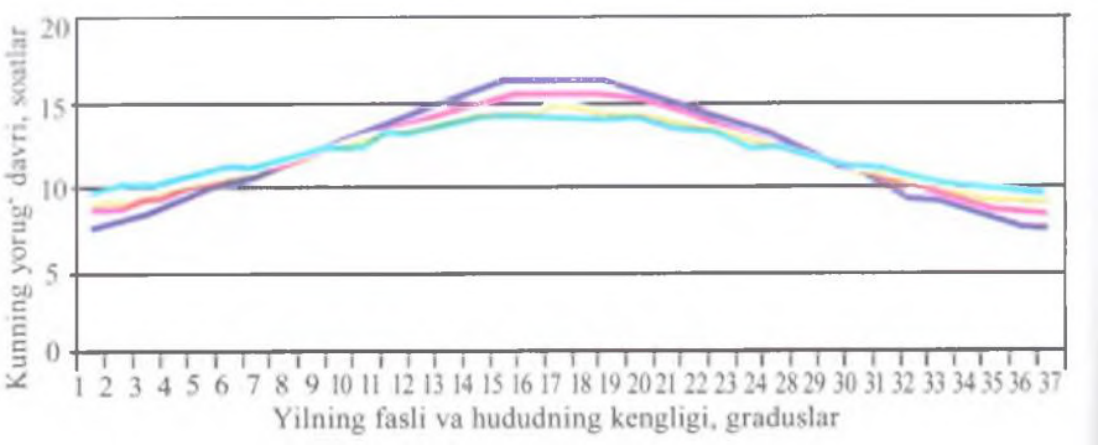
sunlight to 1m2 area is taken into account. The energy of solar radiation reaching the upper part of the atmosphere is 1.395 kW/m2, and this quantity is called the Solar Constant. But before this amount reaches the surface of the earth, it faces various resistances and its amount varies depending on the season of the year and the width of the area under consideration [6-8]. For example, the average intensity of sunlight falling on the Earth's surface:

- in European countries - 2 kW • hour/m2;
- In tropical and Asian countries - 6 kW • h/m2.

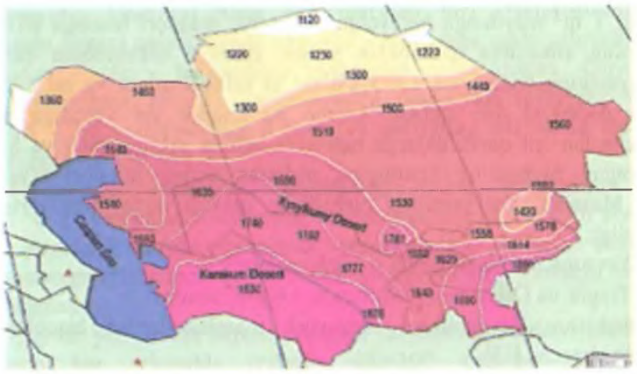
The Republic of Uzbekistan is one of the prosperous countries. Average per year:

- 300 days are considered sunny days;
- 2980 + 3130 hours the average temperature is +42°C, the length of the day is 14-16 hours (Fig. 1);
- the temperature rises to + 70°C in the desert regions;
- up to 1900-2000 kW of solar radiation can be generated in each m2 area in 1 year (Fig. 2).

Figure 1 shows daylight hours in the Republic of Uzbekistan in relation to the width of the territory and the season, and Figure 2 shows the distribution of solar radiation in the countries of Central Asia. Figure 2 shows that the daylight period is 16-17 hours in the 16th and 21st latitudes of the territory of the Republic of Uzbekistan [9-12].




**1-Image. The length of daylight in the Republic of Uzbekistan in relation to the width of the territory and the season of the year.**



**2-Image. Distribution of solar radiation in the countries of Central Asia.**

There is a huge potential for the development of renewable energy sources (RES) in Uzbekistan. While the World Bank statistics mention 100 percent access of the population to the electricity,[13-14] according to some estimates for about 1500 rural settlements of 1,5 million people are not properly connected to the central power grids due to their remote locations and inefficiency of outdated electric power transmission lines. Lack of connection to the electric power supply grids and reduced electricity supplies due to excessive electric power loss on the central transmission and distribution lines create a demand and an incentive for the development of RES in those areas. Over 65 percent of the population in Uzbekistan lives in rural areas. So the biomass energy, small photovoltaic panels and small wind turbines can ensure sufficiency and stability of energy supplies for these peoples.[15] Renewable energy potential in Uzbekistan is estimated to be significant, but with the exception of hydro power is not yet exploited on a larger scale.

Technical potential for the renewable electricity capacity is significant:

- Biomass 800 MW;
- Solar PV 593,000 MW;
- Wind 1,600 MW;
- Small Hydro 1,800 MW.

RES is currently extremely underdeveloped:

- Biomass 1.5 MW;
- Solar PV <1 MW;
- Wind <1 MW;
- Small Hydro 394 MW
-

The government of Uzbekistan, however, aims to reach 21 percent of RES in the overall energy consumption by 2030.[16] To achieve this goal, Uzbek authorities have developed a normative base promoting and regulating the development of RES in the country, including: Bill "On Alternative Energy Sources," State Programme for the "Development Prospects of Alternative Energy Sources and Fuels for 2013–2020," "Long-term conceptual provisions and development directions for the use of renewable energy sources for the production of electric and heat energy in Uzbekistan," and Draft Concept of the Republic of Uzbekistan for development of alternative fuels and energy for 2012–2020.[5] Currently, however, RES are highly underdeveloped since the share of the alternative energy does not exceed 2 percent (excluding medium and large hydro power) of the overall energy consumption. A very low level of awareness of the population and managers about the opportunities of increasing the use of RES remains a pressing concern.

### Solar Energy

Solar energy takes up to 99 percent of the total renewable energy potential in Uzbekistan, which enjoys on average 270–300 sunny days a year. Karakalpakstan enjoys the greatest potential for the production of solar energy of over 19 billion tonnes of oil equivalent (TOE). Andijan region, in the mountainous far Eastern part of the country, has the lowest solar energy potential of 129 million TOE.[17-18] Solar energy research and development in Uzbekistan started in the 1980s, but little progress has been achieved so far. Solar energy potential rich regions of Uzbekistan—Karakalpakstan, Navoi, Bukhara and Surkhandarya—are mostly desert areas with relatively sparsely located population centers and, thus, have prospects for the development of alternative energy. Uzbekenergo and Chinese company Suntech Power have signed an agreement on the establishment of a joint venture for the production of photovoltaic panels for the power of 100 MW. Uzbekenergo, with a loan of US$110 million from the Asian Development Bank, is building a 100 MW capacity photovoltaic power plant in the Samarkand region. The plant is to be constructed by 2019.

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# IMPLEMENTATION OF MINI SOLAR POWER PLANTS IN RESIDENTIAL HOUSES

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**Abstract.** This article contains instructions for drying fruits and vegetables by sunlight, that is, by converting sunlight into heat.

**Keywords:** Drying of fruits and vegetables, Helio-dryer, No energy is used, Effective use of sunlight.

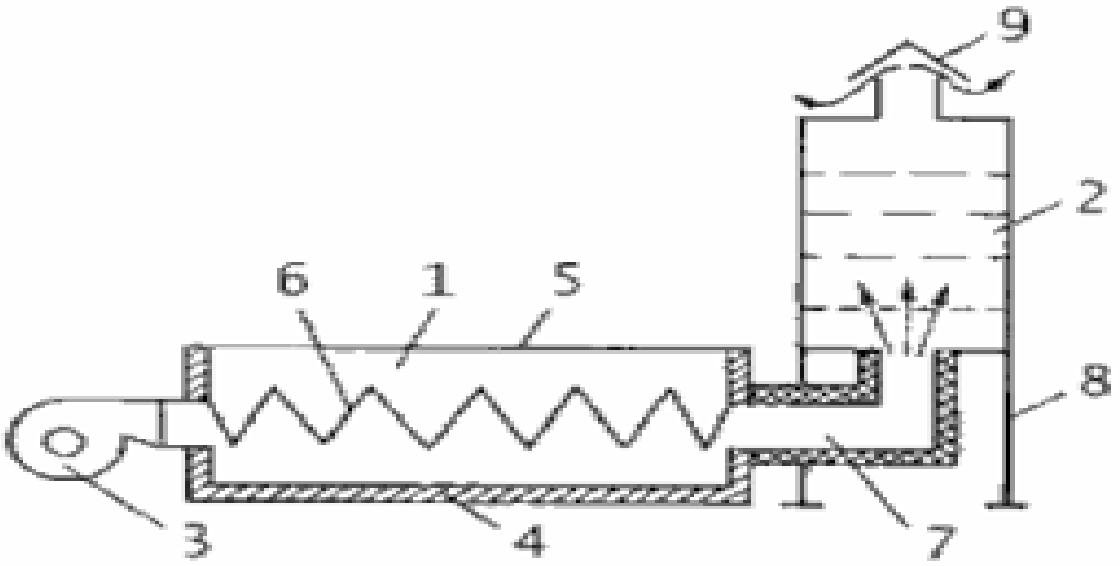
## Enter

Drying is the oldest method of preserving fruits and vegetables. Initially, it was produced only using sunlight, but now special devices - solar or infrared dryers - are used for this purpose [1]. Modern dryers are offered in a wide range, but they mainly consist of several layers of mesh boxes stacked on top of each other. The device is closed with a lid, in the middle of which there is a hole for the release of moist air. The device heats the air masses, which are then directed to the working chamber and affect the ingredients. Metabolic processes are activated in the working chamber, which accelerates their drying process. During the heating process, moisture evaporates from the fruits, and their final moisture content is on average 5-8%. In order to prevent the sudden impact of open air flow on the fruits, it is recommended to first cut them and put them on trays, and after 3-4 days it is enough to store them in a dryer [2].

## MAIN PART

Drying is the oldest method of preserving fruits and vegetables. Initially, it was produced only using sunlight, but now special devices - solar or infrared dryers - are used for this purpose. Modern dryers are offered in a wide range, but they mainly consist of several layers of mesh boxes stacked on top of each other. The device is closed with a lid, in the middle of which there is a hole for the release of moist air. The device heats the air masses, which are then directed to the working chamber and affect the ingredients [3-5]. Metabolic processes are activated in the working chamber, which accelerates their drying process. During the heating process, moisture evaporates from the fruits, and their final moisture content is on average 5-

8%. In order to prevent the sudden impact of open air flow on the fruits, it is recommended to first cut them and put them on trays, and after 3-4 days it is enough to store them in a dryer. Infrared dryer with heating elements This type of dryer emits infrared radiation of a certain wavelength, which is actively absorbed by the water contained in the products, but not absorbed by the fabric of the dried blanks. Thus, when moisture is removed at low temperatures (40-60 degrees), vitamins and biologically active substances are preserved in fruits and vegetables. In addition, they retain their natural color and aroma even after drying [6-8]. The device using infrared heating elements has the following characteristics: retention rate of useful substances: 80-90%; vitamin loss rate: 5-15%; reduction of blanks in size: up to 3-4 times; reduce the weight of blanks: 4-8 times; storage of products after drying: up to 2 years in closed containers [9-12].




**Chamber solar dryer with fan and corrugated heater: 1-Air heater, 2-Drying chamber, 3-Fan, 4-Heat insulated body, 5-Transparent insulation, 6-Black corrugation, 7-Air pipe, 8-Handle, 9 -Hot air outlet.**

The heat-insulated body of the air heater with transparent insulation has a darkened light-absorbing surface made of corrugated metal. In the air heater, the light coming from the sun is converted into heat. Black corrugated is useful for this process [13-14]. The purpose of choosing transparent insulation is to convert sunlight into unobstructed heat. The heat collected in the heater with the help of a fan is directed to the main drying chamber. In order not to lose the quality of the product, a hole is drilled in the upper part of the drying chamber, it prevents the product from becoming too wet [15-18].

## CONCLUSION

Drying of fruits and vegetables has been developed since ancient times, but now devices for drying fruits and vegetables are being developed. Previously, the outdoor environment was used to dry fruits and vegetables, which of course brought many disadvantages, for example, dust impact, bird impact, weather impact, etc. These disadvantages can be avoided with the devices currently manufactured.

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# O‘ZBEKISTONDA QAYTA TIKLANADIGAN ENERGIYA MANBALARIDAN FOYDALANUVCHILARGA BERILGAN IMKONIYATLAR VA BIOMASSA

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**Annotatsiya.** Ushbu maqolada prezidentimizning qayta tiklanuvchi energiya manbalari to‘g‘risidagi qarorlari, mamlakatimizda qayta tiklanuvchi energiya manbalaridan foydalangan jismoniy va yuridik shaxslarga berilgan imkoniyatlari hamda biomassa bioenergetika bilan tanishib chiqamiz.

**Kalit so‘zlar :** yer biosferasi, qayta tiklanadigan energetika, quyosh energiyasi, shamol, daryo, yer osti konlari, bioenergiya, akkumuliyatsiyalashtirish

## KIRISH

O’zbekistonda qayta tiklanadigan energetika sohasidagi davlat siyosatida sanoati rivojlanagan, shu bilan birga rivojlanayotgan qator mamlakatlarning qayta tiklanadigan energiyadan foydalanishdagi rivojlanish tajribasi va ularning miqyosi hisobga olingan. Bu shuni ko’rsatdiki, qayta tiklanadigan energetika sohasida aniq maqsad va vazifani belgilashi hamda davlat tomonidan qo’llab-quvvatlanishi – qayta tiklanadigan energiyaning an’anaviy energiya ishlab chiqarish texnologiyasiga nisbatan raqobatbardosh bo’lishiga ko’maklashadi [1-3].

Qayta tiklanadigan energiya – yer biosferasida to’xtovsiz qayta tiklanadigan va insoniyat miqyosida tuganmas hisoblanadi. Ular – quyosh energiyasi, shamol, okean, daryo, yer osti konlari, bioenergiyadir. Qayta tiklanadigan energiyaning asosiy foydali tomoni – tuganmasligi va ekologik sofligidir. Undan foydalanish sayyoraning energiya muvozanatini o’zgartirmaydi, ya’ni tabiat jarayonlariga ta’sir etmaydi. Bu sifatlari qayta tiklanadigan energetikani chet ellarda, mana endi, Respublikamizda rivojlanishiga xizmat qilmoqda [4-6].

## Asosiy qism

O’zbekiston qayta tiklanadigan energiya bo’yicha ma’lum imkoniyatlarga ega. Yalpi imkoniyat 51 mlrd. t. n. e. (jadvalda ifodalangan) atrofida, lekin hozirgi texnologiya darajasi undan 179 mln.t.n.e.dan foydalanishga imkon bermoqda.

Hattoki, qidi ruv orqali topiladigan yoqilg'ilarni ishlab chiqarishning joriy yillik hajmidan 3 marotaba ortiq [7-9].

Hozirgi kunda mamlakatimiz prezidenti tomonidan qata tiklanuvchi energiya manbalaridan foydalanishni ya`ni yashil energiyadan foydalanishni rivojlantirish maqsadida bir qator ta'kidlab o'tilmoqda hamda qonun va qarorlar imzolanmoqda.

Shunga ko'ra o'tgan yili prezidentimiz Shavkat Mirziyoyevning 16-fevral kuni "2023-yilda qayta tiklanuvchi energiya manbalarini va energiya tejovchi texnologiyalarni joriy etishni jadallashtirish chora-tadbirlari to'g'risida"gi qarorni imzolandi. Qarorga muvofiq 2023- yilda quyidagilar rejalashtirilgan:

- Umumiy quvvati 4 300 MVt bo'lgan qayta tiklanuvchi energiya manbalarini ishga tushirish;
- Qayta tiklanuvchi energiya manbalarini qurilmalarini o'rnatish, iste`molchilarni qayta tiklanuvchi energiya manbalariga o'tkazish va energiya tejamkor texnologiyalarni tadbiq qilish orqali qo'shimcha 5mlrd kilovatt-soat eletr energiyasi ishlab chiqarish va 4.8mlrd mert kub tabiiy gazni iqtisod qilish;
- Ushbu maqsadda jami 15.4 mlrd AQSH dollarni qayta tiklanuvchi energiya manbalariga qaratish rejalashtirillgan;

Shuningdek, ijtimoiyy soxa ob'ektlari, davlat organlari va boshqa tashkilotlarning binolarida kichik quvvatli qayta tiklanuvchi energiya manbalari qurilmalarini o'rnatish va ekspluatatsiya qilish bo'yicha MChJ shaklidagi "Yashil energiya" korxonasi tashlik etilmoqda [10].

Shu bilan birga "Yashil energiya"dan foydalangan aholiga bir qator soliqlardan ozod etilishi belgilanib qo'yildi. Ulardan ba`zilari quyidagilar:

• 2023 yil 1 apreldan boshlab umumiy quvvati 100 Kvtgacha bo‘lgan qayta tiklanuvchi energgiya manbalari qurilmalarini o‘rnatgan jismoniy va yuridik shaxslar ushbu qurilmalar bo‘icha mol-mulk solig‘i, qurima bilan band bo‘lgan maydonlar yer solig‘i hamda yuridik shaxslar tomonidan umumiy tarmoqqa sotgan elektr energiyasi uchun olgan foydasidan xisoblanadigan foyda solig‘ini to‘lashdan ozod etilgan

• quyosh panellaridan foydalanishga topshirilgandan so‘ng 3 yil muddatga; o‘rnatilgan quyosh panellarining quvvatiga nisbatan 25 foizdan kam bo‘lmagan quvvatga ega elektr energiyasini akkumuliyatsiyalashtirilgan bo‘lsa – o‘n yil muddatga soliqlardan ozod etilishi belgilangan.

2023-yil 1 apreldan boshlab “Quyoshli xonadon” dasturi amalga oshirildi va uning doirasida:

• jismoniy shaxslarga tegishli joylarda o‘rnatilgan quyosh panellarida ishlab chiqarilgan elektr energiyasi o‘z iste'molidan ortib qolgan eletr energiyasini davlatga sotishi ham mumkin va bunda davlatimizga o‘tgan har bir kilovatt-soatiga Davlat byudjetidan 1 000 so‘mdan subsidiya ushbu jismoniy shaxsga ajratiladi;

• lekrt energiyasidan kelgan subsidiya to‘lovlari jismoniy shaxslarning jami daromadlari tarkibiga kiritilmaydi;

• ushbu subsidiyalar soliq organlari tomonidan har oyda “Soliq” mobil ilovasi orqali hisobot oyidan keyingi oyning 25-sanasiga qadar fuqarolarning bank plastik kartalariga o‘tkazib beriladi.

Bir oy davomida davlat tomonidan begilab qo‘yilgan iste'mol qilishimumkin bo‘lgan elektr energiyasi hajmidan ko‘p bo‘lgan taqdirda, shu oy uchun elektr energiyasi bo‘yicha to‘lov qilinmaydi. Agarda oy davomida yagona elektr energetika tizimidan iste'mol qilingan elektr energiyasi hajmidan kam bo‘lgan taqdirda, shu oy uchun elektr energiyasi bo‘yicha to‘lovlar iste'mol qilingan va uzatilgan elektr energiyasi farqidan kelib chiqib hisoblanadi [11-13].

Yurtimizda yana bir energiyaga biogaz, biomassaga bo‘lgan qiziqish ham ortib bormoqda. Biomassa o‘zi nima? Biomassa bu - chiqindini yoqish natijasida olinadigan energiyadir. Qurigan daraxt yoki ularning shoxshabbasi, tomorqadan poliz o’simliklarining ildizpoyalari, yog’och qobig’i va qirindilari kabilardir. Bunday chiqindilar tarkibi chorva fermalarida ozuqa va to’shama sifatida ishlatiladigan somon hamdir. Ko’proq miqdorda qishloq xo’jaligi ekinlari: don, paxta, makkajo’xori va boshqalar bo’lishi mumkin [14].

Biomassadan foydalanish juda oddiy. Maxsus pechlar yoqilib, qozonlarda suv isitiladi, buqqa aylantirib va elektr energiyasi olish uchun trubinalar aylantiradi.

Odatda uyimizdan chiqqan, maishiy chiqindilar chiqindixonaga chiqarilib, ko'mib tashlanadi. Maishiy chiqindi ham biomassaning bir turi, undan ham bioyoqilg'i ishlab chiqarishda foydalanish mumkin [15].

Biogaz odatda karbonat angidrid (CO2) va (CN4) metan gazlari aralashmasidir. U havo va kislorod kirishi mumkin bo'lmagan holatda (kislorod bo'lmasligi, «anaerob holati» deyiladi), turli biologik mikroorganizmlar parchalanishidan hosil bo'ladi. Xashak bilan oziqlanadigan hayvonlar, jumladan, yirik va mayda shoxli mollar ko'p hajmda biogaz ishlab chiqaradi. Aniqrog'i, hayvonlarning o'zi emas, ularning me'da-ichak tizimida yashovchi mikroorganizmlar ishlab chiqaradi. Biogaz uskunalari har xil hajmda bo'lishi va uy xo'jaligida har xil hayvonlarning go'ngidan foydalanish mumkin.

