2. When using only a cyclone for peat separation the cleaning efficiency is about η = 98%. The two-stage separation may be due to the need to obtain high-quality granular fractions of peat without dust and fiber connections used, for example, for growing seedlings of plants and other purposes.

3. The terminal velocity of particles increases sharply with increasing their diameter from 1 mm to 2.5 mm It remains constant from 2.5 to 7 mm and drops sharply for fiber connections.

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ALTERNATIVE ENERGY SOURCES

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Human life is unthinkable without energy. We are all accustomed to the use of fossil fuels, such as coal, gas and oil as sources of energy However, as we know, their reserves in nature are limited. And sooner or later they will run out. The answer to the question "what to do in anticipation of the energy crisis?" has already been found: it is necessary to look for other energy sources – alternative, non-traditional, renewable [1]. What are the main alternative energy sources available currently?

Scientists warn of possible exhaustion of known and available oil and gas reserves, depletion of other essential resources such as iron ore and copper, nickel, manganese, aluminum, chromium, etc. Today the world energy is based on non-renewable energy sources. Great hopes in the world are pinned on the so-called alternative energy sources, the advantage of which is that they are renewable and environmentally friendly [2].

Such sources may include [3]:

- solar energy,
- wind energy,
- the energy of tides,
- the inner heat of the Earth,
- biomass fuels.

Let us consider the most relevant types of alternative energy sources for the Republic of Belarus.

Solar energy

The method of generating electricity from sunlight has been known for over a hundred years. The phenomenon of PV was first observed by Edmond Becquerel in 1839. Conducting a series of experiments on electricity, he plunged two metal electrodes in a conductive solution and subjected the setting to sunlight. Some electrical voltage occurred between the electrodes. The development of solar cells in Bell's laboratory in the early 50-es revolutionized the electronics industry. Space industry would be almost helpless without them. Light solar energy generators allowed to approach the problem of creating artificial Earth satellites in a completely different way. In addition, solar energy can be used in solar houses [4].

Solar installations can be designed for heating and hot water supply of residential houses. Solar power systems can save expensive mineral fuel through judicious use of solar energy.

The idea of the solar house (the house in which heat supply, cooling and hot water supply are carried out with the help of solar energy) has become widely known. Perhaps the perfect example of such a house is a traditional Japanese house. Both in summer and in winter it has an acceptable temperature for living. However, real solar houses with a fully developed system of heating and cooling are still relatively few. It is not easy to make them economically viable. However, it is evident that the natural reserves of oil and coal in the world are not enough for the long term and further technical program is inextricably linked with the need to conserve energy.

Wind energy

Apparently, for the first time wind energy was used to move sailing ships, and later – for lifting water and grinding grain. It is believed that the first wind turbines were built in China, Japan and Tibet more than

2 thousand years ago. The ancient Babylonians used them for the drainage of wetlands. In Egypt and the Middle East wind water-elevators and mills were built.

However, wind energy was seriously dealt with much later. In Russia this kind of energy became an object for research only after the revolution [5].

Abroad, wind turbines are most widely used in Australia, New Zealand, Latin America, Greece, etc.

Despite larger capital investments wind turbines are more efficient than thermal plants due to low operating costs (costs are 6 times lower). Hence, the costs are compensated during 1 – 1.5 years. In addition, the service life of wind turbines (relatively slow machines) is much longer than that of heat engines. Therefore, the unit costs of metal per unit of production for the entire period of service, as well as depreciation costs are lower.

The reasons behind the desire to expand the use of wind energy are [4]:

– the rapid growth of energy demand with limited resources of liquid and solid fuels and potential hydropower resources;
– the sharp increase in the prices of mineral fuels;
– the greater use of coal, oil and gas (in chemical industry for the production of synthetic materials);
– significant achievements in the field of aerodynamics and mechanics, aircraft engineering and chemistry, electrical engineering, etc. allow to create better and more efficient wind turbines.

Wind turbines can be most widely used in agriculture for charging rechargeable batteries, desalination of saline water, pumping water for drinking, aeration of basins.

In addition, electrical low-power wind turbines, along with charging the batteries, can energize the beacons and buoys, protect gas and oil pipelines against corrosion. The use of autonomous wind farms operating in isolation is limited to energy supply of water lifting and drainage installations.

Biofuels

Biofuels are biological fuels, various organic materials that emit heat in the process of decay, which is used for heating greenhouses, hotbeds and warmed soil. Manure, household waste, core (bark, taken from trees), sawdust, flax shive, waste textiles, dry leaf, undecomposed peat are used as initial substances.

In contrast to traditional oil or gas, biofuels are produced from renewable biological materials such as plants, manure or waste [6].

Types of bio-fuels. Bioethanol is a biofuel substitute for gasoline. It is made from crops, mostly wheat in the United Kingdom, sugar beet and maize, soya beans and sugar cane in the United States and South America.

