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DEVELOPMENT OF A SAFE SOLAR REFRIGERATION UNIT FOR SMALL ENTERPRISES

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Abstract:

A justification is required for the development of a solar-powered absorption and absorption-diffusion refrigeration machine for small enterprises processing livestock products. The basic design devices of absorption and absorption-diffusion refrigeration units operating on solar and other alternative energy schemes are presented. The principles of operation of such refrigeration machines are described, and the results of the analysis of the advantages and disadvantages of the proposed installations are given.

Keywords: Livestock products, small business, refrigeration machine, solar energy, absorption, absorption-diffusion, electric energy, alternative energy.

INTRODUCTION

Currently, one of the most strategically important paths for Uzbekistan's economic development is the formation and development of small businesses in all sectors of the economy, without exception. This is also relevant for the industry engaged in the processing of livestock products. Having strong refrigeration equipment with an average sobering capacity in the production is very important for all small firms that process livestock products, both for processing milk and meat and fish raw materials, providing the safety of raw materials and high quality of the final products. Such small enterprises for processing livestock products, for the most part, should be located in rural areas, which ensures their proximity to places of mass production of meat, dairy and fish raw materials, i.e. to farms [1].
However, here one should take into account the fact that a large amount of electricity is spent on the production of cold. It is no secret that rural areas are often very poorly supplied with electricity with a large capacity, which ensures the normal operation of the same small enterprises for processing livestock products. Therefore, the issue of developing refrigeration equipment operating on alternative types of energy remains relevant.

Countries located at latitudes less than 45 degrees are characterized by a very high density of solar energy, especially in the summer and autumn-spring periods, when the demand for artificial cold is highest. Our country-the Republic of Uzbekistan (geographical location 41°00 'north latitude and 64°00' east longitude) is one of those countries where the number of sunny days per year is 250 or more. At the latitudes of our republic, the sun gives out up to 6 kW/hour of energy per 1 sq. m. For comparison, the KHN-6.6 refrigerator with an ALS-117 monoblock and an internal volume of 6.6 m3 (produced by Ariada), which can be used in small enterprises for processing livestock products, consumes a power of 2 kW of electricity. Therefore, it certainly makes sense to think about how to use free Solar energy to get cold and thereby reduce the company's electricity costs.

MATERIALS AND METHODS

In context of this thesis, it offers advantages to develop a solar-powered absorption refrigeration machine for smaller companies processing livestock products that is less bulky, less metal-intensive, and does not require noisy and complex devices such as compressors than traditional freon steam compression machines. Here, the first option is a solar cooling absorption unit based on lithium bromide. The production of such installations can be mastered by a fairly small production enterprise with low financial costs. The temperature T = 85-90 ° C required for the operation of lithium bromide installations can be obtained by a conventional vacuum flat solar collector.

Better options are ammonia-water absorption refrigeration units are much more efficient, but their operation requires a temperature of the order of T = 180-200 ° C. It goes without saying that such a temperature can only be achieved with the use of a solar energy concentrator. In the standard version, we are talking about a solar reflector, in addition, here it is necessary to resolve the issue of a tracking system for the Sun. The tracking system and reflector are quite expensive products, but there are options for obtaining inexpensive refrigeration equipment.

For example, in India, inventors build a shape close to a parabola from handy materials (Fig. 1). Then this form is poured with liquid clay and brought to a parabolic shape using a template. After the clay has dried, the surface is covered with food foil and the solar concentrator is ready! The smoked copper tube placed in focus allows heating the coolant up to 300 ° C.

Very good solar concentrators can be made from TV parabolic antennas and from ordinary small mirrors glued to a parabolic surface. As has been shown by individual researchers, if a liter teapot is placed in the focus of a one and a half meter "plate", then the water in it boils in 8 minutes.

RESULTS AND DISCUSSIONS

Of course, cold is needed all the time, and the sun does not shine all the time (especially in winter), so the heater should be supplemented with other alternative energy sources.

In the conditions of Uzbekistan, catalytic heaters operating on gas or gasoline can be used as a reserve. In catalytic heaters, the fuel burns without flame. It has been established that an absorption refrigerator with a volume of 40 liters with a catalytic heater will consume 8-10 grams. gasoline per hour. At the same time, you should use the electric heating of the boiler (Fig. 3), as a reserve and addition to the main solar heating.

As for the reliability of such refrigeration machines, it should be noted that the ammonia-water absorption refrigerators, released 50 years ago, continue to work to this day, and are not going to break down. This speaks of their ultra-high reliability. Therefore, if you need to have a permanently cooled room, and this is what we need within the framework of a small enterprise for the processing of animal products, then such an installation can be made once and forget about it for a long time. The chiller will run as long as there is still one source of energy left. For a small enterprise located in a rural area, this is quite enough. It should be noted here that it is not possible to completely exclude the use of electrical energy in the operation of an absorption refrigeration unit operating on solar and other types of alternative energy, since its structure includes a pump (Fig. 3). It is possible to dispense with the use of electric energy when switching to absorption-diffusion refrigeration units powered by solar energy.