**Biogazning tarkibi**

**1-jadval**

| Ko'rsatgichlar | Metan $CH_4$ | $CO_2$ Komponetlari | $N_2$ | $N_2S$ | 60 foiz CH4+ 40 foiz CO2 aralashmalari |
|---|---|---|---|---|---|
| Hajmdagi hissasi, foiz | 55-70 | 27-44 | 1 | 3 | 100 |
| Hajmdagi yonish issiqligi, MDj/$m^3$ | 35.8 | 10.8 | 22.8 | - | 21.5 |
| Yonish temperaturasi , Co | 650-750 | - | 585 | - | 650-750 |
| Zichligi | | | | | |
| Normal g/l | 0.72 | 1.98 | 0.09 | 1.54 | 1.2 |
| Xavfli holat, g/l | 102 | 408 | 31 | 349 | 320 |

Mamlakatimizning yarmidan ko'p aholosi taxmiman 60-65 %dan ko'proq aholisi qishloq hududida istiqomat qiladi. Biogaz texnologiyasini rivojlantirishning asosiy yo'nalishlaridan biri bu mahalliy fermer xo'jaliklaridir. Dastlabki biogaz zavodlarini yaratish ham ularni amalda sinab ko'rish ham shu fermer xo'jaliklarida amaliyotga tadbiq qilinadi [16-18].

Bugungi kunga kelib yurtimizning Toshkent, Jizzax, Qashqadaryo, Xorazm, Samarqand, Farg'ona, Andijon viloyatlarida biogaz qurilmalari qurilgan va hozirda ishlamoqda. Qurilmalardan faqatgina o'z fermer xo'jaliklari uchun yetadigan biogaz ishlab chiqarishda foydalanib kelinmoqda.

Hozirda mamlakat hududlarida turli xil quvvatga ega bo'lgan 8 dona biogaz qurilmalari ishlab turibdi. Shuningdek, biogaz ishlab chiqarish jarayonida hosil bo'ladigan sifatli tabiiy o'g'it qishloq xo'jaligi mahsulotlari hosildorligini yanada

oshiradi, kimyoviy o‘g‘itlar o‘rnini bosib, fermerlar xarajatlarini tejashga hamda ekologik toza mahsulotlar yetishtirishga xizmat qiladi.

## Xulosa

Qayta tiklanuvchi energiya – bu atrof-muhit energiya oqimidan olinadigan energiyadir. Bu manbani quyosh, shamol, suv resurslaridan hosil bo’lgan energaya, sanoat, qishloq xo‘jalik chiqindilaridan olingan biogas ham tashkil qilib kelmoqda. Yaqin kelajakka kelib har bir barqaror rivojlanishida turgan mamlakatning energetika tarmog‘ida qayta tiklanuvchi energiyaga bog’lanishi kuchayib boraveradi. “Yashil energiya”ga, “Yashil iqtisodiyot”ga o‘tish jarayoni har bir mamlakat uchun alohida ahamiyat kasb etib, tabiiy boylik va iqtisodiy o’sish kabilarga bevosita bog‘liq holda ro‘y beradi. Shu tufayli o‘tish jarayoni uchun huquqiy, infratuzilmaviy va boshqa qulay muhit yaratish zarur. Xulosa qilib aytganda, qazilma resurslarining cheklanganligi va ekologik muammolarning salbiy oqibatlari sharoitida “Yashil iqtisodiyot”ni shakllantirishga ob’yektiv ehtiyoj paydo bo‘lmoqda. “Yashil iqtisodiyot”ga o‘tish resurslardan samarali foydalanish, ekologik muvozanatni ta’minlash, yangi ish o‘rinlarini yaratish, barqaror iqtisodiy o‘sishni ta’minlash imkonini beradi.

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# INCREASING ENERGY EFFICIENCY OF BUILDINGS AND STRUCTURES

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**Annotatsiya**: This article is about the environmental impact of increasing the energy efficiency of buildings and structures. Thermal-physical properties of substances, materials and products properties (IFX) or thermal-physical characteristics (IFT) - heat conductivity, temperature conductivity, heat transfer, heat transfer coefficients, thermal resistance of heat transfer, specific volume or weight heat capacity, blackness level, saturation temperature.The biggest concern in the construction of buildings is environmental damage. The article presents information about the development and use of electricity in Uzbekistan, energy analysis in buildings and structures, and mainly about energy-efficient buildings currently being developed for buildings and structures. Current modern houses have low impact on the environment and information about measures to prevent ecological damage.

**Key words:** ecology, energy analysis, insulated buildings, energy audit, environment.

Increasing the energy efficiency of buildings and structures has a great impact on the environment. This can be done by reducing energy consumption in buildings and structures and applying technologies and methods that include energy use [1-2]. For example, it is possible to increase energy efficiency through amenities and automated systems, optimize heating and cooling systems in facilities, and expand processes such as the use of electricity with recommended technologies. Such actions increase the energy efficiency of buildings and structures and help protect the living environment [3-5].

Light energy consumption: More electricity can be produced by switching to energy methods that derive from light sources (such as solar, wind, water and sound). This energy consumption may be related to energy performance in ecologically advanced species. Increase electricity efficiency: Energy consumption can be

increased by obtaining electricity from the most energy-efficient sources available through transmitters. These different methods can also be prioritized to increase energy consumption for buildings, electric machines and planetary machinery. Faster devices and optimal constructions: Energy consumption can be increased through the use of energy and careful construction and equipment in the manufacturing and production process [6-8]. This can be related to the construction of desired products and services with caution and under the influence of these products. Increasing the energy efficiency of buildings and structures can be good for the environment, as these methods have an environmental impact, and each building and structure with increased energy consumption can be offset by weight and energy costs. Increasing the energy efficiency of buildings and structures has a great impact on the environment. This can be done by reducing energy consumption in buildings and structures and applying technologies and methods that include energy use. For example, it is possible to increase energy efficiency through amenities and automated systems, optimize heating and cooling systems in facilities, and expand processes such as the use of electricity with recommended technologies. Such actions increase the energy efficiency of buildings and structures and help protect the living environment [9-10].

Information on calculated outdoor air temperatures in the cities of the Republic of Uzbekistan and rural areas adjacent to them 1 KMK 2.01.01. - 9 is located in the table of 7. The calculated temperature ts of the hot attic is assumed to be equal to 14°C based on the calculation of the heat balance of the system, including the rooms located below the hot attic. The design temperature of the roof without an attic is assumed to be equal to the design temperature of the outside air. Today, in our Republic, the development of the way of living of the population in rural areas, the construction of houses based on model projects is inextricably linked with the development of rural infrastructures and the construction of infrastructure facilities. Many houses and apartments were built on the basis of model projects in accordance with the "Program for construction of affordable housing according to updated model projects in rural areas in 2017-2021", approved by the decision of the President of the Republic of Uzbekistan No. PQ2639 dated October 21, 2016, and a family in need of improvement of living conditions was provided with housing. 800 low-carbon three-room energy-efficient houses were built in Samarkand, Surkhandarya, Fergana, Khorezm and Bukhara regions within the framework of the project "Supporting the development of energy-efficient rural housing construction in Uzbekistan". Photoelectric plants (FES) with a capacity of 300 Watts are installed

and working in each of these houses for lighting needs. Ten such houses are equipped with solar water heaters with a capacity of 200 liters of water. One of the modern trends in housing construction is to carry out design and construction works taking into account the convenience, environmental and energy efficiency of the houses that are planned to be built. As we know, reserves (oil, gas and coal) are the main sources of energy in the world. According to experts' calculations, energy sources can last up to 100 years. In many developed countries, almost half of the energy consumption falls on houses. Therefore, one of the main ways to save resources is to improve the energy efficiency of buildings. A slightly different approach to energy conservation has developed in commercial real estate construction. Here, the client seeks to improve the thermal properties of the building and reduce utility costs. At the same time, the additional costs incurred to increase the energy efficiency of the building will be returned within 7-10 years. Therefore, energy-saving technologies are quite common in the construction of commercial real estate: banks, administrative buildings, office and commercial buildings. Today, the energy consumption of residential and public buildings in Uzbekistan is about 3 times higher than in the technically developed Scandinavian countries with similar natural and climatic conditions. The absurdity of the current situation is that, in fact, increasing the energy efficiency of buildings is not only environmentally desirable, but also economically useful. Uzbekistan's planned membership in the World Trade Organization (WTO) will lead to the convergence of heat tariffs to the level of prices in Western countries and a decrease in the domestic interest rate, which is currently 15-20%. The government of the Republic of Uzbekistan has since confirmed that the increase in utility tariffs will be equal to 20% annually. Since 2011, wholesale prices for natural gas are calculated according to the formula equal to the profitability of its export trade. It should be noted that the main reason for the introduction of energy-saving technologies in local construction is that our climate is more severe than the European climate. In confirmation, it is possible to bring such indicators as the degree-days of the heating period, which is the main criterion for assessing the severity of the climate.

Knowing the reasons for the deterioration of the environmental situation, it is possible to organize measures to prevent them, for example: use of effective dust collection devices and systems; introduction of the wet method of production; mutual placement of emission sources and settlements, taking into account wind directions; organization of sanitary protection zones; greening of technological processes and, first of all, creation of closed technological cycles, low-waste and

zero-waste technologies, etc. Such measures, of course, do not exclude all negative effects of construction on the atmosphere, but help to significantly reduce its impact. In the second half of the 20th century in the territory of Uzbekistan, almost all large and medium to the standard projects of the industrial series of mass residential construction in cities done according to Most of these houses have been built over the past 40-50 years morally and materially obsolete and now urgently needs to be reconstructed. Energy in operation of existing residential and public buildings in Uzbekistan The consumption is natural and the characteristics of the climate are roughly similar to the technical development compared to other countries, it is 3 times higher. In addition, of the last century Many buildings built in the late 50s and 60s are now dilapidated and dilapidated in the situation. Over the past 10-15 years, theoretical developments have been carried out. Energy saving programs were actively discussed and a number of experimental buildings were built [11-13]. Academic Under the scientific guidance of S.N.Bulgakov, Russia, Belarus and other countries of the CIS on the reconstruction of residential buildings of the first industrial series in cities scientists, architects and project specialists, studying foreign experience and some examples groups of quarters and microdistricts without disturbing or existing buildings minimally by demolishing it and rebuilding it by increasing the residential area by 2-3 times the concept of rehabilitation of residential buildings with five floors and less, technical developed solutions and socio-economic justification. At the moment this There are lively discussions around the topics, in which buildings and structure develop a number of specific recommendations that will help reduce energy consumption developed. In particular, the following recommendations have been developed in the field of urban planning policy. brief conclusions are given. Their specific heat losses of residential and public buildings volume-planning solutions and, in particular, the following indicators have a significant impact:

- the total area of the building and the area of external barrier wall structures proportion;
- the ratio of the area of window seats to the area of external walls;
- the configuration of the buildings on the plan, in relation to the relief and the horizon placing In terms of planning, 1-3-story houses and their facades reduce the area of walls (glazing) and thereby prevent heat loss. At the same time, the main thing is the design of the drum at the entrance and the house. It should be built facing south, because the main heat for heating the house. The source is solar energy. Houses are shaded by other buildings and trees. The heat transfer resistance of the

walls is from 0.15 kW/m2 should not exceed, for this internal or bilateral (internal and external) heat insulation is used [14-19]. Today, the population in rural areas in our Republic development of lifestyle, construction of houses based on model projects development of rural infrastructures and construction of infrastructure facilities is inextricably linked. 21 of 2016 of the President of the Republic of Uzbekistan "In 2017-2021, rural to the program of construction of low-cost housing on the basis of updated model projects Many houses and apartments have been built on the basis of appropriate model projects and accommodation a family in need of improvement was provided with housing. Also in our country, today we build energy-efficient, economical houses as one of the most important factors in the development of the construction industry attention is drawn, in particular, within the framework of state programs in rural and urban areas residences, social sphere objects being built on the basis of model projects Enriching the buildings with these features is the main task is being determined [20-23].

Energy audit - by economic entities costs of consumed energy resources to determine the possible reduction potential and implementation, taking into account the priority of implementation technical and economic basis recommended for increase type of activity aimed at developing proposals. Energy audit anyone who wants to control energy costs is a key part of an organization's energy management program. Creating an accurate and detailed energy audit program from energy the main types of production processes used complex and time-consuming to define, but necessary is a procedure. At the same time, the energy audit is in the enterprise is the first step in the organization of energy management. Energy audit of the arrival, transfer, beneficial use and output of energy includes drawing up reflective balance sheets. Energy audit is a complex and expensive event necessity and usefulness are always clear for company managers it's not. That's why the management of the enterprise at every stage [24-25]. It is recommended to carry out a step-by-step process with finding a consensus will be done. These are certain requirements for the energy audit algorithm puts The results of each previous stage with the representatives of the client ending with discussion, mutual understanding need Only then can you move to the next stage is increased. An important aspect of conducting an energy audit is not only the presentation of the results, but all the energy auditor works is the confidentiality of the documents because it represents a commercial secret possible Energy auditor and energy audit special requirements are placed on the company's qualifications.

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# QUYOSH ISSIQLIK QURILMALARI YORDAMIDA SUV ISITISH TEXNOLOGIYASINI TADBIQ QILISH VA OPTIMALLASHTIRISH

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**Annotatsiya:** Ushbu maqolada quyosh issiqlik qurilmalari vositasida suv isitish texnologiyasi tahlil etiladi. Aytib o`tish joizki, mazkur turdagi qurilmalar yilning 9 oyi davomida suvni isitish uchun elektr energiyasini 100 foiz tejash imkoniyatiga ega bo'ladi. Qish oylarida esa 70 foizgacha energiyani tejashga erishiladi.

**Kalit so'zlar:** issiqlik qurilmasi, texnologiya, isitish, optimallashtirish.

Bugungi kunda energiya tejovchi manbalardan foydalanishga ko'proq ahamiyat berilmoqda. Quyosh nuri orqali ishlaydigan qurilmalarga bo'lgan talab ham oshib bormoqda [1]. Quyosh vakuumli suv isitgichlari yoki kollektorlari yaxlit va bo'lingan turlari bo'lishi mumkin. Shunday qilib, bitta qismli kollektor (monoblok) vakuum shishalaridan va bitta konstruksiyada mahkamlangan issiq suv akkumulyatoridan (termos) iborat. Kollektori-monoblok asosan bino yoki uyning tom qismiga o'rnatiladi va shu bilan iste'mol manbaiga kerakli bo'lgan issiq suv bosimini yetkazib beradi. Saqlash idishi issiq suv haroratining uzoq muddatli saqlanishini ta'minlaydi. Shunday qilib, qishda havo harorati 0 °C darajadan past bo'lganda issiqlik yo'qotilishi faqat 3−6°C daraja bo'lishi mumkin. Ya'ni, agar tunda kollektorda suv harorati + 60 °C bo'lsa, ertalab bu ko'rsatkich 5 °C dan oshmaydi va +55°C bo'ladi. Aqlli tekshirgich (Smart kontroller) barcha ish jarayonlarni, shu jumladan, idishdagi suv darajasini, suv sathini tartibga solishni, agar kerak bo'lsa 1,5 kVt quvvatli elektr isitish moslamasini yoqish va o'chirish ishlarini boshqaradi [2-3]. Mamlakatimizda ham tabiiy boyliklarni tejash va ishlab chiqarish tarmoqlariga ekologik sof texnologiyalarni joriy etishga alohida e'tibor qaratilmoqda. Mutaxassislarning ta'kidlashicha, yurtimiz iqlim sharoitida quyosh noan'anaviy energiya turidan foydalanish borasida ulkan imkoniyatlar mavjud. Respublikamiz hududida yilning deyarli 310-320 kuni quyoshli bo'ladi. Bunday tabiiy imkoniyat bugungi kunda jahon bo'yicha tobora ommalashib borayotgan qayta tiklanuvchi energiya manbalaridan samarali foydalanishda qo'l keladi. Iste'molchi kollektordan, xususan yuqorida aytib o'tilgan yaxlit turidan foydalanib, yilning 9 oyi davomida

suvni isitish uchun elektr energiyasini 100 foiz tejash imkoniyatiga ega bo‘ladi. Qish oylarida esa 70 foizgacha energiyani tejashga erishiladi. Bir qismli vakuumli quyosh suv isitgichlari suvni 100 darajadan yuqori darajada isitish imkoniyatiga ega va shu bilan tabiiy gaz, elektr energiyasi va qattiq yoqilg‘iga muqobil energiya manbai bo‘lib hisoblanadi. Yaxlit quyosh tizimi har qanday uy-ro‘zg‘or o‘jaligiklarida, shuningdek, shaxsiy va tijorat maqsadlarida foydalanish uchun mo‘ljallangan va ayniqsa, issiq suv hajmi 4−10 iste’mol nuqtalari uchun kuniga 1000 litrdan oshmaydigan holatlarda afzal hisoblanadi. Uskunalar hech qanday operatsion xarajatlarni talab qilmaydi, chunki aqlli tekshirgichning ishi tufayli u mustaqil ravishda ishlaydi, uni issiq suv iste’moliga qarab bir marta sozlash kifoya [4-7]. Bundan tashqari, O‘zbekistonda energiya samarador va energiya tejaydigan qurilmalarni sotib olganligi uchun kompensatsiya puli olish va ushbu maqsadlar uchun olingan kreditlar bo‘yicha foiz xarajatlarining bir qismini qoplash mumkin. Bunday kompensatsiyalarni taqdim etish tartibi to‘g‘risidagi nizom Vazirlar Mahkamasining 2021-yil 14-aprelda qabul qilingan 217-sonli qarori bilan tasdiqlangan. Nizomga muvofiq, O‘zbekiston Davlat budjetidan kompensatsiya quyidagi xarajatlarning bir qismini qoplash uchun beriladi:

- jismoniy shaxslarga — quyosh fotoelektr stansiyalari, quyosh suv isitgichlari, shuningdek energiya tejaydigan energiya samarador gaz-gorelkali qurilmalarni sotib olish xarajatlari;
- jismoniy va yuridik shaxslarga — tijorat banklaridan qayta tiklanuvchi energiya manbalari qurilmalari, energiya samarador gaz-gorelkali qurilmalar va qozonlar, shuningdek, energiya samarador boshqa uskunalarni xarid qilish uchun olingan kreditlar bo‘yicha foiz xarajatlarining bir qismi qoplashga.

Nizom talablari 2020-yil 1-yanvardan o‘z mablag‘i va kreditlar hisobidan energiya samarador va energiya tejovchi qurilmalarni xarid qilgan va o‘rnatgan shaxslarga tatbiq etiladi [8-13].

Kompensatsiya Davlat byudjetidan quyidagi miqdorlarda ajratiladi:

a) jismoniy shaxslarga quyosh fotoelektrik stansiyalari, quyosh suv isitkichlari, shuningdek, energiya samarador gaz-gorelkali qurilmalarni sotib olish xarajatlarining 30 foizi miqdorida, biroq:

- quyosh fotoelektrik stansiyalari uchun — 3 million so‘mdan;
- quyosh suv isitkichlari uchun — 1,5 million so‘mdan;
- energiya samarador gaz-gorelkali qurilmalar uchun — 200 ming so‘mdan oshmaydigan miqdorda;

b) tijorat banklaridan qayta tiklanuvchi energiya manbalari qurilmalari, energiya samarador gaz-gorelkali qurilmalar va qozonlar, shuningdek, energiya samarador boshqa uskunalarni xarid qilish uchun olingan kreditlar bo‘yicha foiz xarajatlarining bir qismi qoplashga:

- jismoniy shaxslarga — 500 million so‘mdan oshmaydigan kreditlar bo‘yicha — Markaziy bankining qayta moliyalash stavkasidan oshgan qismida, biroq 8 foiz punktidan ko‘p bo‘lmagan miqdorda;
- yuridik shaxslarga — 5 milliard so‘mdan oshmaydigan kreditlar bo‘yicha — Markaziy bankining qayta moliyalash stavkasidan oshgan qismida, biroq 5 foiz punktidan ko‘p bo‘lmagan miqdorda.

Kompensatsiya faqat bir turdagi xarajat uchun jismoniy yoki yuridik shaxsning xohishiga ko‘ra taqdim etiladi [14-17].