Biodiesel is a biofuel substitute for diesel. It is made from oil crops – mostly rapeseed in Europe and palm oil in South-East Asia.

Two of the above forms are the so-called "first generation biofuels", as they are produced from the crude material, which can be used in food production.

Biogas is a biofuel to replace natural gas. It is produced from organic waste, including waste from livestock farms and waste collected from municipal, commercial and industrial sources that have undergone the process of anaerobic decomposition. In Europe biogas is produced from animal waste, and due to the emission of landfill gas.

Benefits of using. The main practical use of alternative bio-fuels is that they can be combined with traditional "fossil" fuel and used in existing energy systems, such as engines in cars and trucks.

In the use of biofuels instead of fossil fuels there are two main environment-saving factors. First, biofuel is a renewable resource, so it is a long-term, relatively cheap and reliable source of energy. Secondly, biofuel emits far fewer greenhouse gases in its production cycle and use [7].

The so-called "second generation biofuels", synthetic fuels, although derived from biomass, simulate chemical characteristics of fossil fuels. This allows us to integrate it into the existing fuel system more deeply. It also can be made with a higher proportion of wooden biomass, such as straw.

Increasing environmental pollution, the disruption of thermal balance of the atmosphere are gradually leading to global climate changes. The energy shortage and limited fuel resources show the inevitability of the transition to non-traditional, alternative energy sources with increasing sharpness. They are environmentally friendly and renewable, their basis is the energy of the Sun and Earth, water and air.

The role of energy in maintaining and further development of civilization is undeniable. Today, active research of all possible renewable energy sources is being conducted. In some cases, the results even seem to be very optimistic and allow to hope for some changes.

Energy is not only one of the most discussed concepts today; in addition to its main physical content, it has numerous economic, technical, political and other aspects. Mankind needs energy, and the demand for it increases every year. However, the reserves of traditional fossil fuels (oil, coal, gas and others) are exhaustible. The reserves of nuclear fuels, such as uranium and thorium are also limited.

There are two ways: austerity in the expenditure of energy and the use of unconventional renewable energy sources.

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COMPUTER SIMULATION OF STATIC ELECTRON BEAM ENERGY ANALYZER USING IBSIMU PACKAGE

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The possibility of computer simulation systems of electron and ion optics by means of the open source computer code IBsimu was considered. The results were get and their analysis was carried out within the applied task of restoring the values of the initial energy of beam electrons.

There are many simulation packages that allow the solution of problems of electron optics and, in particular, to carry out the simulation of processes of extraction and transportation of electron and ion beams from plasma sources. Possibilities and methods of these packages differ markedly. Many packages are developed in academic institutions, while others are only available on a commercial basis. All of them can be divided into three groups [1] :

a) A computer code includes simulation of appearance and disappearance of charged particles in plasma;

b) a computer code that allows to calculate the trajectories of charged particles (i.e., provides an exceptional opportunity to solve the problem of electron optics);

c) a computer code with a simplified model of plasma, which gives the opportunity to solve the problem of of extraction of electron and ion beam from plasma source and the problem of its further transportation, focus, etc.

Plasma simulation packages often use methods of continuous media (hydrodynamic), or the so-called method of "particle in cell" (particle in cell (PIC), integration methods of Monte Carlo or hybrid methods. The development of plasma models is very time consuming and calculations take a lot of computer time.

Packages that build trajectories of charged particles, providing a solution to problems of electron and ion optics, often work within the formalism of transfer matrix method. Moreover, the packages are able to solve the problem of associated arbitrary electric and magnetic fields calculation. The most well-known examples of this group of packages include the following: SimIon, Cobham Vector Fields and Integrated Engineering Software Lorentz. These packages have broad opportunities, but are spread only on commercial bases.

The third group, i.e. packages allowing to extract beams of plasma sources with restrictions are PbGuns and IGun (work in two-dimensional and cylindrically symmetric geometry, allowing to simulate plasma sources of positive and negative ions), Kobra-INP (works with three-dimensional geometry and extraction from plasma positive ions). The disadvantages of these packages also include their commercial nature. Package IBsimu, which belongs to the same group, but which is distributed freely, was used in this research.

IBSimu – Ion Beam Simulator package was developed at the University of Jyvaskyla, Finland, Kalvasom T. (T. Kalvas) and posted on the Internet for public access [2] under the GNU General Public License (GPL). This package is a library of classes and methods, which is written in the programming language C++ and is available for use under the operating systems Linux and Windows.

The main feature of this package is to calculate the electrostatic field and potential distribution determination by solving the Poisson equation (1) by means of finite element method. One-, two- and completely three-dimensional tasks are available. The description of the distribution of space charge of the beam particles in