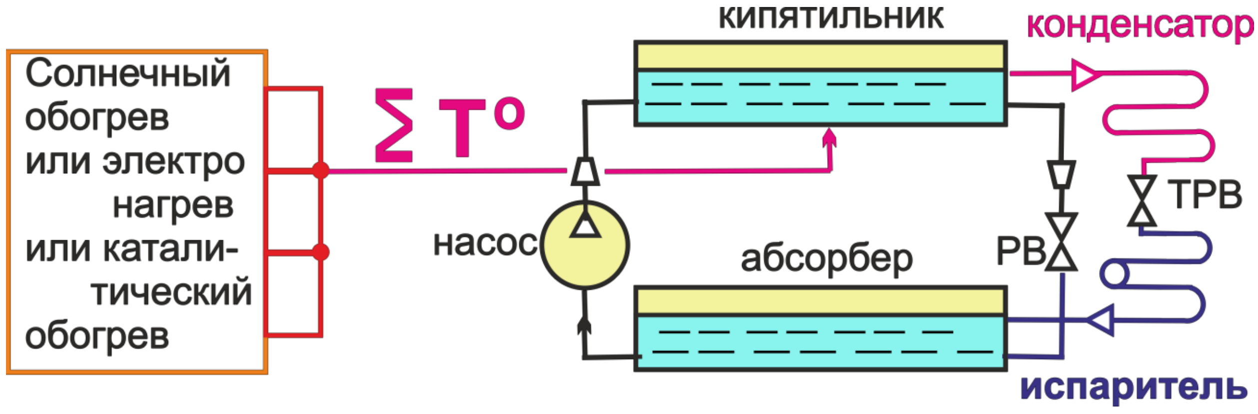

Fig. 3. Diagram of an absorption refrigeration unit operating on solar and other types of alternative energy.

By introducing into the circuit, in addition to the working agent and the absorbent, a third medium in the form of a light gas creates a continuous absorption unit that does not have such a mechanism as a pump. Such installations with an average refrigerating capacity can be used for refrigerating chambers of small enterprises for the processing of livestock products. Figure 4 shows a schematic diagram of the absorption-diffusion installation of the refrigerating chamber. The working agent in this unit is ammonia NH3; the absorbent is water H2O; , diffusion medium - hydrogen H2.During operation, the same total pressure p = 1.44 - 1.6 MPa is established in all devices of the installation. However, the partial pressures of ammonia pa and hydrogen pw, which are terms of the total pressure, are different in individual apparatuses. The difference in partial pressures pa - pw in the installation is used as the main driving force for the circulation of the working agent NH3, absorbent H2O and diffusion medium H2.

The installation works as follows: The concentrated solution from the receiver of the absorber X enters the heat exchanger of the solution VI, where it is heated by a weak solution passing through the counterflow to it, which is directed from the generator I to the absorber. The heated concentrated solution enters the thermosiphon VIII, which is heated by a solar heater IX. In the thermosiphon, the solution partially boils and is fed into the generator in the form of an emulsion, where the solution continues to boil with heat from a solar heater. From the heater, ammonia vapors with some admixture of the absorbent (water) enter the deflegmator, where, thanks to external cooling, a partial release of phlegm occurs and the vapor is enriched with a working agent. After the deflegmator, the vapors of the working agent enter the condenser, where they condense due to external cooling . The condensate of the working agent enters the cooler VII, where it is additionally cooled as a result of heat exchange with cold vapors after the evaporator IV, which are sent to the cooler VII .

The cooled condensate enters the evaporator IV, which contains a mixture of ammonia NH3 and hydrogen H2 vapors under a total pressure of 1.4 — 1.6 MPa. The partial pressure of ammonia in this mixture is 0.3-0.4 MPa . As a result of a sharp drop in pressure, the ammonia in the evaporator boils . Its boiling point is set in accordance with the partial pressure [2].

As a result of the supply of heat to the evaporator from the medium to be cooled, liquid ammonia evaporates. Ammonia vapors are mixed in the evaporator with hydrogen entering the evaporator from the top of the absorber through the cooler. A mixture of ammonia and hydrogen vapors is removed from the evaporator through cooler VII to absorber V. At the same time, a weak solution, previously cooled in a solution heat exchanger, is supplied to the absorber from the generator. Here ammonia vapors are absorbed by the weak solution. The heat of absorption is removed through the developed outer surface of the absorber.

The concentrated liquid solution enters the absorber receiver, and hydrogen is removed from the upper point of the absorber through the cooler to the evaporator.