Quyoshdan quvvat oladigan suv isitgich moslama-lar quyosh kollektorlari orqali suv haroratini oshirish uchun quyosh nurlari energiyasidan foy-dalanadi. Shaffof qoplamali havo o‘tkazmaydi-gan korpusli, qora rangga bo‘yalgan, suv o‘tkazgich naychalarga ega singdiruvchan metall plastina va korpusining orqa hamda yonbosh devorlarida issiqlikni yo‘qotmaslik uchun izolyatsiyalangan yassi quyosh kollektorlari keng tarqalgan. Passiv tizimlarning ikkita - yopiq-qo‘shqavat va o‘z oqimi bilan uzatiladigan turi mavjud [18-22]. Yopiq-qo‘shqavat tizimlarda gorizontal suv to‘plagich rezervuar bevosita kollektorning ustida - tomda montaj qilinadi. Bu tizim uni montaj qilishga ketadigan xarajatlarga nisbatan ancha tejamli hisoblanadi. Biroq uning unumdorligi yilning salqin va sovuq vaqtlarida suv to‘plagich rezer vuarda issiqlikning yo‘qotilishi sababli pasayadi.

Quyosh nuridan quvvat oladigan suv isitgich paneli quyosh energiyasidan to‘liq foydalanishni ta’minlash uchun quyosh harakati trayektoriyasiga muvofiq joylashtirilishi lozim. Odatda kollektorlar ufq burchagiga qarab joylashtirilganda ish samaradorligi yuqori ish samaradorligi yuqori bo‘ladi [23-25]. Negaki bunday holatda quyosh nurlari quyosh kollektorlari ustiga ko‘proq tushadi hamda isitish jarayonini yaxshilaydi.

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# IMPLEMENTATION OF SMALL HYDROPOWER PLANTS IN AGRICULTURE

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**Keywords:** Small hydroelectric plants, hydropower of Uzbekistan, Small hydroelectric plants, Small hydroelectric plants are their types.

**Abstract.** In this article, the guidelines for the application of small hydropower plants to agriculture were considered.

## Enter

Currently, the design and construction of water management networks and complex hydroelectric units is carried out in accordance with the requirements of water supply of the national economy, irrigation, hydropower, water transport, fisheries and other sectors. The main problem of modern national economy is the problem of rational integrated use of water resources and its protection [1-4]. The development of industry and agriculture, the improvement of the urban and social situation creates demands for the use and protection of many water resources. From 1961 to 1980, water consumption in the Commonwealth of Independent States (CIS) more than doubled. Every year, the national economy uses more than 300 km3 of water, which is 6% of the total annual river water volume and is equal to 4.74 thousand km3. The most important current water consumer is agriculture (irrigated land) up to 60% and industry up to 30% of total water. Heat energy, metallurgy, fuel, oil, chemical, industries that have a great need for water include [5-7]. The amount of water used for utilities is not very large. With the increase in the level of water use, industrial, agricultural and municipal wastes are being poured into rivers and water bodies. As a result, pollution of many water sources or deterioration of water quality is observed.

## MAIN PART

Uzbekistan is a country rich in hydropower, oil and gas fuel, and coal, which are effective types of energy sources. Currently, fuel products are the main source of electricity production in our republic. 60 billion in our country every year. About m3 of gas is produced. Gas and other fuel products can be used up in 30-40 years.

Approximately 48 thousand GW in one year in our republic. hour of electricity production, the share of gas and fuel-fired power plants is 84%, the share of coal-fired power plants is 3.5%, and the share of hydroelectric power plants is 12.5% [8-11]. Until 1923, there was only Murgob HPP with capacity N=1350 KW in Uzbekistan. Since 1923, hydropower began to develop in Uzbekistan, and in 1930 the Hydroproject was established, in 1926 the Bozsuv HPP with a capacity of N=4 MW, in 1933 the Kadirya HPP with a capacity of N=13 MW, in 1936 with a capacity of N=6.4 MW Borijar hydroelectric power plant, 1938-1941, the construction of Tavoqsoy hydroelectric power plants with N=73.6 mW and Komsomol hydroelectric power plants with N=86.4 mW began; The years 1941-1960 are characterized by increasing experience in hydraulic construction [12-18]. During this period, new technical methods of hydrotechnical construction were developed, from the construction of small and medium hydroelectric power stations to the construction of large hydroelectric power stations. During this period, Chirchik - Bozsuv tract hydroelectric power stations, Farhod hydroelectric power station with capacity N = 126 MW, Namangan hydroelectric power stations 1, 2, 3, 4, Aksuv hydroelectric power station, Okkavok hydroelectric power station, 6, 7 Shahrihan hydroelectric power station, Hishrav hydroelectric power station, Kumkurgan hydroelectric power station and other hydroelectric power stations were built; In 1961-1984, the construction of hydraulic engineering reached the level of high world practice. High dams were built, large hydroelectric power plants: Chorvoq hydroelectric power station, Khojakent hydroelectric power station, Ghazalkent hydroelectric power station, Tuyamoyin hydroelectric power station with a capacity of N=150 MW, Andijan hydroelectric power station with a capacity of N=140 MW were designed and started to be built; 1984-1990, during this period the first aggregates of the unique Charvoq HPP were put into operation; Gazalkent HPP with capacity N=120 MW, Uchkorgon HPP with capacity N=180 MW were built [19-25]. The design and construction of hydropower facilities has risen to the highest world level. In the use of the hydropower potential of the rivers of Uzbekistan, the requirements of many sectors of the national economy, especially the irrigation sector, were taken into account, and it was carried out in harmony with the construction of general hydrotechnics; stage from 1990 to the present. agricultural energy consumption in 2005 was estimated at 11.7 billion. KWh has reached, by 2010 this figure will be estimated at 20 billion. It can reach KW hours and cause electricity shortages [26-28].

## CONCLUSION

Currently, half of the irrigated land in Uzbekistan is related to energy-consuming machine water pumping, the ever-increasing electricity tariff is an urgent issue today, that is, to supply the national economy with hydroelectric power stations, which are a cheap energy source. is cleaning up the ride. Economic studies of foreign scientists show that hydroelectric power plants will remain the main source of electricity production in the long term, as the price of fuel products increases, and the construction and operation of thermal and nuclear power plants become more expensive. At the current stage, taking into account all the difficulties associated with the construction of large hydroelectric power plants, it is possible to build medium and small hydroelectric power plants in existing irrigation networks and water reservoirs. It has been a long time since all existing small hydroelectric power plants in Uzbekistan were built and paid for, and today they are operating efficiently.

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# SELECTING CONTROLLERS AND INVERTORS FOR SOLAR CELLS

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## Abstract

In this article we are going touch on some of the topics about solar cells, invertors , controllers as well as in what they are more beneficial and at their best sufficiency. Also we are going do discuss what are the advantages and disadvantages of installing solar cells and how much does one need to wait until those cells to pay off. And keeping with that theme we are also going touch on the ways that these devices including invertors, controllers as well as solar cells function.

**Key words:** AC,DC efficiency, monobloc, thermos, solar cells, solar radiation

## Introduction

Solar cells can be arranged into large groupings called arrays. These arrays, composed of many thousands of individual cells, can function as central electric power stations, converting sunlight into electrical energy for distribution to industrial, commercial, and residential users [1]. Solar cells in much smaller configurations, commonly referred to as solar cell panels or simply solar panels, have been installed by homeowners on their rooftops to replace or augment their conventional electric supply. Solar cell panels also are used to provide electric power in many remote terrestrial locations where conventional electric power sources are either unavailable or prohibitively expensive to install. Because they have no moving parts that could need maintenance or fuels that would require replenishment, solar cells provide power for most space installations, from communications and weather satellites to space stations [2]. (Solar power is insufficient for space probes sent to the outer planets of the solar system or into interestler space, however, because of the diffusion of radiant energy with distance from the sun.)

For solar panels to be a reliable source of electricity it is necessary to provide additional elements in the system: cables, depending on the type of system (grid-connected FES, autonomous, reserve) depending on the structure, electronic inverter,

battery pack and charge-discharge controller. Such a system is a total solar photovoltaic system or solar station is called.Solar photoelectric plants used in ground conditions can be divided into the following classes according to their application [3-4]. These systems are mainly divided into 3:

1) Autonomous Solar Photoelectric Stations (AFES);

2) Reserve Solar Photoelectric Stations (RFES);

3) Solar photoelectric plants connected in parallel with the power grid.

In turn, components are used to operate these photoelectric plants. For example, inverter, controller, storage battery, etc. Below we will discuss how to choose an inverter and controller.

The term "invertorization" comes from the Latin inversio ─ to turn over, to change. The principle of operation of the inverter is the opposite of the principle of operation of the rectifier, that is, while the rectifier converts AC energy into DC energy, the inverter converts DC energy into AC energy [5-7].

**Invertors.** The inverter device's role is to control the voltage and frequency of the power supply and seamlessly change the rotation speed of motors used in home appliances and industrial machineries.

The first thing to keep in mind when it comes to enriching your understanding of the internal structure of an inverter device, is that the converter circuit converts alternating current (AC) coming from the power source into direct current (DC), and the inverter circuit changes the converted direct current (DC) back into alternating current (AC). They work as a set. The diagram below shows the role they both play and the way they work [8-12].

Converts low-voltage direct current to alternating current (220 V, 50 Hz). Inverters range from 250W to 8000W. Inverters of 3000W and above are often capable of handling up to several units. in parallel connection, the total output power must be increased by a suitable number. They can also be combined to build a 3-phase network. The electricity produced by modern sine wave inverters is better than what comes to your home from the local grid. There are also "modified" sine wave inverters - they are not very expensive, but they are suitable for most home applications. They can cause small noises in electronic equipment and telephones. An inverter can also act as a "buffer" between the home and the utility grid, allowing excess electricity to be sold to the utility grid. The main things to consider when choosing an inverter: Each inverter has a rated voltage, for example, 12V, 24V, etc. In general, the standard quantities for all household appliances designed for 220-230 volts and 50 hertz are important for us. Here, one of the most important factors is

that the output power of the inverter should be greater than the maximum power of the consumer. During operation, it is not recommended to start the charging and inverter process at the same time, and it is not recommended to open its internal parts during operation [13-16]. In practice, small solar power plants cannot be used without inverters, as we all know that the battery accumulates constant current charge. So what kind of inverters to choose. One and three-phase pure sine inverters can be used depending on the power to be installed in the house.

**Inverter WK 500W 12/24/48 V**


**Controllers**. As we all know, solar panels cannot be directly accumulated, because playing with the amount of voltage required by the batteries will cause them to fail. The solar power management device, i.e. controllers, serves this task, i.e. control of the charging process. The controller is an important element of a solar power plant and is considered to be the main mechanism for ensuring that the rest of the equipment works properly, especially that the batteries can be properly charged [17].

Here is how a typical controller looks like

There are two main types of control device:

• MPPT charge controller. It is a device that has a significant effect on the amount of energy collected, increasing it by 25-30% compared to other charge testers. The principle of operation of this device is based on the algorithm of tracking the maximum power point of the solar module. The efficiency of such systems is

high. Despite the high initial cost of this product, the payback period of the solar power plant is much shorter. If you have made a choice in favor of the MPPT controller, then the next step is to choose the right model according to the number of solar modules already selected and the technical parameters [18].

• We recommend using a PWM charge controller only in areas with very high solar activity. This is an "economical" version with a very simple algorithm. In regions with low solar activity, their use is not appropriate and not economical.

When choosing a battery charge tester, you should follow the following rules:

1. Input voltage. Manufacturers regulate the voltage of connected solar panels. Therefore, the maximum allowable input voltage indicated in the technical data of the control devices must correspond to the open circuit voltage of the solar cell (SB) or the sum of the open circuit voltages of a group of solar modules connected in series and the excess limit. at least 20% [19].

2. The total power of the solar panels should not exceed the product of the output current of the controller and the system voltage. In this case, it is necessary to obtain the system voltage for discharged batteries. Also, in case of abnormally high solar activity, at least 20% backup should be taken [20].

## Conclusion

Solar energy is a renewable energy source, meaning you don’t ever use it up. Solar energy is clean. It creates no carbon emissions or other heat-trapping “greenhouse” gases. It avoids the environmental damage associated with mining or drilling for fossil fuels. Furthermore, solar energy also uses little to no water, unlike power plants that generate electricity using steam turbines.

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# IMPLEMENTATION OF MINI SOLAR POWER PLANTS IN RESIDENTIAL HOUSES

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**Keywords:** Development of solar energy in Uzbekistan, conversion of solar energy into electricity,

**Abstract.** This article was prepared on the application of mini solar power plants to residential houses

## Enter

In recent years, large-scale work has been carried out to improve energy efficiency and expand the use of renewable energy sources in the economic and social sectors of our republic [1]. Today, the further development of renewable energy sources by our country and the adoption of a number of decisions and decrees by the president in this regard indicate how much the industry is growing on a global scale. Wide introduction of renewable energy sources in social and housing and communal services and economic sectors, ensuring compensation of energy deficit in the republic's territories by increasing energy efficiency, comprehensive organization of work in this regard, and development of favorable conditions and incentive mechanisms for investors output is one of the important tasks of the field. This decision of the President of the Republic of Uzbekistan, No. PQ-57 dated 16.02.2023, that is, "On measures to accelerate the introduction of renewable energy sources and energy-saving technologies", serves as the program for the execution of these works. The plan to install 20,000 small-capacity renewable energy sources in public facilities and government offices per year is included in the program [2-3].

## MAIN PART

The history of using solar energy in Uzbekistan began in the 70s of the 20th century. At that time, the magazine "Heliotechnika" started to be published, and a decision was made to build a solar oven necessary for testing materials that can withstand temperatures of more than 2000 degrees. In 1929, evaporation of tobacco extract using sunlight was carried out (A.I. Lastak), in 1930, experimental greenhouses heated by sunlight were built (L.N. Satikov), in 1934, a heliotechnical

laboratory was established in Tashkent, and in 1943, within the framework of the Institute of Physics and Technology of Uzbekistan FA a heliotechnical laboratory was established. Solar water devices, fruit dryers, solar cocoon coolers and dryers, and solar sulfur liquefaction device were developed and put into practice. In 1946, a paraboloid device with a mirror diameter of 10 meters was built in Tashkent. This device made it possible to conduct research related to room heating and air conditioning, steam and ice extraction (G. Y. Umarov). The first helioapparatus factory was built in Bukhara (1978), producing a large number of helio water heaters and helio kitchens [4-9].

In 1963, the Department of Geophysics was established, where devices were created that pulsed solar energy before planting the seeds of agricultural crops without the use of toxic chemicals. Taking into account the practical importance of large solar concentrators, academician S.A. Azimov a scientific production complex including the "Big Solar Cell" (KQS) with a heat capacity of 1000 kW was created under the leadership of The large solar farm of the complex was launched in 1987 in the Parkent district, 45 km from the city of Tashkent. Until now, such a device existed only in Odeo (France). The concentrator of the device is a paraboloid with a cut from the top and bottom and a focal length of 18 m, and has a size of 54x42 m. The heliostat area (the area where the mirrors are located) consists of 62 heliostats of the same size, located in a certain order on an inclined plane. The task of the field is to provide the concentrator with sunlight in the direction of its optical axis throughout the day. In 1993, the Institute of Materials Science was established within the "Fizika-Quyosh" scientific production association. At present, the great scientists of the institute are Risqiyev T.T., Odilov G'.T. and others, extensive scientific research is being conducted in the field of physics of difficult-to-melt materials [10-15].

The Earth's atmosphere, based on its optical properties, is a selective light filter that modifies solar radiation coming from space. If the radiation flow passes through the atmosphere and falls vertically on the Earth's surface, then the optical distance traveled by the radiation is considered to be equal to one atmospheric mass and is denoted by AM1. The length of the optical distance of obliquely incident rays can be determined by comparing them with the magnitude of the optical distance AM1. If the radiation flux does not change under the influence of the atmosphere, its optical atmospheric mass is equal to zero, and it is designated as AM0 [16-20].

The energetic illumination of the Earth's surface in the open air during twilight at sea level of directly incident solar radiation is estimated to be equal to ≈100 mW cm2.

Insolation refers to the amount of solar radiation falling on the Earth's surface in a certain geographical area. Insolation depends on the seasonal fluctuations of the distance in the Earth-Solar system, geographical latitude, the environment of the area and the mass of the atmosphere.

## CONCLUSION

Development of solar energy in Uzbekistan, conversion of solar energy into electricity, determination of the main parameters of solar cells. In the conditions of Uzbekistan, it is aimed to improve the efficiency of small solar power plants by applying electr mechanical systems. In addition, the commissioning scheme of the solar power plant is given with drawings of various structures for their installation.

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# THE EFFECT OF THE ANGLE OF INCIDENCE OF SUNLIGHT ON THE SOLAR PANEL

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## Abstract

This paper implements a simple model of solar electricity generation for a solar array in the "Main" building of the Andijan Mechanical Engineering Institute, Andijan, Uzbekistan. This model is compared to recorded data for one specific day near summer solstice, which approximates it well to the maximum possible daily output. In addition, this article calculates the angle of sunlight falling on the solar panel, the movement of the sun during the day, and the parameters of the sun. A solar cadastre is drawn up depending on the geographical location of the place. The influence of the angle of incidence of solar radiation on the efficiency of the solar panel during the summer months is highlighted.

**Key words:** Solar radiation, local solar time**,** sunangle, solar array, elevation of the sun

## Indroduction

The angle of incidence affects the energy output of a solar cell because it affects how much sunlight the solar cell can absorb.

The angle of incidence is the angle between a light ray and a line perpendicular to the surface of a material. When sunlight shines on a solar panel, it hits the surface at various angles. The solar panel can only absorb light that hits it at certain angles, and so the energy output of the solar panel depends on the angle of incidence [1-2].

The angle of incidence has a major impact on the amount of light that solar cells can absorb. If the rays hit at a larger angle, they will be reflected completely. This means that less sunlight is absorbed by the panel and so it generates less electricity than if the rays had struck more directly [3-4].

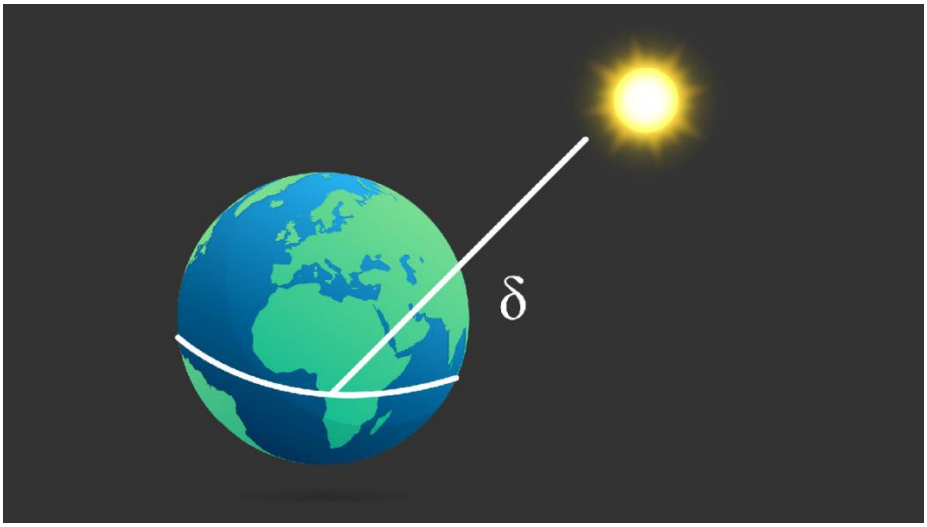
One factor is matching your location's latitude; this minimizes seasonal variations in energy output. Another important consideration is whether you will mount the panels vertically or horizontally. Horizontal arrays capture direct beams from sunrise and sunset better than vertical ones but may lose sunrays between noon and 3 PM depending on where you live. Getting advice from an experienced installer or engineer is usually worth the investment [5-8].

If you are looking to generate energy from the sun, then it is important to consider how much sunlight your solar cells can absorb and what angle they will be in when they do. By understanding these factors and optimizing for them, you can maximize the amount of electricity that your panels generate.

**Theoretical power production**

Define declination of the sun and latitude of the solar panels.

