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APPLICATION OF HEAT PUMPS IN THE AGRO-INDUSTRIAL COMPLEX OF THE REPUBLIC OF BELARUS

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Summary. The article discusses the heat pump and the advantages of its application in the rural economy. Examples of heat pump application in agriculture in the Republic of Belarus are given.

Key words: heat pump, agriculture, energy, alternative energy temperature, kilowatt.

Formulation of the problem. Agriculture plays a significant role in the national economy of any country. To achieve high yields and food production it is necessary to provide optimal conditions for the growth and development of plants and animals. In this context, providing reliable and energy-efficient heating of agricultural facilities is very important. One innovative approach in this area is the use of heat pumps.

Basic research materials. A heat pump (HP) is a heat boosting transformer, a device that takes heat from the environment and transfers it to the heating and hot water system. When a heat pump operates, energy is not spent on directly heating the cooling agent, but on pumping and converting heat from the environment to the facility. Thus, high energy efficiency of the equipment is achieved. The number of kilowatts of electrical energy used to operate the compressor is composed of 3 to 5 kilowatts of thermal energy (compressor heat coefficient is 3 to 5 units).

Heat pumps are divided into three types:

Aerothermal (air-source heat pumps), which extract heat energy from the atmosphere.

Geothermal. They extract heat from the earth.

Aquathermal (water pumps). It is a class of equipment that utilizes heat from the aquatic environment: rivers, lakes, seas, as well as underground aquifers. [5]

Among the advantages, the following can be emphasized:

- easier installation and lower cost compared to, for example, gas heating, as no special permits and re-planning of the place are required, and in general it is much more expensive to install gas than a heat pump;

- cost-effectiveness. On average, each kW of electricity used to operate the device gives 3-5 kW of heat for heating water and heating the house;

- maintenance savings. The operating costs of the thermal devices are minimal;

- automation of the control process. The unit operates without human intervention;

- increased fire safety, as the heat pump does not heat up to critical temperatures, at the same time the load on the electrical wiring is significantly reduced compared to the use of other heating systems;

- universality or the ability to switch to summer mode. Most models can be used in hot weather as an air conditioner to cool the air;

- compactness, quietness. The unit does not take up much space and does not make almost any sounds when operating;

- long service life. Such devices are reliable and durable;

- environmental friendliness. The use of alternative energy sources has a positive impact on the environment.

Disadvantages should be noted as well:

- depending on the condition of the facility and environmental conditions, as well as the availability and prices of other energy sources, the

initial investment in purchasing the equipment and its installation can be very substantial and the payback period quite long;

- due to the peculiarities of heat pump operation in regions where the air temperature drops below $-15\text{ }^{\circ}\text{C}$ during the cold season, it will be necessary to install additional heat sources, such as, for example, a gas boiler or an electric heater;

- water and ground (geothermal) devices disturb the ecosystems in which they operate (soil and water bodies).

The use of air source heat pumps (air-water) for on-farm agriculture has saved a lot of money on energy bills. Old farms have been given a second life. They are equipped with heating, toilets and showers. Farms also require large quantities of hot water to clean dairy equipment such as milking machines and milk lines in milk tanks. [3]

Let's consider some examples of heat pump application in agriculture in the Republic of Belarus.

The farm "AgroBoxZootech" in Minsk region installed an integrated milk cooling system on a dairy farm.

An integrated system of milk cooling and water heating with HP as well as a combined system of water heating with the use of HP were installed on a commercial farm. This system allowed milk to be heated from $36\text{ }^{\circ}\text{C}$ to $4\text{ }^{\circ}\text{C}$. The experts evaluate this system as follows.

This cooling system allows for extra milk that can be used for weaning. It is also possible to use systems of warm milking to obtain 2-3 liters of milk per cow per day.

Greenhouse plant "Berestyie" built a geothermal station equipped with a heat pump with a capacity of 1.163 MW (1 Gcal/h). The heating of water at the plant up to $60\text{ }^{\circ}\text{C}$ is done by geothermal water with a temperature of $24\text{ }^{\circ}\text{C}$. The station heats some of the greenhouses with heated water and provides a hot water supply.

The experience of operation of the station “Berestyie” is of great importance for the development of geothermal energy in Belarus. Many exploratory wells were drilled and then mothballed in our country in search of oil. There is water with a temperature of 8 - 9 °C at shallow depths (about 100 meters) and water with a temperature of 20 - 25 °C at greater depths (1 - 1.5 km). Exploration wells can be used for the construction of heat pump geothermal stations, which will significantly reduce capital costs.

Conclusions. From all of the above it can be said that heat pumps can be an indispensable means of heat supply of agricultural farms, in particular dairy farms. Their application is limited only by the economic situation, as well as the small number of national manufacturers. Nevertheless, heat pumps have a high degree of energy saving and high efficiency.

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