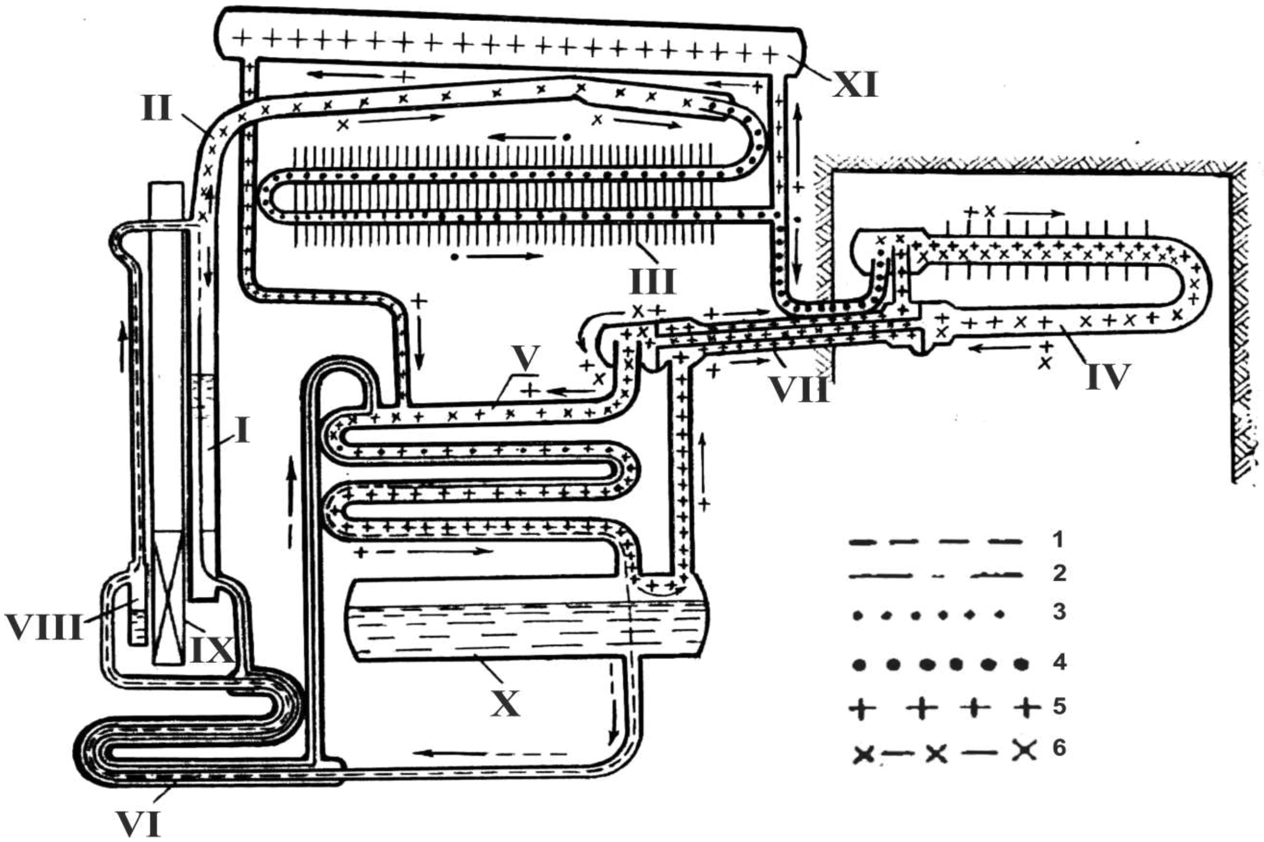

Fig. 4. Schematic diagram of the absorption-diffusion unit of the refrigerating chamber: I - hendephlegmator; III - capacitor; IV - evaporator; V - absorber; VI - solution heat exchanger; VII - cooler for liquid ammonia and hydrogen; VIII - thermosyphon; IX - solar heater; X - absorber receiver; XI - hydrogen receiver; 1 - strong water-ammoniaerator; II - a single solution; 2 - weak ammoniacal solution; 3 - ammonia vapors; 4 - liquid ammonia; 5 - hydrogen; 6 - a mixture of hydrogen and ammonia vapors.

The advantage of the absorption-diffusion installation of the refrigerating chamber is determined by the simplicity of the device, as well as due to the absence of moving mechanisms and the associated reliability of operation [3].

The use of solar energy to heat the generator significantly increases the energy efficiency of the absorption-diffusion installation. During periods of lack of solar energy and at night for you can use waste heat or gas fuel to heat the generator.

CONCLUSION

This article is a summary of the results of the initial stage of the study, i.e. the stage of studying literary sources and collecting materials for research and development work**.** The analysis shows that the development and creation absorption and absorption-diffusion refrigeration machines operating on solar and other types of alternative energy, for small enterprises for processing livestock products located in rural areas, is very important both in terms of reducing energy costs and in terms of reducing the dependence of enterprises on the supply of electricity energy. This, in turn, ensures the uninterrupted operation of refrigerators for storing raw materials and finished products in small enterprises, which undoubtedly affects the production of high-quality meat, dairy, fish products in sufficient quantities to meet the growing demand of the population..

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