Declination is the angle of the sun from the equator:




It depends on the time of year.

```
dec = 23.45       % Summer solstice
lat = 40 + 46/60  % Andijan: 40° 42'
Convert from degrees to radians
dec = deg2rad(dec);
lat = deg2rad(lat);
```

Make a vector of times from 5:30 to 20 (slightly after sunrise to slightly before sunset). Use 1/4-hour increments (to match measured data).

```
t = 5.5:0.25:20;
```

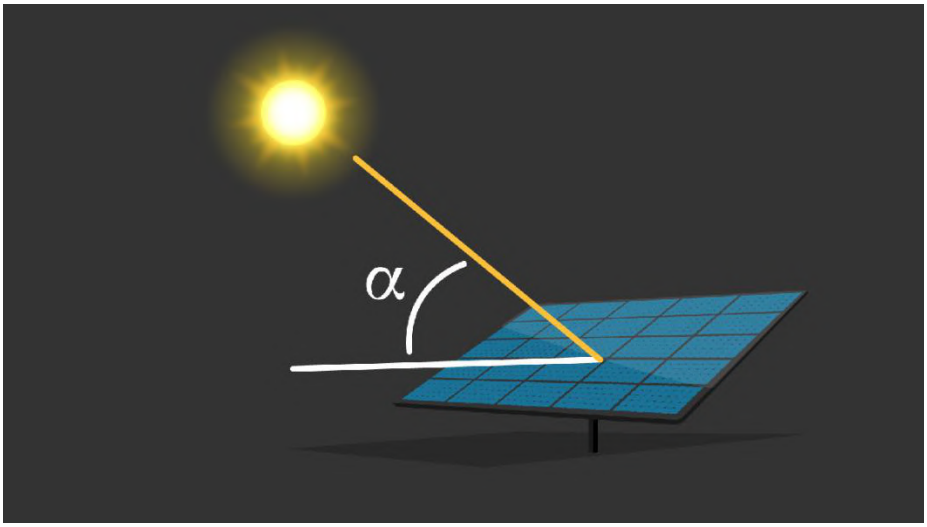
Calculate local solar time. Solar panel longitude is 72° 20' W. EST median longitude is 75°. Time correction is therefore 4*(75-72.33) = 10.68 minutes. Also adjust for daylight savings.

```
LST = t - 1 + 10.68/60;
```

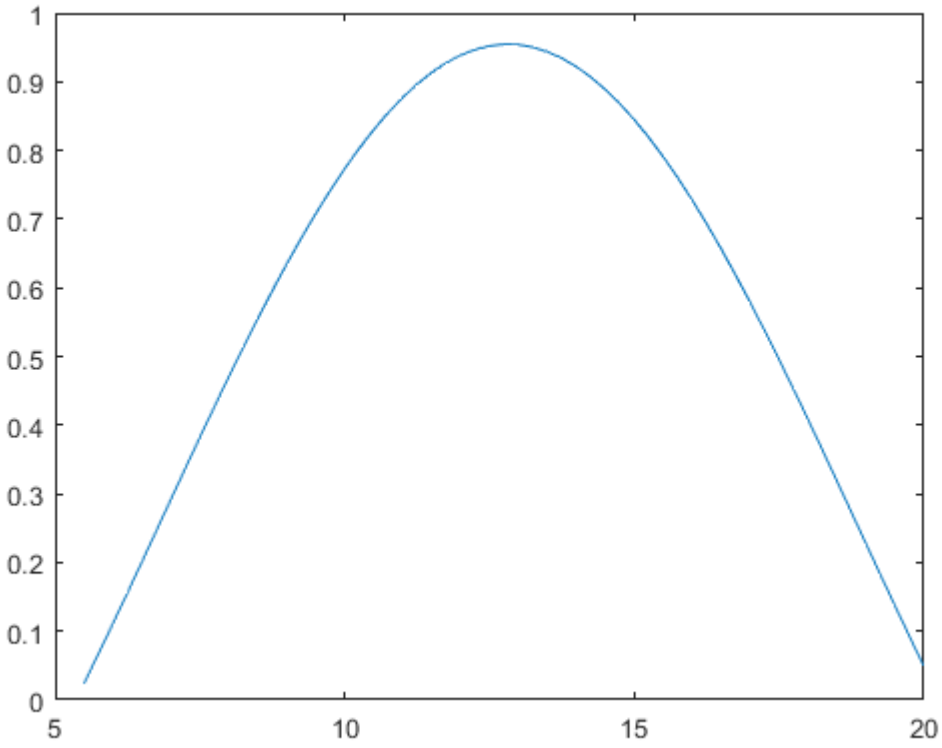
Determine the amount of solar irradiance on the solar panels:

$S_{panel} = S_{incident} \sin(\alpha)$, where $S_{incident} = 1.4883 \times 0.7^{\sin(\alpha)^{-0.678}}$ and $\alpha$ is the elevation of the sun, given by

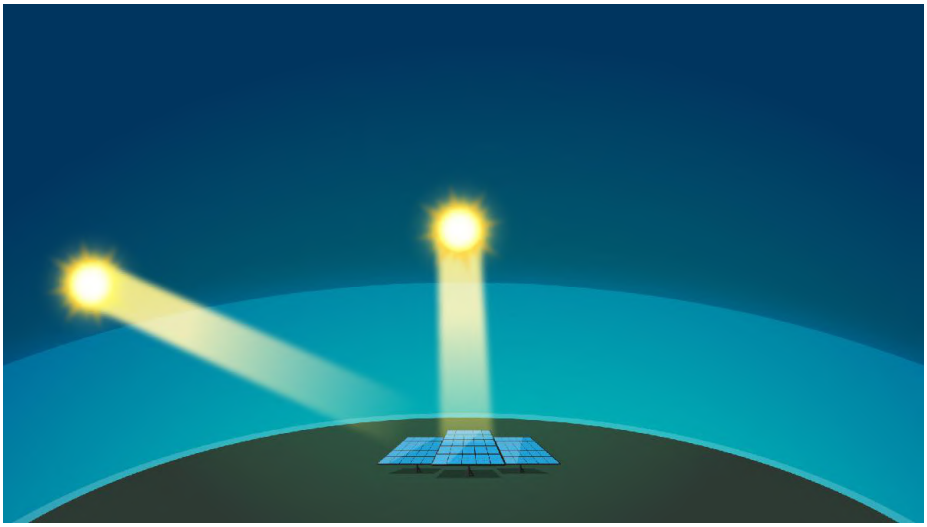
$\sin(\alpha) = \sin(\delta)\sin(\phi) + \cos(\delta)\cos(\phi)\cos(15^{\circ}(LST - 12))$, where $\delta$ is the declination of the sun and $\phi$ is the latitude.




```
sunangle = sin(dec)*sin(lat) + cos(dec)*cos(lat)*cosd(15*(LST - 12));
plot(t,sunangle)
```



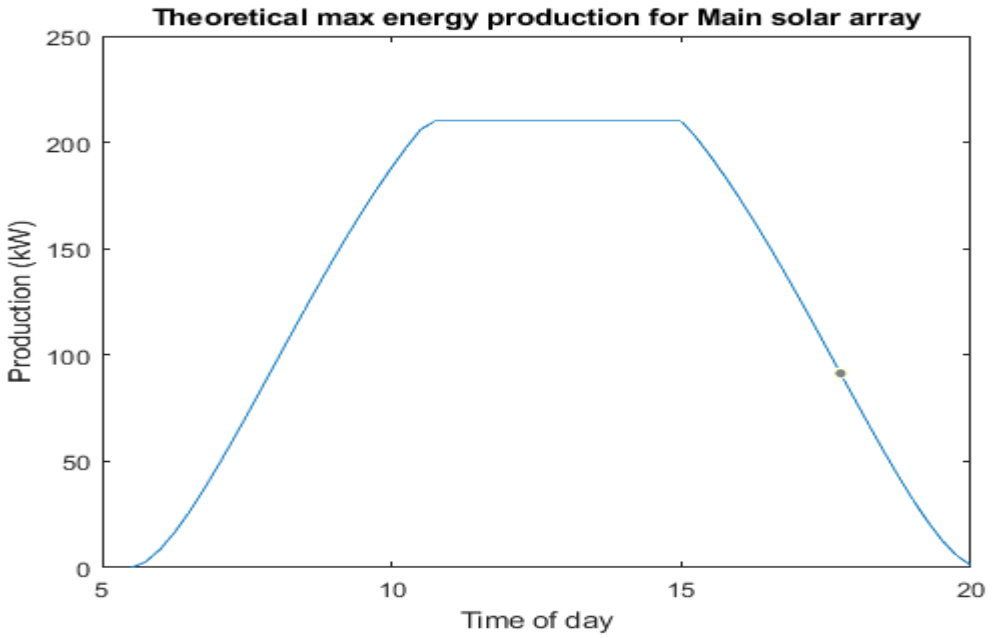

$S_{incident}$ is an empirical formula that models the reduction in incident energy due to the atmosphere - the more air the sunlight has to pass through, the more energy is lost:



S_inc = 1.4883*0.7.^(sunangle.^-0.678);

Calculate the final theoretical production for the whole array of panels, including the inverter limit (210 kW).

production_theory = 250*S_inc.*sunangle;
production_theory = min(production_theory,210);
plot(t,production_theory)
xlabel('Time of day')
ylabel('Production (kW)')
title('Theoretical max energy production for Main solar array')



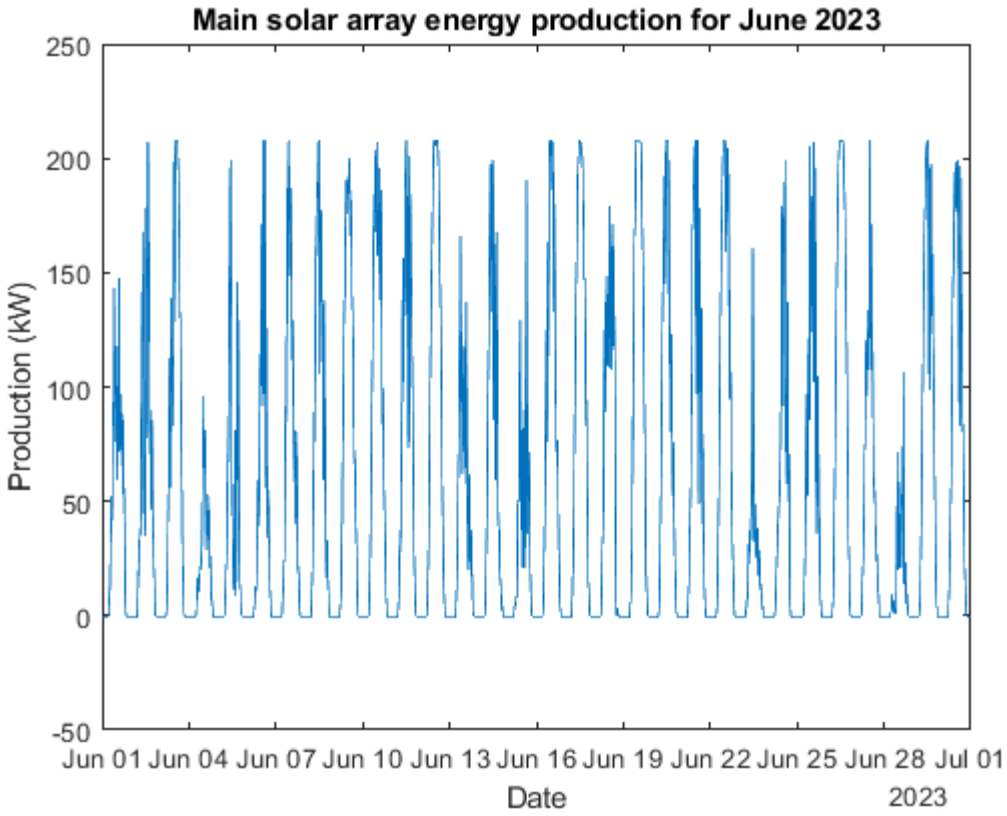

**Compare with recorded data**

Import data for June 2023 from file.

production = readtable("SolarArrayProduction.xlsx"); % equivalent to using the Import Tool

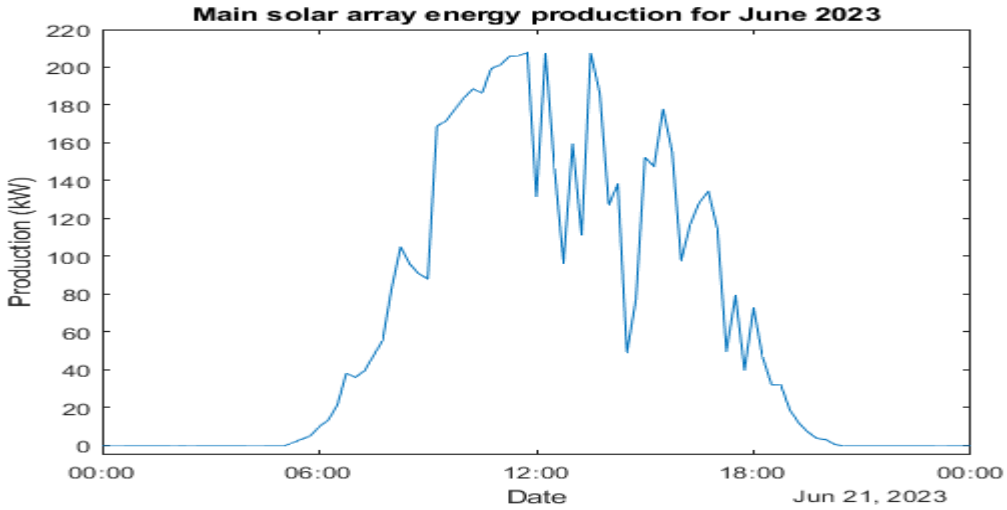
plot(production.Timestamp,production.Main)

```
xlabel('Date')
ylabel('Production (kW)')
title('Main solar array energy production for June 2023')
```




Zoom in on June 21 (summer solstice).

```
xlim(datetime(2023,6,21:22))
ylim([-5 220])
```




Zoom in on June 26 (completely clear day).

```
xlim(datetime(2023,6,26:27))
ylim([-5 220])
```

Reorganize data into a matrix of times by days (4*24 = 96 times, by 30 days).

June2023 = reshape(production.Main,96,30);

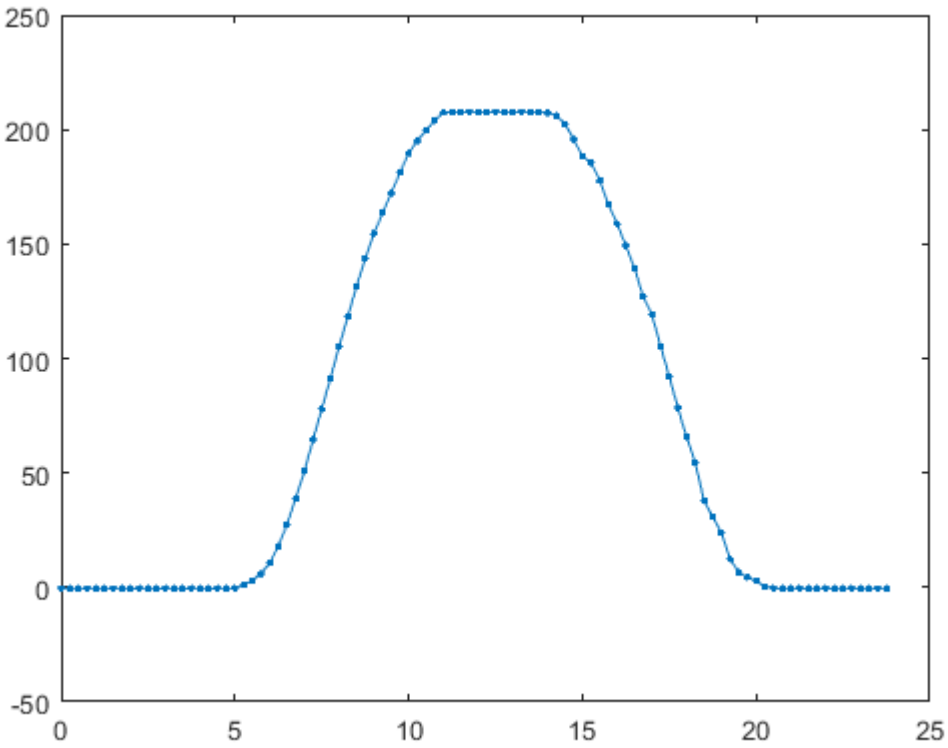
Extract a specific day (June 26 because it is close to the solstice and completely clear).

dayofinterest = June2023(:,26);

Make a vector of times and plot the data for one day.

tfullday = 0:0.25:23.75;

plot(tfullday,dayofinterest,'.-')



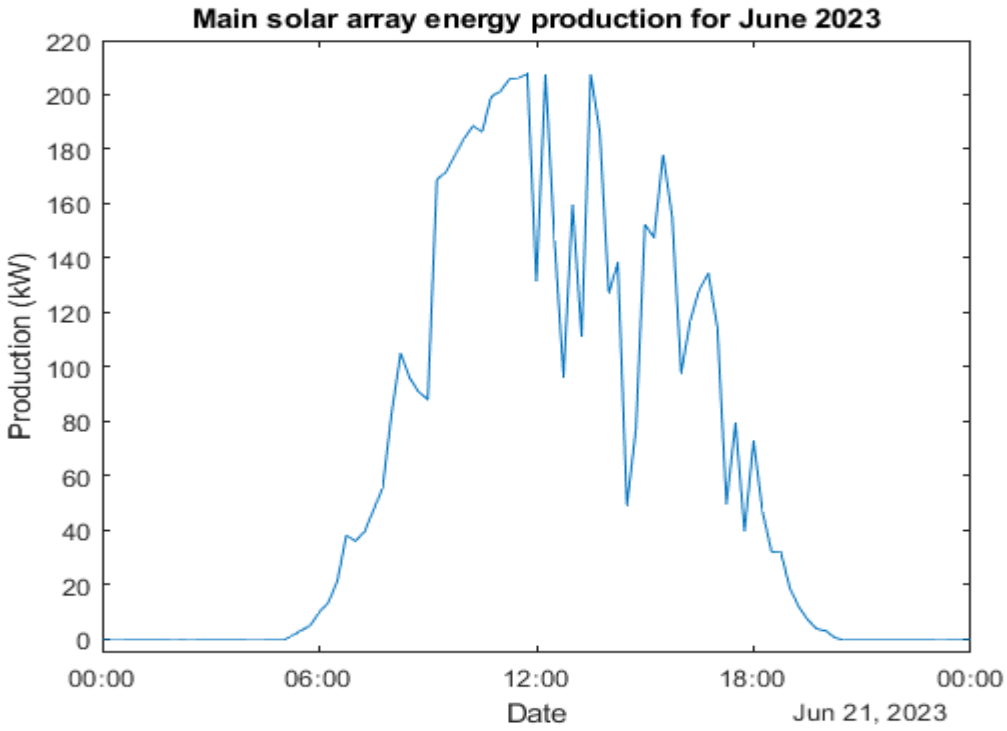

Compare against theory.

plot(tfullday,dayofinterest,'.-',t,production_theory)

xlabel('Time of day')

ylabel('Production (kW)')

legend('Measured data','Theoretical maximum')

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# RK-4 RUSUMLI SILKITUVCHI MASHINALARNING TEHNIKAVIY TAVFSIFLARI

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**Annotatsiyasi**

Mashinaning ishlashi kichik o`lchamdagi aylana shakildagi sho`tkalar yordamida uncha katta bo`lmagan pillalarning ip chularini qidirishga asoslangan ,bunda sho`tkalar aylana shaklidagi kanalda harakatlanadi va pillaning uchlari sho`tkaning uzluksiz tasiri ostida iplarning uchlarini avtomatik qidirish, iplarning uchlari topilgan pillalarni ipsiz uchlari bo'lmagan pillalardan saralash. Pillani silkitish uchlari topilmagan pillalarni ajratish va ularni yana shotka kallagiga qaytarish uchun zo`na . Cho'tkasi kallagi,qo`zg`almas ustun atrofida aylanuvchi 8 ta cho`tkalar o`rnatilgan diskdan iborat.

**Kalit so'zlar**:silkituvchi mashina, Cho'tkasi kallagi,qo`zg`almas ustun, Ipsiz pillalar

**Annotation**

The operation of the machine is based on the search for thread Chus of small sized circular saw blades ,in which the shafts move in a circular channel, and the ends of the Saw are automatically searched for the ends of the threads under the continuous influence of the saw, sorting the saw blades found at the ends of the threads from non-threaded ends. The cocoon is zoned to separate the cocoons where the tip of the cocoon has not been found and return them back to the scotka Calla . The brush head consists of a disc with 8 brushes mounted that rotate around the fixed column.

**Keywords**: Shaker machine, Brush Head, non-slip column, Threadless cocoons

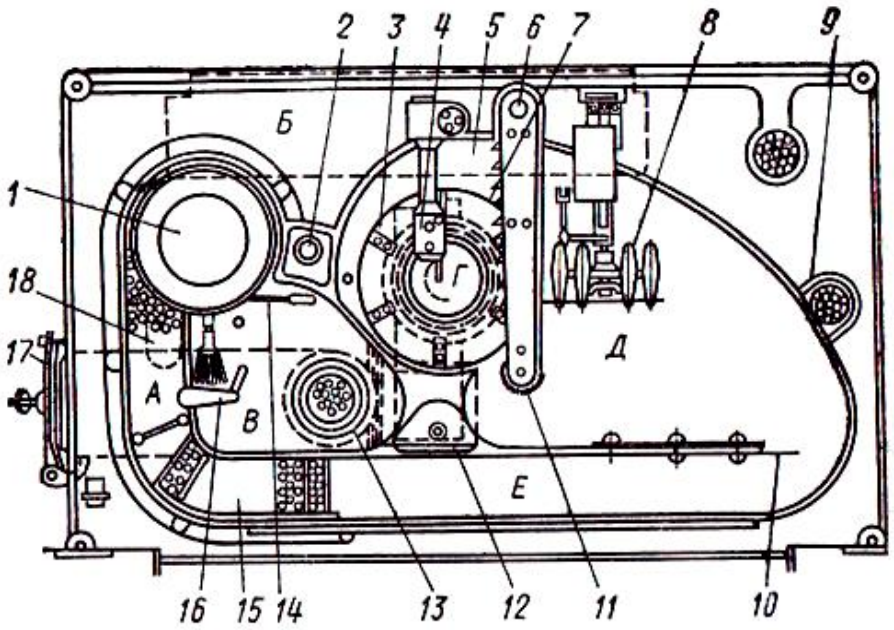
RK-4 silkituvchi mashina (1-rasm) iplarning uchlarini avtomatik qidirish, iplarning uchlari topilgan pillalarni ipsiz uchlari bo'lmagan pillalardan saralash va saralash uchun mo'ljallangan . Mashinaning ishlashi kichik o`lchamdagi aylana shakildagi sho`tkalar yordamida uncha katta bo`lmagan pillalarning ip chularini qidirishga asoslangan ,bunda sho`tkalar aylana shaklidagi kanalda harakatlanadi va pillaning uchlari sho`tkaning uzluksiz tasiri ostida iplarning uchlarini avtomatik

qidirish, iplarning uchlari topilgan pillalarni ipsiz uchlari bo'lmagan pillalardan saralash [1-5].

Havzada plastinka ochilgan – ikki yon ramkaga o'rnatilgan to'shak.mashinaning tog`orasi plitka uyani staninaga o`rnatilgan,stanina o`z navbatida yonlanma ikki yamaga ornatilgan/Tog`ora to`siqlar yordamida bir necha zo`naga ajratilgan;1.iplarning uchlarini qidirish uchun aylana shaklidagi zo`na2.Uchlari topilgan pillalarni yeg`ishtirish uchun trapetsiya shaklidagi zo`na3.

Pillani silkitish uchlari topilmagan pillalarni ajratish va ularni yana shotka kallagiga qaytarish uchun zo`na . Cho'tkasi kallagi,qo`zg`almas ustun atrofida aylanuvchi 8 ta cho`tkalar o`rnatilgan diskdan iborat [6-10].

**1.-rasm. RK-4 silkituvchi mashinasi:**




Bunda;1-cho'tka mexanizmi 2-cho'tka zonasining to'lib toshishi; 3 pichoqli disk; 4-chayqalishmexanizm; 5-chayqalish zonasining tomog'i; 6-ipli tutqich - silkinish zonasining fextavonie; 8-g'altak; 9 zonali toshqin artiblash; 10-damper; 11-ushlagich; 12-qo'l tormozi; 13 silindrli assimilyatsiya tarmog'i trubkasi; 14-sovuq dush; Odonets uchun 15-savat; 16 olinadigan taroq; 17-filtr;18 oval assimilyatsiya aloqasi

Tutqich kichik tishli rulmanga ulangan, katta markaziy vitesga ulangan, vertikal shaftdan o'zaro harakatni oladi. Cho'tkali disk chuvalchang tishli bilan aylantirilgan ichi bo'sh milga o'rnatiladi. Har bir cho'tka tishli uzish moslamasi bilan jihozlangan.

Bundan tashqari, cho'tka boshi taroq zonasidan o'tayotganda cho'tkalarni gorizontal holatga ko'tarish uchun boshqaruv dastagi va qurilmasi bilan jihozlangan. Shayker-bu profil baraban bilan o'zaro ta'sir qiladigan tebranuvchi ikki qo'lli tutqich.

Qurilma korpusga o'ralgan va ulagich bilan jihozlangan (qo'lni boshqarish bilan) va mashinaning umumiy haydovchisidan aylanadi. Tebranuvchi qo'lning ishchi uchi ilgak shakliga ega, u orqali yalang‘'och ip o'tadi.

O'rim-yig'im moslamasi - mashina haydovchisiga olinadigan va ishqalanish bilan bog'langan g'altak. Ip ushlagichi-gorizontal V-kamar, ushlagich bilan yopiladi, u iplarni kamardan olib tashlaydi va ularni igna atrofiga o'rab oladi.

Suv aylanma qurilmasi filtr va nasosdan iborat. Filtr-bu korpusga o'ralgan va cho'tka boshi, taroq va chayqalish joylari bilan naychalar bilan bog'langan to'rli baraban [11-13].

Nasos tarmoq trubkasi bilan pillani silkitish zonasiga ulangan korpus ichida aylanadi. Filial trubkasi oxirida pichoqli konus shaklidagi disk havzada aylanib, zonada radial suv oqimlarini hosil qiladi. Namlik assimilyatsiya qilish moslamasi - tashqi kontur bo'ylab havzani aylanib o'tadigan va tuynukning chiqindi tizimiga ulangan teshilgan korpus.

Sovuq suv quvuri - bu havzaning pastki qismida taroq va ip uchlari orasiga o'rnatilgan qo'l tormozi va dush trubkasi orqali havzaga suv etkazib beradigan qurilma. RK mashinasidagi suv cho'tka boshi sohasida jonli bug 'bilan isitiladi.

Mashina plastinkaning pastki qismidan osilgan alohida elektr motor bilan boshqariladi. Elektr dvigateli V-kamar bilan nasos milini harakatga keltiradi, harakatni mashinaning boshqa barcha mexanizmlariga uzatadi.

Mashinaning barcha ishchi qismlariga (nasosdan tashqari) tishli uzatma mil, mashinaning orqa tomoniga o'rnatilgan maxsus qutiga joylashtiriladi. Kinematik diagrammada cho'tka boshi uchun alohida haydovchi mavjud. Drayv sizga mashinaning ishchi organlari rejimlarini keng o'zgartirish imkonini beradi.

RK-4 mashinasining kamchiliklari quyidagilardan iborat: pillani qo'lda tushirish va yuklash tufayli yuqori mehnat zichligi; pillani qo'lda qo'shimcha tozalash bilan tushirish va pilla sdiriga ipak yigirish natijasida xom ipakning sezilarli darajada yo'qotilishi [14-18].

Bu kamchiliklarni bartaraf etish uchun RK-4 dastgohlari modernizatsiya qilinmoqda, unga simli oldingi va pilla tushirish mashinalari etkazib berilmoqda.

RK tipidagi mashinalarning texnik tavsiflari 1.1 -jadvalda keltirilgan.

1.1 –jadval

**Silkituvchi mashinalarining texnik xususiyatlari**

| Ko‘rsatkichlari | RK-3 | RK-4 | Gunze turiidagi RM |
|---|---|---|---|
| Elektr dvigatelning quvvati, kVt | 1,7 | 1,1 | 1,5 |
| Valning aylanish tezligi, ayl·min$^{-1}$ | 960 | 1420 | - |
| Aylanish tezligi, ayl·min$^{-1}$<br>cho‘tka diski<br>motovila<br>ushlagich | <br>1,0-3,0<br>3,0-8,3<br>40,0 | <br>1,35-0,85<br>0,8-1,23<br>- | <br>2,0<br>3,0<br>- |
| Cho‘tkaning minutdagi yurish soni | 29-101 | 353 | 28,0 |
| Ip ushlagichning xarakat tezligi, m·min$^{-1}$ | 10,0 | 10,0 | 10,0 |
| Yig‘ishtiruvchi qurilmaning o‘rash tezligi, m·min$^{-1}$ | 0,15-0,2 | - | - |
| Ilgakning minutdagi tebranishlarining chastotasi | 1950 | 353 | 400 |
| Cho‘tka kallagi xarakatini uzatish ko‘rinishi | tishli mufta | tishli mufta | konusimon shesternyalar |
| Unumdorlik, quruq pillalarni, kg·s | 10,0 | 15,0 | 10,0-12,5 |

RK-4M dastgohi pilla o'rash mashinasiga pillalarni to'g'ridan-to'g'ri mashina oldiga qo'yadigan saqlash moslamasi bilan ulangan. Ipsiz pillalarni cho'tka boshining uchiga qaytarish kanali mashinaning orqa tomonida joylashgan. Zonadan chiqqandan so'ng, cho'tka iplarning uchlarini oldingi ipga tashlaydi va keyin taroq bilan taraladi. Ipning oldingi ipidan ajratilgan ip qoqib qo'yiladigan ilgakka, u erdan esa g'altakka o'tadi.

RK-4M dastgohi pilla o'rash mashinasiga pillalarni to'g'ridan-to'g'ri mashina oldiga qo'yadigan saqlash moslamasi bilan ulangan. Ipsiz pillalarni cho'tka boshining uchiga qaytarish kanali mashinaning orqa tomonida joylashgan. Zonadan chiqqandan so'ng, cho'tka iplarning uchlarini oldingi ipga tashlaydi va keyin taroq bilan taraladi. Ipning oldingi ipidan ajratilgan ip qoqib qo'yiladigan ilgakka, u erdan esa g'altakka o'tadi [3,5].

Iplarning ilgakli uchlari bo'lgan pilla, oldingi ipning zonasidan cho'tka boshi bilan sinxron ishlaydigan yuk tushirish moslamasi chayqalish zonasiga o'tkaziladi. Chayqalish zonasidan chiqib ketgach, pilla saralash zonasiga kiradi. Bunda iplarning uchlari topilgan pillalar konveyer tomonidan omborga olib ketiladi va ularning iplarining uchlari tutqich tomonidan ipga o'xshash yalang'och ipga biriktiriladi, ular doimiy tezlikda chiqariladi.

Mashina yuvilmagan pillalarni iplarning uchlari bo'lmagan holda cho'tka boshiga tashish uchun kanalga o'tkazish uchun asbob bilan jihozlangan. Saqlash moslamasi pillani o'rash mashinasining oldingi havzasiga o'tkazish uchun tushirish moslamasi bilan jihozlangan

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# KRISTALLARDA GALVANO- VA TERMOMAGNIT HODISALAR

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**Annotatsiya:** Yarimo'tkazgichlarda kechadigan galvano- va termomagnit hodisalar namunaning tashqi elektr, magnit, deformatsiya va issiqlik maydonlari ta'sirida xossalarining o'zgarishi bilan tavsiflanadi.

**Аннотация:** Гальвано- и термомагнитные явления, происходящие в полупроводниках, характеризуются изменением свойств образца под воздействием внешних электрических, магнитных, деформационных и тепловых полей.

**Abstract:** Galvano- and thermomagnetic phenomena occurring in semiconductors are characterized by changes in the sample's properties under the influence of external electric, magnetic, deformation and thermal fields.

Bunday tur kinetik hodisalarning amaliy ahamiyati sezilarli, chunki ularning yordamida tok tashuvchilar konsentratsiyasi va harakatlanuvchanligi, sochilish mexanizmlarini tavsiflovchi fizikaviy kattaliklar, yarimo'tkazgichlar zonaviy strukturasining parametrlari, masalan, ta'qiqlangan zona kengligi, tok tashuvchilar effektiv massalari miqdoran aniqlanadi [1-3].

Galvano- va termomagnit samaralar texnikada ham keng qo'llaniladi. Magnit maydoni kuchlanganligini aniqlash imkonini beruvchi Xoll datchiklari, Xoll va magnitoqarshilik samarasiga asoslanib ishlaydigan elektr signallarini o'zgartirgichlar, Nernst-Ettingsgauzen samarasiga asoslanib ishlaydigan issiqlik energiyasini elektr energiyasiga aylantiruvchi datchiklar hamda Ettingsgauzen samarasiga asoslanib ishlaydigan sovutgichlar va termostatikaviy qurilmalarning hayotimizning qator sohalarida qo'llanilishi yuqridagi fikrimizning asosi bo'la oladi [4-6].

Shunday qilib, galvano va termomagnit va bunday tur kinetik hodisalarni keng qamrovda o'zrganish, ularning mexanizmlarini qaralayotgan hollarga, masalana kvantlashgan o'ralarda yokri anizatropiyani e'tiborga olgan holda, tekshirish o'z mazmunini yo'qotganicha yo'q. Shu sababdan bunday tur hodisalarni, dastlab,

fenomenologiviy, so'ngra, hech bo'lmasa, kvaziklassik yaqinlashishda tadqiq etamiz [7-10].

**Tashqi magnit maydon ta'siri**

Yarimo'tkazgichlarning qator xossalari tashqi magnit maydon ta'sirida o'zgartiradi, uning ta'sirida yangi tabiatli hodisalar, masalan, Xoll samarasi, sodir bo'lishi mumkin.

Umuman olganda, $\vec{\varepsilon}=(\varepsilon_x,\varepsilon_y,\varepsilon_z)$ kuchlanganlikli elektr va $\vec{B}=(B_x,B_y,B_z)$ induksiyali tashqi magnit maydonlari zaryadli zarralarga

$$\vec{F}=-|e|\cdot\vec{\varepsilon}-\frac{|e|}{c}(\vec{V}\times\vec{B})$$

Lorens kuch bilan ta'sir etadi Bu ifodada $e$-elektron zaryadi, $c$-elektromagnit to'lqinlar vakuumda tarqalish tezligi, $\vec{V}$-zaryadli zarraning tezligi.

Izotrop nomagnit muhitlarda $\vec{B}$ induksiya vektori $\vec{H}=(H_x,H_y,H_z)$ tashqi magnit maydon kuchlanganligiga miqdoran teng bo'ladi. Magnit xossasi sezilarli muhitlarda esa, $\vec{B}=\vec{H}+4\pi\vec{M}$ munosabat o'rinli bo'ladi. Bunda $\vec{M}$-muhitning spontan (o'z-o'zidan) magnitlanish vektoridir.

Quyida, agar alohida qayd qilingan bo'lmasa, u holda muhitni izotrop nomagnit muhit deb hisoblaymiz. Agar tashqi elektr maydoni ta'siri bo'lmasa, ya'ni $\vec{\varepsilon}=0$ bo'lsa, u holda Lorens kuchi ta'sirida zaryadli zarra $\omega_c=|e|B/(m_0c)$ siklik chastota bilan magnit maydoni induksiya vektori atrofida aylanadi. Bunday holda, ma'lum bir yo'nalishlarda, elektron energiyasi, tabiatan o'zgarmasa-da, biroq ayrim yo'nalishlarda, $\vec{B}$ yo'nalishiga tik bo'lgan tekislikda elektron energiyasi kvantlashib qoladi, ya'ni elektronlar Landau sathlariga taqsimlanadi. Har ikki qo'shni Landau sathlari orasida ekvidistans energiyaviy oraliklar bo'ladi va bu oralik miqdoran $\hbar\omega_c$ kattalikka teng bo'ladi. Natijada bunday elektronlar sistemasida qator fizikaviy kattaliklar, miqdoran, magnit maydoni induksiya vektorining son qiymatiga qarab ostsillyatsiyalanib qoladi. Jumladan muhit diamagnit kirituvchanligining ostsillyatsiyalanishi de Gaaz-van Alfen samarasi deb yuritilsa, o'tkazuchanligining ostsillyatsiyalanishi Shubnikov-de Gaaz effekti, qo'ndalang magnitoqarshiligining ostsillyatsiyalanishi magnit teshilish samarasi deb yuritiladi. Bunday ostsillyatsiyalanuvchi samaralara yordamida yarimo'tkazgichlarning qator miqdoran noma'lum fizikaviy kattaliklari hisoblanadi. Xususan metallarda Fermi sirtlarning fizikaviy tabiati shunday samaralar hisobiga aniqlanadi [11-15].

Elektr o'tkazuvchanlikka magnit maydoni ta'sirining klassik nazariyasi

Masalani oydinlashtirish maqsadida magnit maydoniga o'rnatilgan metalldagi erkin elektronlarning elektr o'tkazuvchanlikka beradigan ulushini, elektronlarning elektr o'tkazuvchanligini impuslar relaksatsiyasi vaqti yaqinlashishida tadqiq etaylik. Lorens kuchi ta'sir etayotgan erkin elektronlarning harakat tenglamasi quyidagicha yoziladi

Bu yerda $\ddot{\vec{r}} = \frac{d^2\vec{r}}{dt^2}$, $\dot{\vec{r}} = \frac{d\vec{r}}{dt}$ belgilanlar kiritilgan, $\tau$-elektronlar impulsi relaksatsiya vaqti. Masalani to'la hal qilish maqsadida oxirgi tenglamaning vektor kattaliklarning tashkil etuvchilariga nisbatan qayd qilamiz, ya'ni

$$m_0\ddot{x} + \frac{m_0}{\tau}\dot{x} = -|e|\varepsilon_x - m_0\omega_c\dot{y},$$

$$m_0\ddot{y} + \frac{m_0}{\tau}\dot{y} = -|e|\varepsilon_y - m_0\omega_c\dot{x},$$

$$m_0\ddot{z} + \frac{m_0}{\tau}\dot{z} = -|e|\varepsilon_z.$$

Bu holda magnit induksiya vektori $z$ o'qi bo'ylab yo'nalgan, ya'ni $\vec{B} = (0,0,B)$ deb hisobladik.

Aytaylik tashqi elektr maydoni $\omega$ chastotali garmonik o'zgaruvchan tabiatli, ya'ni $\vec{\varepsilon} = \vec{\varepsilon}_0 \exp(i\omega t)$ ko'rinishda olinsin. U holda (12.3) tenglamadan

$$m_0\left(i\omega + \frac{1}{\tau}\right)\dot{z} = -|e|\varepsilon_z$$

kelib chiqadi. Tok zichligining $z$ tashkil etuvchisiga nisbatan qayd qilingan

$$j_z = -|e|n\dot{z}$$

munosabatda (12.4) ifodani e'tiborga olsak, u holda

$$j_z = \frac{ne^2}{m_0\left(i\omega + \frac{1}{\tau}\right)}\varepsilon_z = \frac{ne^2\tau}{m_0(1+i\omega\tau)}\varepsilon_z = \frac{1+i\omega\tau}{1+\omega^2\tau^2}\frac{ne^2\tau}{m_0}\varepsilon_z,$$

bu yerda $n$-elektronlar konsentratsiyasi.

Agar Om qonunini

$$j_\alpha = \sum_{\beta=x,y,z}\sigma_{\alpha\beta}\varepsilon_\beta$$

ko’rinishda tanlasak, u holda

$$\sigma_{zz}=\frac{1+i\omega\tau}{1+\omega^2\tau^2}\frac{ne^2\tau}{m_0}=\frac{1+i\omega\tau}{1+\omega^2\tau^2}\sigma_0$$

va $\sigma_0=\dfrac{ne^2\tau}{m_0}$.

(12.3) tenglamalar sistemasining dastlabki ikki tenglamalarini $xOy$ tekisligiga nisbatan echamiz. Buning uchun $r_\perp=x+iy$ $\left(\dot r_\perp=\dot x+i\dot y\right)$ shakl almashtirishlar qilamiz. Natijada quyidagi munosabatga ega bo’lamiz

$$m_0\ddot r_\perp+\frac{m_0}{\tau}\dot r_\perp=-|e|\varepsilon_\perp+im_0\omega_c\dot r_\perp,$$

bu holda $\varepsilon_\perp=\varepsilon_x+i\varepsilon_y$. Yuqoridagidek, elektr maydonni garmonik o’zgaruvchan deb hisoblasak, u holda

$$m_0\left(i(\omega-\omega_c)+\frac{1}{\tau}\right)\dot r_\perp=-|e|\varepsilon_\perp$$

va oxirgi munosabatdan

$$\dot r_\perp=-\frac{1}{1+i(\omega-\omega_c)\tau}\frac{|e|\tau}{m_0}\varepsilon_\perp$$

U holda

$$j_\perp=\frac{1-i(\omega-\omega_c)\tau}{1+(\omega-\omega_c)^2\tau^2}\sigma_0\varepsilon_\perp$$

foydali munosabatni olamiz. Bundan tok zichligining tashkil etuvchilari uchun

$$j_y=\frac{\sigma_0}{1+(\omega-\omega_c)^2\tau^2}\left[\varepsilon_y-(\omega-\omega_c)\tau\varepsilon_x\right]$$

ifodalarni olamiz.

Agar tok zichligini

$$\begin{bmatrix}j_x\\j_y\\j_z\end{bmatrix}=\begin{bmatrix}\sigma_{xx}&\sigma_{xy}&\sigma_{xz}\\\sigma_{yx}&\sigma_{yy}&\sigma_{yz}\\\sigma_{zx}&\sigma_{zy}&\sigma_{zz}\end{bmatrix}\begin{bmatrix}\varepsilon_x\\\varepsilon_y\\\varepsilon_z\end{bmatrix}$$

ko’rinishda ifodalasak, u holda (12.7), (12.8), (12.12.3) va (12.14) munosabatlardan

$$\begin{bmatrix} j_x \\ j_y \\ j_z \end{bmatrix} = \frac{\sigma_0}{1+(\omega-\omega_c)^2\tau^2} \begin{bmatrix} 1 & -(\omega-\omega_c)\tau & 0 \\ (\omega-\omega_c)\tau & 1 & 0 \\ 0 & 0 & \frac{1+(\omega-\omega_c)^2\tau^2}{1+\omega^2\tau^2} \end{bmatrix} \begin{bmatrix} \varepsilon \\ \varepsilon \\ \varepsilon \end{bmatrix}$$

natijaga kelamiz.

Shuni qayd qilish o'rinliki, $\sigma_{\alpha\beta}$ elektr o'tkazuvchanlik tenzorining $xOy$ tekislikdagi tashkil etuvchilari

$$\sigma_\perp = \frac{1}{1+i(\omega-\omega_c)\tau}\sigma_0 = \frac{1-i(\omega-\omega_c)\tau}{1+(\omega-\omega_c)^2\tau^2}\sigma_0$$

ko'rinishda bo'lib, oqibatda

$$\begin{bmatrix} j_x \\ j_y \end{bmatrix} = \begin{bmatrix} \sigma_{xx} & \sigma_{xy} \\ \sigma_{yx} & \sigma_{yy} \end{bmatrix} \begin{bmatrix} \varepsilon_x \\ \varepsilon_y \end{bmatrix}$$

yoki

$$\begin{bmatrix} j_x \\ j_y \end{bmatrix} = \frac{\sigma_0}{1+(\omega-\omega_c)^2\tau^2} \begin{bmatrix} 1 & -(\omega-\omega_c)\tau \\ (\omega-\omega_c)\tau & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_x \\ \varepsilon_y \end{bmatrix}$$

$xOy$ tekislikdagi Om qonunini ifodalaydi.

Oxirgi ifodadan $\sigma_\perp$ kattalikning haqiqiy qiymati, ya'ni $\mathrm{Re}(\sigma_\perp)$ kattalik $\omega = \omega_c$ shartda maksimal qimatga erishadi, mavhum qiymati, ya'ni $\mathrm{Im}(\sigma_\perp)$ kattalik esa nolga aylanadi. Bu holda siklotronli rezonas hodisasi deb yuritiladi [15-18].

Shuni ham qayd qilmoq zarurki, (12.15) ifoda Drude natijasi bo'lib, statik maydon yaqinlashishida, ya'ni $\omega = 0$ shartda yangi tabiatli hodisa Xoll samarasini tavsiflovchi kattaliklarni olamiz.

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# DEVELOPMENT AND APPLICATION OF 3rd GENERATION SOLAR ELEMENTS

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**Abstract:** This paper is designed to achieve low-cost and high power conversion efficiency for the production of third-generation solar panels. These solar cells have the ability to exceed the Shockley-Queisser limit. This review focuses on various third-generation solar cells, such as dye-sensitized solar cells, perovskite-based cells, organic photovoltaics, quantum dot solar cells, and tandem solar cells, a collection of different materials that exploit the maximum solar spectrum. achieve high power conversion efficiency. Along with these solar cells, other third-generation technologies are discussed, including up-conversion, down-conversion, hot carrier, and multi-excitation. The article includes an overview of previous work in this area, as well as an introduction to the technologies, including their working principles and components. Advances in various components and improvements in performance parameters such as fill factor, open circuit voltage, conversion efficiency and short circuit current density are discussed. There is also talk about the widespread distribution of these technologies in sales.

**Keywords:** third generation; single crystal; polycrystal; perovskite; sensitive to dye; tandem solar cells; organic photovoltaics

A solar cell is a power source based on semiconductor photocells that directly converts solar radiation energy into electrical energy. The operation of solar cells is based on the internal photoeffect phenomenon. The first solar cell was developed in 1953-1954 by US scientists G. Pearson, K. Fuller and D. Chapin [1-5]. The capacity of the solar cell depends on the semiconductor material, the structural features of the solar cell and the number of cells in the cell. Silicon in the manufacture of solar cells, materials based on gallium Oa, arsenic Az, cadmium Syo, sulfur 5, antimony 8, and tellurium Te are used. A solar cell is usually made of a solar cell in the form of a flat panel with a shiny coating on top. The number of solar cells in the battery is up to several thousand, the level of the panel is tens of thousands, the current is hundreds

of A, the voltage is tens of V, and the generator power is up to several tens of kW [6-8].

The solar cell is mainly used to supply space and earth satellites with electricity. On Earth, the solar battery is used as a power source in portable automatic radio stations and radio receivers. The Institute of Physics and Technology of the Academy of Sciences of Uzbekistan deals with the issues of using solar energy in Uzbekistan.

Solar cells (SC), often called photovoltaic (PV) cells, use the PV effect to convert light energy into electricity and are one of the most important environmentally friendly energy sources, along with hydropower and wind/wave energy. Over the past two decades, PV technologies have been steadily evolving to improve the power conversion efficiency (PCE) of solar cells. SCs can be divided into different categories according to the period of development, as well as the materials they use. These categories include:

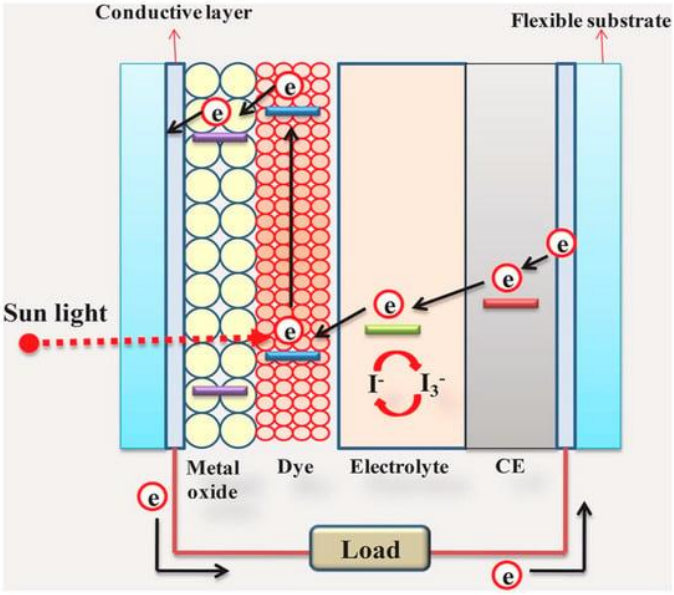
(1) First generation of silicon (Si) type and most efficient, but efficiency decreases as temperature increases.

(2) Thin film second generation is cheaper than type Si and is already commercially available

(3) Third generation, which are PV technologies processed with solutions based on semiconductors.

One of the most important technological advances in the world of solar cells is the DSSC. It acts as a cell that mimics the method used by plant cells to produce energy [9-13]. Photoelectrochemical cell is a photoelectrochemical cell, created by the combined effect of photon energy and chemical reactions. DSSC has the potential to be a future energy source because it is slightly more transparent and cheaper than conventional solar photovoltaics. However, some issues still need to be addressed before it can be claimed as a viable commercial product. These issues and the significant advances in DSSC technology in recent years are highlighted in this section. We provide a clear understanding of the latest DSSC updates related to various components. According to different DSSC components, we can divide this section into sub-sections and get a brief feedback of improvements suggested by different researchers. Innovative research on the use of nano-sized TiO2 (titanium dioxide) porous film electrodes in DSSCs was originally published by O'Regan and Gratzel. DSSC quickly became an active area of research because it was found to have very high photon-to-electricity conversion efficiency. Since then, a large amount of work has been reported [14-18].

Photoanode, sensitizer, electrolyte and counter electrode are important elements of DSSC. The photoanode is designed using semiconductor nanostructures. A variety of nanostructures, including nanorods, nanotubes, nanowires, nanocones, and nanorods, have been created in transparent conductive glass. Successfully developed an 11.4% efficient DSSC by designing and synthesizing donor–acceptor type co-adsorbents, which were found to be effective in competitive light absorption by I-/I3-, prevented dye aggregation, and reduced charge recombination. , the carboxy-anchored organic dye of LEG4 was shown to work well as a co-sensitizer with the silyl-anchored dye of ADEKA-1 in DSSCs. The authors were able to produce a 14.3% efficient cell with an optimized cobalt (III/II) complex redox electrolyte solution and GNP counter electrode. This indicates that silyl-anchor dyes are a suitable option for use as photosensitizers in DSSCs, which is mainly due to the good adsorption properties of ADEKA-1 to the TiO2 electrode. The figure below shows the schematic of the DSSC [19-25].




DSSC scheme. Reproduced with permission from Devadiga et al., Renewable and Sustainable Energy Reviews, Elsevier, 2022.

The photoanode consists of semiconductor nanoparticles embedded in transparent conductive glass and is dye-sensitive. Many semiconductor oxides such as ZnO, SnO2, WO3 and TiO2 are used as photo-anode materials. Among these semiconductor oxides, TiO2 has been more widely used due to its availability, low cost, compatibility, and non-toxicity. The morphology of the semiconductor plays an important role in the DSSC because it acts as a substrate to absorb the dye and receive electrons from the dye. The dye, after photo-excitation, introduces an electron into

the conduction band of the semiconductor, where it is again passed through the counter electrode and causes a circuit. TiO2 nanoparticles are frequently used due to their excellent dispersion and crystallinity. Anatase, brookite, and rutile are the three most stable polymorphs of TiO2; The complex synthesis process of brookite makes it the least common of the mentioned polymorphs of TiO2. Anatase and rutile have the same solar energy conversion performance to some extent; however, anatase is preferred over rutile due to its higher charge transport, larger specific surface area, and higher electron Fermi level [26-28].

We know that among renewable energy sources, solar energy provides more energy. As an example of small self-consumption facilities, Spain is gradually growing. More and more houses have chosen to install photovoltaic panels because they save money on electricity bills and we can take environmental responsibility that is time-consuming. However, many people don't know how solar panels work.

How Photovoltaic Solar Panels Work

As the name suggests, it uses solar energy to generate electricity. Among the advantages of solar energy that we have, it does not pollute the environment, but it is unlimited, but there are some disadvantages, such as its continuity.

Photovoltaic generation is a property that must have certain materials that generate electricity under the influence of sunlight. This happens when the energy in sunlight ejects electrons, creating a flow of electricity. We should know that solar radiation is a stream of photons. The performance of a solar panel depends mainly on how strong the light it receives is. To understand how solar panels work, we need to know how the power of a solar module is calculated.

It is important to understand that the amount of solar radiation falling on the solar panel varies depending on the day and time of year. The generated current must be calculated using significant fluctuations, and this makes the calculation difficult.

There are different ways to compare silicon-based panels, and they can basically be divided into a few categories: amorphous, polycrystalline, and monocrystalline. We will analyze what are the unique features of each of the solar panels:

-Amorphous panels: they are used less often, because they do not have a defined structure and in the first months of work they lose a lot of efficiency.

- Polycrystalline panels: they are distinguished by the fact that they are composed of crystals of different orientations and have a blue color. The manufacturing process has the advantage of being cheaper, but the disadvantage is an inefficient product.

- Monocrystalline panels: they are considered the highest quality products. Here, the cells form a panel and are made of high-purity silicon crystal solidified at a uniform temperature. Thanks to this construction, it has high performance and efficiency, allowing free movement of electrons. Despite the fact that the production process is more expensive, it gives the modules great efficiency.

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# APPLICATION OF HYBRID SYSTEM IN MULTIFUNCTIONAL DEVICES USING BOTH RENEWABLE AND CONVENTIONAL ENERGY RESOURCES

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## Abstract

In this article we examine hybrid renewable energy systems that combine solar and wind energy technologies, focusing on their current challenges, opportunities, and policy implications. Despite the individual merits of solar and wind energy systems, their intermittent nature and geographical limitations have spurred interest in hybrid solutions that maximize efficiency and reliability through integrated systems. A critical analysis of available literature indicates that hybrid systems significantly mitigate energy intermittency issues, enhance grid stability, and can be more cost-effective due to shared infrastructure. The review identifies key challenges, such as system optimization, energy storage, and seamless power management, and discusses technological innovations like machine learning algorithms and advanced inverters that hold the potential for overcoming these hurdles. Importantly, the review elucidates the role of policy in accelerating the adoption of these systems by highlighting successful case studies of government incentives, public-private partnerships, and regulatory frameworks that have fostered investments in hybrid renewable energy systems. The study concludes with the outcomes obtained that signify the potential for hybrid renewable energy systems to not only meet but exceed future energy demands sustainably, provided there is concerted effort in research, investment, and policy-making.

**Key words:** Ash$CO_2$ treatment ,Construction materials, Solid waste, Mechanical properties

## Introduction

Sustainability, environmental concerns, and technological advancements are the main motivations for the construction industry to employ more designed high-performance materials that are environmentally friendly and affordable than traditional construction materials. Such materials can considerably enhance the

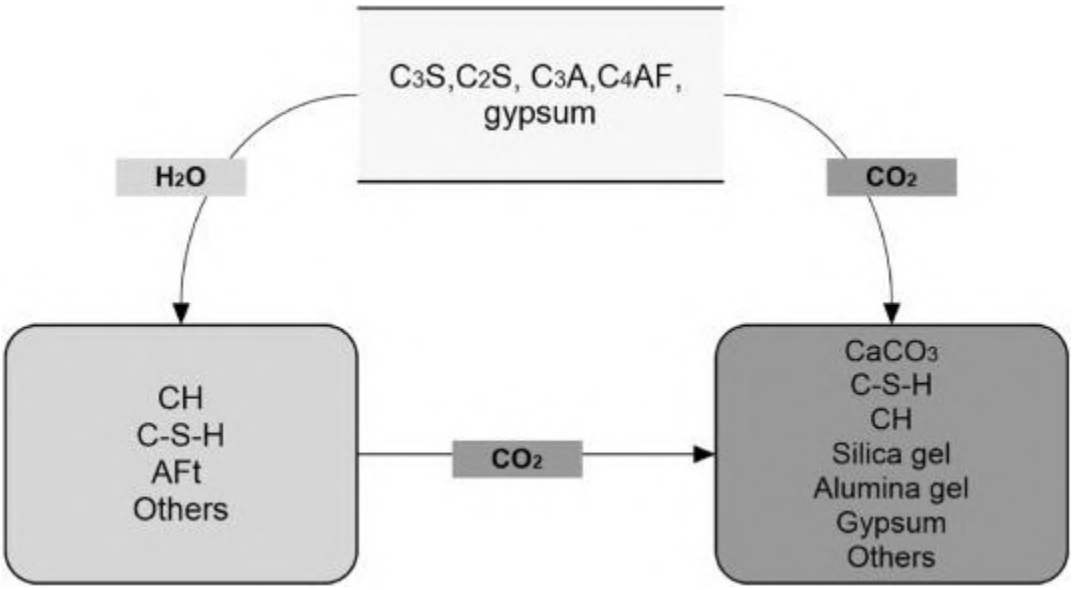
service life of buildings while also drastically reducing the need and cost of maintenance . Industrial and agricultural wastes that fulfill the mineral composition criteria of cement have prompted many researchers to investigate their application in construction . Such wastes can replace cement or aggregate, enhancing its chemical and physical characteristics, saving costs, and reducing environmental effects [1-5]. The use of plastic waste materials, building and demolition debris, and bottom ash as aggregates in cement mortars and concrete has been a focus of several studies . The use of such recycled aggregate may affect the properties of fresh concrete. It has been found that the use of recycled coarse aggregates reduces the consistency and fluidity of concrete within the first hour after mixing when compared to concrete created with natural aggregates . The use of a sufficient amount of bottom ash improves the strength of concrete; the addition of 10 % increases the strength of plain and self-compacting concrete . The abrasion and shrinkage resistance of normally vibrated bottom ash concrete has improved, but it has decreased in self-compacted concrete at various curing ages [6-9].

Previous investigations have shown that presenting chemical or physical treatments for the waste materials could overcome these issues such as the calcination, grinding and carbon dioxide ($CO_2$) curing process which results in a faster rate of growth in waste-based materials properties than the conventional curing processes .Since $CO_2$ is the principal greenhouse gas and a contributor to global warming, it is important to understand its role. One of the main sources of $CO_2$ emissions is the cement sector; a contemporary cement plant will create between 0.49 and 0.92 kg of $CO_2$ for every kg of cement produced .On average, it is reported that 0.79 tons of $CO_2$ will be emitted to produce one ton of cement .As a result, responsible companies and researchers have made major efforts to minimize $CO_2$ emissions from industrial and especially cement production by establishing a new manufacturing technique and substituting cement or aggregates with supplemental materials of equal or greater importance [10-15].

Many strategies for reducing $CO_2$ emissions as well as the collection, storage, and sequestration of emitted $CO_2$ have been the subject of research .As a result, there has lately been a lot of interest in using collected $CO_2$ in a process that yields valuable materials. One of the most well-known instances of $CO_2$ sequestration is the carbonation of $CO_2$ and the creation of a product with commercial value .Numerous studies in this area have shown that $CO_2$ curing of cement-based materials (such as mortar, paste, concrete, aggregates, and solid waste from these cement-based products) is a more effective type of $CO_2$ collection . Prior research

has found that $CO_2$ improves the durability and properties of cement-based building materials . Such a process can improve the mechanical properties of concrete and reduce its drying shrinkage . $CO_2$-cured concrete is known to provide an extremely rapid strength growth rate and can improve its resistance and durability performance. Introducing the carbonation process early during the cement hydration process will expedite the reaction rate as compared to the conventional hydration processes. The compressive strength of the mortar was nearly the same after 1 h of $CO_2$ curing as it had been after 7 days of wet curing .

$CO_2$ reacts with cement clinker materials (calcium silicates and their hydrate products) through the carbonation reactions to form calcium carbonate ($CaCO_3$) . Such reactions can positively affect the concrete properties by improving their strength . Formation of dimensionally stable crystals of $CaCO_3$ and the associated expansions when young plain concrete is exposed to high concentrations of $CO_2$ attributes to considerable early strength . depicts a description of the carbonation and hydration of various cement mineral phases [16-20].




Methodology

The systematic review was performed by using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria . PRISMA is an effective method for being acquainted with the greatest accessible research information on a specific issue. The effectiveness of a systematic review is enhanced by the clarity of each stage of the synthesis process, as well as allowing the reader to concentrate on the advantages of each finding made in collecting information, instead of being attracted to the unnoted difference between studies, as is sometimes the case in other

types of reviews . While bibliometrics is a popular approach for building a large picture in a literature evaluation .

This work provides a thorough and systematic analysis that seeks to synthesize, identify, and evaluate the literature by detecting curing with $CO_2$ for solid waste-based construction materials in publications. More specifically, all publications during the last six years have been collected and investigated based on the standards for the systematic reviews and our research objectives. The available literature was collected by utilizing search engines from various databases. The same search possibilities were repeated for each database, utilizing the keyword combinations depending on the search strategy accredited in the database.

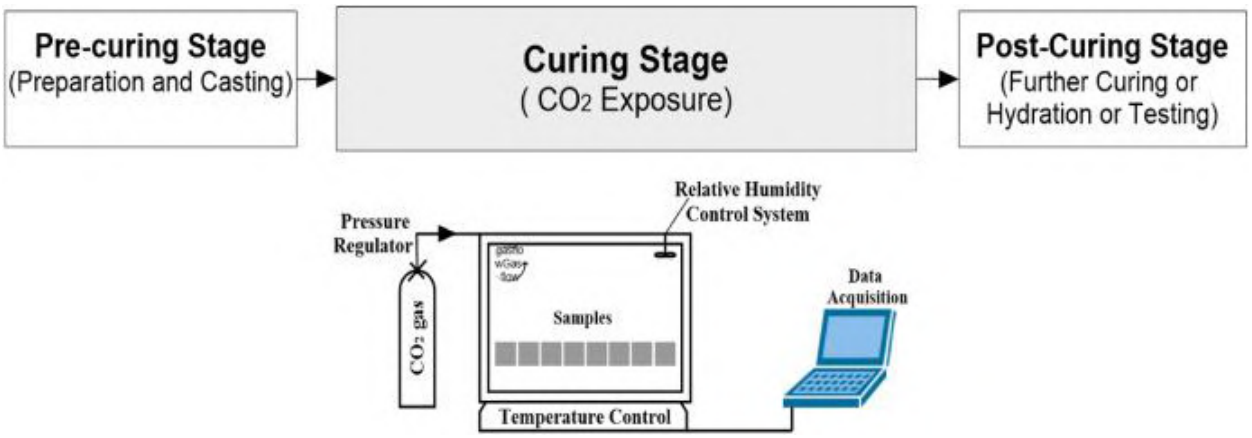
The following terms were checked in each database by applying the advanced search options and setting the search period to the previously mentioned range. The web of science (WoS) database was searched using the intended search terms as" TS= ((carbon dioxide curing OR $CO_2$ curing OR carbonation) AND (ash OR solid waste) AND (concrete OR aggregate OR cement* OR construction materials))". Also, the Scopus database was searched by using the "TITLE-ABS-KEY (((carbon dioxide curing OR $CO_2$ curing OR carbonation) AND (ash OR solid waste) AND (concrete OR aggregate OR cement* OR construction materials)))" combination. Publications involving $CO_2$ curing have increased throughout time, which can be ascribed to the expansion of scientific research itself.

The main body of the literature involved 715 studies. About 80 % of the extracted publications were from WOS with the lion's share of the journal papers distantly followed by conference papers. 572 papers were excluded after examining the titles and abstracts and removing duplicates to avoid repetition. After the full-text reading, only 71 papers were connected to the inclusion criterion. These investigations were thoroughly studied to create the overall foundation for the study map on $CO_2$ curing in waste-based building materials. The study only used original research publications, reviews, and conference papers. To assure the review's quality, every duplicate was carefully checked. To ensure the accuracy and relevance of the data used in the review process, the article titles were selected and analyzed for evaluation. The validity of the approach and outcomes was then verified by conducting a thorough analysis of the study abstracts.

$CO_2$ curing of waste-based construction materials

During cement hydration, the dry cement mixes with water and forms a solid hydrate phase, leading to volume expansion and reduced porosity, resulting in a strengthened material . Carbonation, on the other hand, is a more challenging process in which gaseous $CO_2$ penetrates the concrete, dissolves in the pore solution, and reacts with cementitious phases to form $CaCO_3$ and silica gel . However, due to the fine porosity and water content of hydrated cement, carbonation proceeds slowly under normal conditions . Nevertheless, concrete structures exposed to $CO_2$ can act as a $CO_2$ sink over time . Additionally, crushed concrete, demolition debris, and industrial solid wastes can also absorb significant amounts of $CO_2$, although it may occur in an unpredictable manner [21-22].

This section provides an analysis of the usage of $CO_2$ as a curing method, including the reaction mechanism, implementation procedure, carbonation quality, and mechanical properties of the final product. It also provides details regarding the effect of carbonation curing on waste-based materials, alternative binders, and recycled aggregates. In addition, looking for the conditions of the curing technique in each study was the major key to understanding the differences in the resulting carbonated construction materials. A pre-curing stage is crucial for achieving effective carbonation developments. Pre-curing regulates the removal of water from a mixture after casting and before $CO_2$ exposure. The most important sub-reactions happen in the aqueous state, thus there must be enough water before carbonation can start. High water content can impede the process by obstructing $CO_2$ diffusion to the reactants, while low water content can lead to an insufficient reaction with ineffective outcomes . The $CO_2$ curing stage may be accomplished in two ways, enclosed and flowable reactor systems. The capacity to support increased $CO_2$ partial pressures makes the enclosed system has better reaction efficiencies .Laboratory scale experiments are often carried out in enclosed pressure containers where continuous reaction conditions are carefully regulated and monitored .After carbonation, post-curing allows for additional hydration of the remaining unreacted hydraulic phases. To ensure the best hydraulic reaction, water depletion due to carbonation should be effectively considered at this stage [23-24].




## Conclusion

Key research needs include understanding the link between $CO_2$ curing methods and material durability, evaluating long-term performance against various stress factors, and further exploring the environmental benefits, including material design, $CO_2$ absorption quantification, modeling carbonation processes, and safety considerations.

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# ATMOSFERA MUHITIDA ORGANIK QUYOSH ELEMENTLARINING FOTOELEKTRIK PARAMETRLARINING O‘ZGARISHI

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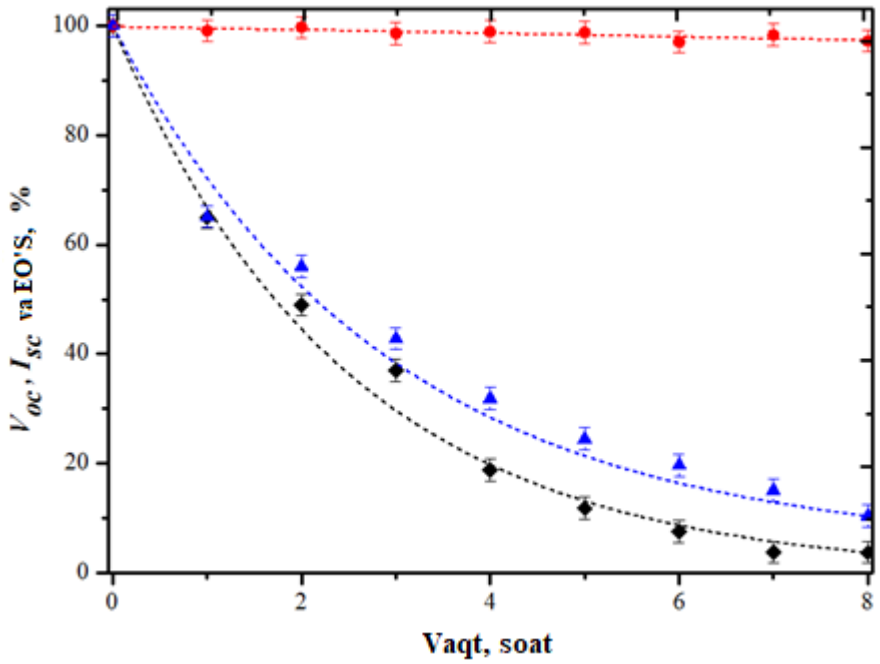
**Annotatsiya:** Ushbu maqolada organik quyosh elementlarining samarali va barqaror hamda uzoq muddatli xizmat ko’rsatishini ta’minlash uchun atmosfera muhitida ularning fotoelektrik parametrlarining o’zgarishi o’rganildi. Tajribada fulleren va fulleren bo’lmagan organik quyosh elementlari qiyosiy o’rganildi.

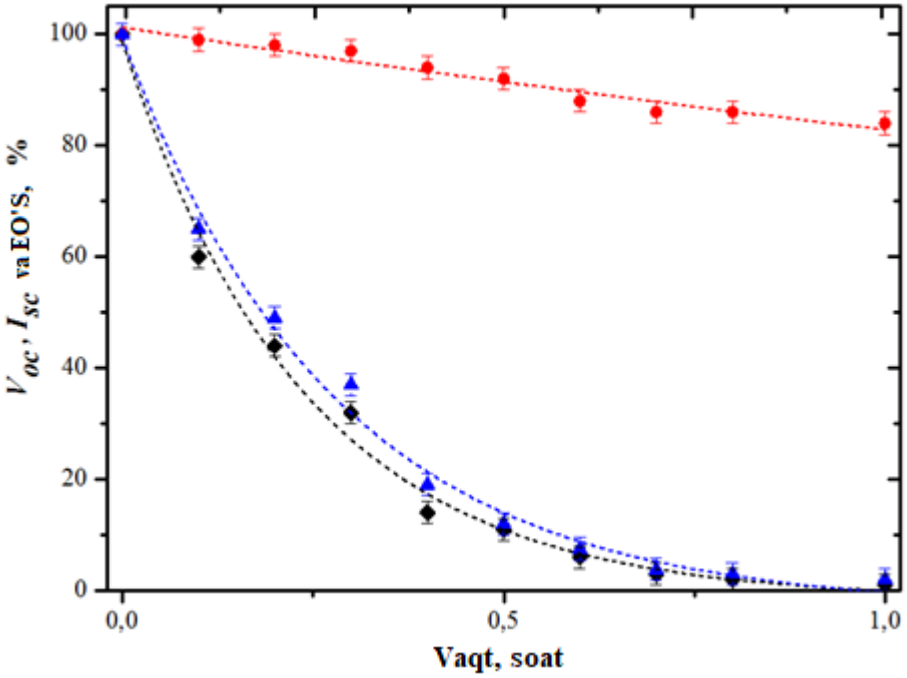
**Kalit so’zlar:** Organik quyosh elementlari, fulleren va fulleren bo’lmagan asosli organik quyosh elementlari, polimer quyosh elementlari, mexanik, kimyoviy, nurlanish ta’sirlar, atmosfera sharoiti, PCBM, ITIC, P3HT

Quyosh fotoelementlariga qo‘yiladigan asosiy vazifalardan temperatura, mexanik ta’sirlar, kimyoviy hamda nurlanishlar ta’sirlariga chidamliligidan tashqari atmosfera muhitida barqaror ishlash talabi ham qo‘yiladi [1-5]. Chunki, bu kabi qurilmalarning tijoriy maqsadlarda ishlab chiqarila boshlangach, ularning real ish mexanizmlari jarayonlari hammamizga ma’lum bo‘lgan atmosfera muhitida kechadi. O‘rganilayotgan fullerenli va fullerensiz organik moddalar aralashmasidan iborat yupqa qatlamli fotoelementlarni atmosfera muhitidagi barqarorligini solishtirishda OQElarning samarali va barqaror hamda uzoq muddatli xizmat ko‘rsatishini taminlash uchun muhim xulosalar olishimiz mumkin. Shu sababdan P3HT:PCBM va P3HT:ITIS asosida OQElarini atmosfera muhitida samaradorlik va barqarorlik ko‘rsatkichlari tadqiq etildi [6-8].

1 va 2-rasmlarda atmosfera muhitida joylashgan P3HT:PCBM va P3HT:ITIC asosidagi OQEdagi $V_{OC}$, $I_{sc}$ va EO‘S normallashgan qiymatlarining pasayish egri chiziqlarini keltirilgan. Tajribada o‘rganilayotgan ob’yektlar fotoelektrik parametrlarning vaqt o‘tishi bilan o‘zgarishi 1-8 soat davomida kuzatildi. Degradasiya jarayonlariga asosiy sabablardan biri kislorod va suv molekulalari hisoblanadi [9-10].




1 - rasm. Atmosfera muhitida joylashgan P3HT:PCBM asosidagi OQEda $V_{oc}$ (doira), $I_{sc}$ (uchburchak) va EO‘S (romb) qiymatlarining o‘zgarish egri chiziqlari.




2 - rasm. Atmosfera muhitida joylashgan P3HT:ITIC asosidagi OQEda $V_{oc}$ (doira), $I_{sc}$ (uchburchak) va EO‘S (romb) qiymatlarining o‘zgarish egri chiziqlari.

1 va 2-rasmlardan ko‘rinadiki, har ikkala OQElarda ham o‘zgarmas $V_{oc}$, $I_{sc}$ i EO‘S qiymatlari qisqa vaqt ichida deyarli nolga tushadi. Bunday o‘zgarishlar o‘rganilayotgan OQElar turiga xos bo‘lib, ularning mexanizmi asosan yuqori katod

qatlami Al ning tez oksidlanishi va uning yupqa qatlamga diffuzion tarqalishi bilan bog‘liq [11-13]. P3HT:PCBM asosidagi OQEdagi EO‘Sning kamayish davri taxminan 8 soatni tashkil etadi, bu boshqa ishlarda bo‘lgani kabi bir xil [14]. Biroq, P3HT:ITIC ga asoslangan OQElarda EO‘Sning pasayish davri sezilarli darajada kichik bo‘lib, bir soatdan kam vaqtda deyarli to‘liq degradasiyaga uchrar ekan. P3HT:PCBM asosidagi OQE holatida Al elektrod yupqa qatlamining oksidlanishi va uning fotoaktiv qatlamga tarqalishi bilan aniqlangan va tushuntirilgan bir necha soatlik xarakterli degradasiya vaqti ushbu optik tadqiqot natijalariga to‘g‘ri keladi, P3HT:ITIC asosidagi OQEda esa bunday degradasiya davri juda qisqa ekan. Bir xil donor matrisali polimerga ega bo‘lgan, ammo har xil akseptor molekulali ikkita organik quyosh elementlarining degradasiya natijasida parchalanish tezligidagi bunday farq ularning fotoaktiv qatlamining o‘ziga xos tuzilishi bilan bog‘liq ekan [15-17].

Bir xil donor P3HT polimerli, ammo turli xil PCBM va ITIC akseptor molekulalari bo‘lgan OQElarning fotovoltaik va optik xususiyatlarini qiyosiy o‘rganish misolida, bunday qurilmalarning yutilish va fotolyuminessensiya spektrlari ma’lumot beruvchi vosita sifatida keyingi ilmiy tadqiqot ishlarida foydalanish mumkin, ya’ni EO‘Sning kamayishi va degradasiya darajasini, quyosh energiyasini o‘zgartirish qurilmalarining xizmat ko‘rsatishga yaroqli ekanligi kabi parametrlarini baholash mumkin.

1:1 nisbatdagi P3HT:PCBM aralashmasi asosidagi OQEda qolgan ikki xil boshqa nisbatlardagi aralashmalar asosidagi OQElardan farqli ravishda yuqori EO‘S olingan. Natija 30 $^0$S haroratda AM1.5 spektrli 100 mVt/sm$^2$ intensivli yorug‘lik ta’sirida 3,6% EO‘Sga erishilgan bo‘lsa, 1:2 hamda 1:4 nisbatdagi aralashmalardan tayyorlangan OQElarda esa mos ravishda, EO‘S 2,2% hamda 0,7%ni tashkil etgan. Qisqa tutashuv toki zichligi $J_{cs}$=9.5 mA/sm$^2$ va to‘ldirish faktori FF=0.63ni tashkil etdi. Bu esa, 1:1 nisbatdagi aralashmada donor va akseptor materiallari o‘rtasidagi mutanosiblikni va ularning interfeysi optimal darajada shakllanishini ko‘rsatadi. Demak, donor va akseptor materiallarining aralashmadagi nisbati 1:1 bo‘lganda, yorug‘lik yutilishida poydo bo‘ladigan eksitonlarni elektron va kovaklarga ajralishi va ushbu zaryadlarning elektrodlarga tashilishi optimal darajada bo‘ladi [18-19].

Har xil nisbatdagi materiallar aralashmasidan tayyorlangan P3HT:ITIC faol qatlamli OQElar uchun, yuqoridagi natijalar kabi, 1:1 nisbatda optimal EO‘Sga erishish mumkinligini quyidagi ishlardagi natijalar xam tasdiqlaydi Jadvalda katod sifatida Al tanlangan bo‘lib, katod va faol qatlam orasiga PFNning yupqa qatlami yotqizilgan. PFN materiali metanol suyuqligida 0.2 mgr/ml konsentrasiyada erititilib

tayyorlangan va 20 sekund davomida 2000 ayl/min tezlikda syentrofugalash usulida faol qatlam ustiga 5 nm qalinlikda yotqizilgan.

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# FARG'ONA VILOYATIDA REPRODUKTIV YOSHDAGI AYOLLARNI KONTRASEPTIV VOSITALARNI QO'LLASH USULLARI HAQIDAGI XABARDORLIK DARAJASINI O'RGANISH

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**Annotatsiya:** Mazkur maqolada Farg'ona viloyatida reproduktiv yoshdagi ayollarni kontraseptiv vositalarni qo'llash usullari haqidagi xabardorlik darajasini o'rganish, zamonaviy, samarali va xavfsiz bo'lgan kontraseptsiya usullari, Reproduktiv yosh, Bachadon ichi kontraseptiklari haqida ma'lumotlar berilgan.

**Kalit so'zlar:** Reproduktiv, infratuzilmani, BMT, JYYK, Oral kontraseptiklar, Qin halqalari, Plastirlar, Demografiya.

**Аннотация:** В данной статье представлена информация об уровне информированности женщин репродуктивного возраста Ферганской области о методах использования контрацептивов, современных, эффективных и безопасных методах контрацепции, репродуктивном возрасте, внутриматочных контрацептивах.

**Ключевые слова:** Репродуктивная система, инфраструктура, ООН, JYK, Оральные контрацептивы, Вагинальные кольца, Пластыри, Демография.

**Abstract:** This article provides information on the level of awareness of women of reproductive age in Fergana region about the methods of using contraceptives, modern, effective and safe methods of contraception, reproductive age, intrauterine contraceptives.

**Key words:** Reproductive, infrastructure, UN, JYK, Oral contraceptives, Vaginal rings, Plasters, Demography.

## KIRISH

O'zbekiston Respublikasida aholi salomatligi va sog'liqni saqlash tizimi mustaqillikning birinchi kunlaridanoq davlat siyosati darajasiga ko'tarildi. Mamlakatimizda ko'rilayotgan chora-tadbirlar natijasida aholiga tibbiy xizmat ko'rsatishning samaradorligi, sifati va qulayligini oshirish ta'minlandi, BMT Ming yillik rivojlanish maqsadlarining asosiy parametrlariga erishildi.

Biz tibbiyot xodimlari Farg'ona viloyatidagi reproduktiv yoshdagi ayollar bilan kontraseptiv vositalarni qo'llash usullari, ularni qay tarzda qo'llash va nojo'ya qo'llaganda qanday kasalliklar kelib chiqishi haqida ma'lumotlar berdik.

Reproduktiv yosh (shuningdek, tug‘ish yoki fertil yoshi) — bu ayolning hayotidagi bolani ko‘tarish va tug‘ish qobiliyatiga ega bo‘lgan davr. Demografiyada bu davrning davomiyligi uning chegaralarini ko‘rsatish bilan tavsiflanadi. Ayollar uchun reproduktiv yosh deganda 15-49 yosh tushuniladi (tug‘ilish darajasi past bo‘lgan mamlakatlarda — 15-44 yosh). Qoida tariqasida, reproduktiv yoshdagi ayollarning ulushi ancha barqaror va 25-30 % ni tashkil qiladi.

O‘zbekiston Respublikasi Prezidentining 2021-yil 17-martdagi qaroriga ko’ra:

Reproduktiv yoshdagi ayollar, homiladorlar va bolalar uchun zamonaviy, yuqori texnologik, ixtisoslashtirilgan tibbiy yordam ko‘rsatish tizimini yanada takomillashtirish maqsadida hamda 2019 — 2025-yillarda O‘zbekiston Respublikasining sog‘liqni saqlash tizimini rivojlantirish konsepsiyasiga muvofiq:

1. Quyidagilar reproduktiv yoshdagi ayollar, homiladorlar va bolalarga ko‘rsatiladigan tibbiy yordam sifatini oshirish va ko‘lamini yanada kengaytirishning ustuvor yo‘nalishlari etib belgilansin:

•reproduktiv yoshdagi ayollar, homiladorlar va bolalarga ko‘rsatiladigan birlamchi tibbiy yordam hajmini kengaytirish va sifatini oshirish;

•ayollar va bolalarga malakali, ixtisoslashtirilgan yuqori texnologik tibbiy yordam ko‘rsatish uchun zamonaviy infratuzilmani shakllantirish;

•homilador ayollar va bolalar uchun ixtisoslashtirilgan yuqori texnologik tibbiy xizmat ko‘rsatadigan muassasalarning moddiy-texnika bazasini mustahkamlash, shuningdek, ularning binolarini rekonstruksiya qilish, mukammal ta’mirlash va yangilarini qurish;

•nogironligi bo‘lgan bolalarni tibbiy-ijtimoiy reabilitatsiya qilish va sog‘lomlashtirish, ularning jamiyat hayotida ishtirok etishi uchun shart-sharoitlar yaratish bo‘yicha chora-tadbirlarni amalga oshirish;

•zamonaviy talablarga javob bera oladigan va ilg‘or texnologiyalarni egallagan yuqori malakali tibbiyot kadrlarini tayyorlash, qayta tayyorlash va malakasini oshirish orqali reproduktiv yoshdagi ayollar, homiladorlar hamda bolalarga ko‘rsatiladigan tibbiy xizmat sifatini yaxshilash;

## ADABIYOTLAR VA METADOLOGIYA.

Darhaqiqat, fan tarixchisi Merrili Borellning fikriga ko'ra, tug'ilishni nazorat qilish harakatining qonuniyligini ta'minlashda biologlar asosiy rol o'ynagan. Afsuski, 1920-yillarda olimning qiziqishini uyg'otishning eng yaxshi usuli yevgenika tili edi (bu o'sha paytda reproduktiv salomatlikni o'rganishdan ko'ra asosiyroq edi). Sangerning ta'kidlashicha, "tug'ilishni nazorat qilish "yaroqsiz" tug'ilish darajasini cheklash uchun zarur edi", deb yozadi Borell. Bugungi kunda qanchalik dahshatli tuyulmasin, Sangerning yevgenikaga asoslangan argumenti ishladi - biologlar kontratseptsiyadan inson evolyutsiyasini nazorat qilish vositasi sifatida foydalanish va'dasi bilan vasvasaga tushishdi.

1937-yilda Amerika Tibbiyot Assotsiatsiyasi tug'ilishni nazorat qilish vositalaridan foydalanishga ruxsat berdi va Amerika Tug'ilishni nazorat qilish

federatsiyasi uni ta'minlash uchun davlat sog'liqni saqlash dasturlarini rag'batlantirish uchun tuzildi. 1940-yilda nashr etilgan Life Magazine hikoyasida Janubiy Karolina rasmiylari kambag'al onalarga kontratseptsiyani taklif qilish uchun davlat pullaridan foydalanganliklari uchun maqtovlar yozilgan.

## NATIJA VA MUHOKAMA.

Bugungi kunda zamonaviy, samarali va xavfsiz bo'lgan kontraseptsiya usullari juda ko'p. Ularni shartli ravishda guruhlarga bo'lish mumkin:

1. **Homiladorlikdan saqlovchi tabiiy usullar** — qoida tariqasida, hayz sikli fazasini aniqlash va jinsiy aloqani to'xtatilishiga asoslanadi. Ular ishonchli emas va jinsiy yo'l bilan yuquvchi kasalliklardan (JYYK) himoya qilmaydi. Shunga qaramasdan, bu usullarga ko'pchilik amal qiladi.
2. **Baryer usullar** — homiladorlikni oldini olish uchun samarali bo'lishi mumkin, prezervativlar esa JYYK`dan himoya qilishda ham. Samaradorlik darajasi ulardan to'g'ri foydalanishga bog'liq. Ko'pincha ularni yanada samaraliroq usullar bilan birgalikda qo'llash tavsiya etiladi.
3. **Bachadon ichi vositalari** — tarkibida metall (mis, kumush) va gormonlar saqlashi mumkin, ularning ta'siri kimyoviy moddalarning spermatozoidlar va tuxum hujayraga, bachadon bo'yni shillig'iga va endometriyga ta'siri bilan tushuntiriladi. Bu usulning samaradorligi yuqori, lekin ular JYYK`dan himoyalamaydi.

Bachadon ichi spirali haqida→

4. **Gormonal usullar** — juda samarali, lekin JYYK`dan himoyalamaydi. Bunga oral kontraseptivlar (tabletkalar), plastirlar, vaginal halqalar, implantatlar va favqulotda kontraseptsiya usullari kiradi.

### Bachadon ichi kontrasepsiyasi

A'zoga, ya'ni bachadon bo'shlig'iga "yot" bo'lgan jismlarni joylash yo'li bilan amalga oshiriladi. Bachadon ichi kontrasepsiyasi yuqori iqtisodiy rivojlangan mamlakatlarda keng tarqalgan masalan Xitoy, Rossiya va Skandinaviya mamlakatlari. Bu usul XX asr boshlarida ilk bor qo'llanilgan va bunda bachadon ichiga turli xil metallardan tayyorlangan halqalar joylashtirilgan. 1935 yilda bachadon ichi kontrasepsiyasidan foydalanish inkor etildi, bunga sabab infeksion asoratlar ko'payib ketganligidir.

1962-yilda Lipps bachadon ichiga plastikmassadan tayyorlangan va uning uchida tortib olish uchun maxsus ipchasi bor bo'lgan kontraseptiv vositani o'ylab topdi. Shu vaqtdan boshlab bachadon ichi kontrasepsiyasini qo'llash takomillashib bormoqda.

Bachadon ichi kontraseptiklari ikki xil bo'ladi: inert va medikomentoz. Inert kontraseptiklar hozirgi kunda qo'llanilmaydi. Medikomentoz vositalar esa o'zida metal yoki gormonlar saqlaydi. Ular quyidagilar bo'lishi mumkin:

- MultiloadCu-375 – F harfini eslatuvchi spiral, mis bilan qoplangan, 5 yilgacha xizmat qiladi;
- Nova-T – T harfi shaklida, mis bilan qoplangan;
- CooperT 380 A – T-shaklidagi spiral, 6 yilgacha xizmat qiladi;
- Mirena – hozirgi kunda eng mashhur bo‘lgan kontraseptiv spiral, bachadon bo‘shlig‘iga doimo levonorgestrel gormonini ajratib turadi, bu gormon esa progesteron gormoni bilan bir xil ta’sirga ega, ya’ni homiladorlik ro‘y berishiga qarshilik ko‘rsatadi va davolovchi xususiyatga ham ega.

Gormonal kontrasepsiya

Gormonal kontrasepsiya gestagen yoki esterogen gormonlaridan tashkil topgan bo‘ladi.

**Gormonal kontrasepsiya turlari**

**Kombinatsiyalangan:**

- Oral kontraseptiklar;
- Qin halqalari;
- Plastirlar.

**Gestagen:**

- mini—pili;
- ineksion;
- implantatsiyalanuvchi.

**Tabiiy usullari**

Zamonaviy ma’lumotlarga ko’ra, tuxum hujayra ovulyatsiyadan keyin o’rtacha olti soatdan bir sutkagacha urug’lanish qobiliyatini saqlab turadi. Spermatozoidlar ayol jinsiy a’zolarida 2-8 kungacha yashashga qodir, lekin tuxumni urug’lantirish qobiliyatiga faqatgina bachadonda va bachadon nayida olti-yetti soat bo’lganidan so’ng erishadi.

Buning mazmuni: ovulyatsiyadan sakkiz kun oldin va ovulyatsiya kuni himoyalanmagan jinsiy aloqa qilish homiladorlikka olib kelishi mumkin. Bu nazariy jihatdan. Amalda — siklning har qanday kunida homilador bo’lib qolish mumkin. Chunki insonda nafaqat barmoq izlari va ko’z rangi, balki uning o’zi va jinsiy hujayralarining hayot davomiyligi ham individualdir. Shu sababli, istalmagan homiladorlikdan hayz siklning har qanday kunida himoyalanish kerak!

**XULOSA.** Xulosa qilib aytadigan bo’lsak, oila qurganda erkak va ayol o’z jinsiy nafsini qondirish uchun aloqada bo’lishadi, lekin bunda ikkalasining ham jismoniy va ruhiy salomatliklariga jiddiy salbiy ta’sir ko’satmasliklari kerak. Buning uchun ular kontraseptiv vositalardan tog’ri foydalanishlari va albatta bir oyda bir marta bo’lsa ham doktorlarimiz qabuliga maslahat olishliklari uchun yoki ko’rikdan o’tib turishlarini maslahat beramiz.

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# NEMIS TILIDA TINISH BELGILARINING QO'LLANILISHI

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**Anotatsiya:** Ushbu maqolada nemis tilini o'qitishda tinish belgilarining ishlatilishi, tarjimalari va ahamiyati ko'rsatilgan. Nemis tilidagi tinish belgilarining o'zbekcha ekvivalenti va asosiy qoidalari misoolar bilan ko'rsatilgan.

**Kalit so'zlar:** Nemis tili grammatikasi, punktuatsiya, qo'shtirnoq, ko'p nuqta, undov belgisi, so'roq belgisi, chiziqcha, ikki nuqta, qavs, to'trburchak qavs, vergul, nuqta, nuqtali vergul

Barcha tillardagi kabi nemis tilida ham tinish belgilari juda muhim hisoblanadi. Tinish belgilari punktuatsiya bo'limida o'rganiladi va nutqga qo'shimcha ma'no berish uchun ishlatiladi. Tinish belgilarining har birini o'z nomi va ishlatilishi mavjud bo'lib ular darsliklarda va kundalik hayotdagi materiallarda ham keng qo'llaniladi.

| | |
|---|---|
| die Anführungszeichen –qo'shtirnoq | " " yoki « » |
| die Auslassungspunkte –ko'p nuqta | ... |
| das Ausrufezeichen -undov belgisi | ! |
| der Apostroph -apostrof | ' |
| der Bindestrich –chiziqcha | - |
| der Doppelpunkt/das Kolon –ikki nuqta | : |
| der Ergänzungsstrich -chiziqcha | – |
| das Fragezeichen -so'roq belgisi | ? |
| der Gedankenstrich –uzun chiziq | — |
| runde Klammern -qavs | ( ) |
| eckige Klammern –to'rtburchak qavs | [ ] |
| das Komma-vergul | , |
| der Punkt –nuqta | . |
| das Semikolon-nuqtali vergul | ; |

Nuqta (der Punkt) darak gap oxirida qo'yilib, tovushning pasayishini va ikkinchi gap boshlanguncha bo'ladigan pauzani ko'rsatadi: Wir gehen ins Kino. Sie

schreiben ein Diktat. Raqam bilan yozilgan tartib sonlardan keyin nuqta qo'yiladi: Der 5. Student; Der 8. Dezember; Der 1. September.

So'roq belgisi (das Fragezeichen) So'roq belgisi (das Fragezeichen) so'roq gap oxirida qo'llanib, tovushning balandga ko'tarilishini ifoda etadi: «Gehen wir ins Kino?» fragt er mich. Wo wohnst du? Bist du Student?

Undov belgisi (das Ausrufungszeichen) Buyruq, istak, xitob (undash) ma'nolarini ifoda etadigan gaplar oxirida: Macht Schlufi! Komm!

Yolg'iz qo'llangan yoki qaytarilgan undov so'zlardan keyin: O, meine Freunde! - O, do'stlarim! (J.W.Goethe, DieLeiden des jungen Werther) Xitob ma'nosini ifodalovchi so'zlardan keyin: O, Bestimmung des Menschen! - O, insoniylik burchi! (J.W.Goethe, Die Leiden des jungen Werther) Tire (der Gedankenstrich)

Tire dialogdagi ikki gap o'rtasida qo'llanib, so'zlovchining o'zgarishini ko'rsatadi: «Ich sali, als uns der Herr knipste, - glaub ich, — links», meint Luise nachdenklich (Erich Kastner, Die Zwillinge). Tire gap ichida qo'llanadi. U biror masala haqidagi darak oldidan bo'ladigan cho'ziq pauzani anglatish, tugallangan nutqni ifoda etish uchun qo'llanadi.

Qo'shtirnoq odatda kitoblarda, gazetalarda ishlatiladi. Muallif gapidan so'ng keladigan ko'chirma gapni ko'rsatishda ishlatiladi. Shuningdek she'rlar, maqolalar, qisqa hikoyalar, qo'shiq va teleshovlar, kitoblar , asarlarning nomlarini yozishda ham ishlatiladi

„Hänsel und Gretel" ist ein Grimm-Märchen.

Die Brüder Grimm haben „Kinder- und Hausmärchen" geschrieben.

Ikki nuqta muallif gapi va ko'chirma gap o'rtasida qo'llaniladi

Sie sagten: «Das Mädchen ist sehr schön.»

Ismlar quyidagi tovushlar bilan tugasa apostrof qo'yiladi (i.e., spelled -s, -ss, -ß, -tz, -z, -x,

-ce), va egalikni bildiradi.

des Prinz' Ross

Ba'zi qisqartmalar, dialiektlar, iboralar yoki she'riy birikmalarda apostrof ishlatiladi

wie geht's? (wie geht es?)

ich hab' (ich habe)

Vergul ikkita mustaqil gapni boshqa bog'lovchi yoki tinish belgilarisiz bog'lashda ishlatiladi. Shuningdek uyushiq bo'laklarni ham ajratishda ishlatiladi. without a conjunction; the other

Der Frosch stand vor der Tür, die Prinzessin erschrak.

Die sieben Zwerge sind Brummbär, Chef, Happy, Hatschi, Pimpel, Schlafmütz undSeppl.

Narxlarni aytishda vergul o'nlik sonlarni birlik sondan ajratish uchun ishlatiladi. Katta sonlarda vergul mingliklarni ajratishda ishlatiladi

Beispiel:

€9,95

1 000 000 or 1.000.000

A dash or long dash indicates a pause, a Chiziqcha yoki uzun chiziq pauzani, davomiylikni yoki qarama-qarshilikni ifodalaydi

Auf einmal - ein lautes Weinen!

Agarda gapda boshqa qo'shtirnoq belgisi bo'lmasa chiziqcha gapirayitgan shaxlarning birin ketin o'zgarayotganini bildiradi

- Aschenputtel, komm mal her!

- Ja, ich komme sofort!

Shuningdek chiziqcha yoki uzun chiziq narxning o'zgarmasligini

€10,-

Tinish belgilari - bu tinish belgilariga oid qoidalar to'plami. Tinish belgilarining maqsadi o'quvchiga yozilgan narsaning ma'nosini to'g'ri tushunishni ta'minlashdir. Tinish belgilarining asosini nutqning semantik artikulyatsiyasi tashkil etadi. Ko'pincha semantik bo'linish uning grammatik bo'linishiga, og'zaki nutqda esa intonatsion bo'linishga mos keladi; boshqacha aytganda, semantik artikulyatsiya grammatik va intonatsion jihatdan ifodalanadi. Bunda tinish belgilari uchun semantik, grammatik va intonatsiya asoslarining mos kelishi yoki tinish belgilarining strukturaviy-semantik asoslari haqida gapirish mumkin.

Biroq, ko'rsatilgan uchta asos: semantik, grammatik va intonatsiya mos kelmasligi mumkin bo'lgan holatlar mavjud. Shunday qilib, ko'pincha nutqning semantik va grammatik artikulyatsiyasi uning intonatsion artikulyatsiyasi bilan mos kelmaydi. Ko'pincha "nima" birlashmasi bilan asosiy va bo'ysunuvchi qismlar intonatsiyani ajratmaydi: U tez orada keladi, deyishadi. Va aksincha, semantik va grammatik nuqtai nazardan integral bo'lgan jumlalar ko'pincha tonatsiyaga bo'linadi; Masalan, juda keng tarqalgan mavzu va predikat (o'tgan asrning o'rtalarida ikki qavatli savdo uylari butun qirg'oq bo'ylab umidsizlik bilan cho'zilgan) va prepozitiv juda keng tarqalgan holat va gapning qolgan qismi o'rtasida deyarli har doim pauza mavjud. (May oyining aniq ertalabki soat oltida Mayya bog'ga chiqdi) va boshqa sub. Bunday hollarda, yuqoridagi misollardan ko'rinib turibdiki, tinish belgilari semantik

va grammatik artikulyatsiyaga (yoki uning yo'qligiga) va intonatsiya artikulyatsiyasidan (yoki uning yo'qligi) qat'iy nazar qo'yiladi (yoki qo'yilmaydi.

Boshqa tomondan, semantik artikulyatsiya grammatik jihatdan qo'llab-quvvatlanmaydigan holatlar ham tez-tez uchraydi, ya'ni. gramm. bo'linish maxsus shakllarda ifodalanmaydi. Bunday hollarda tinish belgilarining yagona sababi semantik artikulyatsiyadir; mos keladigan grammatik va intonatsion artikulyatsiya tinish belgilarini taklif qiladi. Demak, masalan, “quyosh porlayapti, qushlar sayrayapti” gap bo‘lagi grammatik va intonatsion jihatdan ikki mustaqil gap (Quyosh porlayapti. Qushlar sayr qilmoqda) va murakkab gap (Quyosh – quyosh porlayapti. Qushlar sayr qilmoqda) shaklida ifodalanishi mumkin. porlaydi, qushlar qo'shiq aytadi). Shunday qilib, nutqning ma'lum bir qismining grammatik va intonatsion bo'linishi uning tinish belgilari bilan ifodalangan semantik talqiniga bog'liq. Intonatsiya yozuvchiga nutqning semantik artikulyatsiyasini aytib berishi mumkin bo'lsa, istisno - bu ovozdan og'zaki nutqni yozib olish - diktant. Oxir oqibat, bir hil va heterojen ta'riflar ma'no jihatidan farq qiladi, ba'zida kirish so'zlari va gap a'zolari (He may be at school va He may be at school)va boshqa konstruktsiyalar. Nihoyat, semantik (va intonatsion) artikulyatsiya grammatikaga zid bo'lgan holatlar mavjud. Masalan: U menga havza va soqol olishimni eslatdi. Va poyabzal uchun lak. Va cho'tka. Grammatik birikma nuqtai nazaridan "botinkalar uchun krem ham, cho'tka ham" bir hil qo'shimchalardir, ammo muallif ularni ma'no va intonatsiya jihatidan mustaqil jumlalarga ajratadi va buni tinish belgilari bilan ifodalaydi. Shunday qilib, ko'rib chiqilgan barcha holatlarda tinish belgilarining asosi aynan nutqning semantik bo'linishi bo'lib, ular grammatik va intonatsiya bo'linmalariga mos kelishi mumkin, lekin ulardan biri bilan mos kelmasligi va hatto unga zid bo'lishi mumkin.

Tinish belgilari ikkita asosiy vazifani bajaradi: 1) ajratish, 2) tanlash. Tinish belgilarining ayrimlari faqat ajratish uchun xizmat qiladi (ajraladigan tinish belgilari) - bular bitta tinish belgilari: nuqta, nuqtali vergul, undov va savol belgilari, ellipsis, ikki nuqta; bu xatboshiga ham tegishli. Bu belgilar yordamida gaplar, ayrim murakkab gaplarning predikativ qismlari, ba'zan bir jinsli a'zolar va boshqa konstruktsiyalar bir-biridan ajratiladi. Boshqa tinish belgilari faqat ta'kidlash uchun xizmat qiladi (tinish belgilarini ta'kidlash) - bular qo'sh belgilar: qavslar va tirnoq belgilari. Ushbu belgilar yordamida kirish va interkalyar iboralar va gaplar (qavslar) va to'g'ridan-to'g'ri nutq (tirnoq belgilari) farqlanadi. Uchinchi tinish belgilari (vergul va tire) ko'p funktsiyali, ya'ni. qo‘llanishning o‘ziga xos sharoitiga qarab ham ajratuvchi, ham ajratuvchi vazifasini bajara oladi. Demak, vergul yordamida murakkab gapning ikkala qismi ham, bir jinsli a'zolar ham bir-biridan ajratilishi

mumkin; chiziqcha yordamida bir qator hollarda murakkab gaplarning bo‘laklari, umumlashtiruvchi so‘zdan bir jinsli a’zolar, ba’zi to‘liqsiz gaplarda va boshqa konstruksiyalarda boshqa a’zolar ajratiladi. Vergul yordamida turli xil ajratilgan burilishlar, murojaatlar, kirish so'zlari ajralib turadi; chiziqcha yordamida kirish va oraliq gaplarni farqlash mumkin. Ba'zi hollarda, masalan, to'g'ridan-to'g'ri nutqqa ega bo'lgan jumlalarda, farqlovchi va ajratuvchi belgilarning murakkab birikmalaridan foydalaniladi.

Tinish belgilarining bu asosiy funktsiyalari ko'pincha shaxsiy, mazmunli funktsiyalar bilan murakkablashadi. Demak, gapning tugallanish belgilari bir gapni boshqa gapdan ajratibgina qolmay, balki aytilgan gapning maqsadi yoki hissiylik darajasi nuqtai nazaridan nima ekanligini ham ifodalaydi: U kelmaydi. U kelmaydimi? U kelmaydi! Bu jihatdan birlashmagan gaplarda tinish belgilarining qo‘llanilishi ko‘rsatkich bo‘lib, unda tinish belgilari ham semantik yukni ko‘tarib, birlashmagan gaplarning grammatik ma’nosini bildiradi. Demak, masalan, “U kelmaydi, u kutmoqda” gapida sanoq munosabatlari, “U kelmaydi – u kutmoqda” gapida esa qarama-qarshi munosabatlar ifodalangan. Barcha tinish belgilarining asosiy vazifalari, shuningdek, ularning semantik vazifalari ruscha tinish belgilarining qoidalari to'plamida tasvirlangan.

Muloqot jarayonida ko'pincha boshqa birovning nutqini etkazish zarurati tug'iladi (bu atama odatda boshqa odamning nutqini ham, ilgari aytilgan o'z nutqini ham anglatadi). Shu bilan birga, ba'zi hollarda birovning nutqining mazmunini emas, balki uning shaklini (uning aniq leksik tarkibi va grammatik tashkil etilishi), boshqalarida esa faqat mazmunini etkazish muhimdir; shuning uchun ba'zi hollarda birovning nutqini aniq takrorlash zarur bo'lsa, boshqalarida esa shart emas. Ushbu vazifalarga muvofiq tilda birovning nutqini uzatishning maxsus usullari ishlab chiqilgan:

1) to'g'ridan-to'g'ri uzatish shakllari (to'g'ridan-to'g'ri nutq);

2) bilvosita uzatish shakllari (bilvosita nutq).

To'g'ridan-to'g'ri nutqqa ega bo'lgan jumlalar boshqa birovning nutqini (uning mazmuni va shakli) aniq takrorlash uchun maxsus mo'ljallangan. bilvosita nutq-faqat birovning nutqining mazmunini etkazish uchun. Bular boshqa birovning nutqini uzatishning eng keng tarqalgan shakllari. Ulardan tashqari, faqat mavzuni, birovning nutqining predmetini etkazish, muallif nutqiga birovning nutqi elementlarini kiritish va boshqa, ekspressiv-stilistik vazifalarni hal qilish uchun mo'ljallangan boshqa shakllar mavjud. Shunday qilib, biz birovning nutqini uzatish shakllarining butun tizimi haqida gapirishimiz mumkin.

Nemis tilida yozishda ma’noni to’g’ri ifodalash uchun va to’g’ri imloviy qoidalarga rioya qilish uchun punktuatsiya qoidalarini yaxshi o’rganish va qo’llash juda muhim hisoblanadi. O’quvchilar tinish belgilarini o’rganish uchun nemis tilidagi kitoblarni va badiiy asarlarni ko’proq muatoala qilishlari va ulardagi tinish belgilariga alohida e’tibor berishlari lozim.

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