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IMPROVING ENERGY CHARACTERISTICS OF GENERATORS-THERMOSYPHONS OF ABSORPTION REFRIGERATION DEVICES

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Switching to natural refrigerants, carried out at the moment, attracts the attention of developers to the absorption refrigeration units (ARU) and the absorption refrigeration devices (ARD) based on them.

ARU's working body is a water-ammonia solution (WAS) with the addition of an inert gas – hydrogen or helium. So, ARU are completely environmentally safe and have zero values of the ozone-depleting potential and the potential of the "greenhouse" effect.

ARD with ARU also have a number of unique qualities, such as: noiselessness, high reliability, ability to use several different sources of thermal energy in one device and ability to work with low-quality energy sources. What's more, they provide the entire temperature range of refrigerated storage in domestic conditions (from minus 18°C to 12°C), both in stationary and in transport conditions.

At the same time, the production of ARD in different countries of the world makes up only 5-10% of the total output of household refrigeration devices. Such a structure of production has developed due to their increased (by 40-60%) energy consumption compared to compression analogs.

Theoretical studies of the operating modes of serial ARU produced by the Vasilkovsky refrigerator factory (Kyiv region) with a U-shaped horizontal bubbling rectifier, carried out at Odessa National Academy of Food Technologies, showed that: ARU energy efficiency with burner devices is 3 times higher than with electric energy sources (for the conditions of Ukraine); the main energy losses in ARU are due to the processes of steam generation and transportation of a liquid phase in a generator-thermosiphon (when working on electricity – 72%, with burner devices – 64%).

As results of the pumping thermosyphons' experimental studies, numerical values of the heat input power and the temperature at the output of the generator-thermosyphon, corresponding to the minimum energy consumption, were identified.

The presence of a minimum of energy consumption is explained by the fact that in the studied range of the thermosiphon regime parameters, an optimal ratio of the composition of liquid and vapor phases at the generator-thermosiphon's output is achieved.

Two types of ARD in the “medium temperature” and “low temperature” versions, differing in the composition of the working body (WAS), were taken as study objects.

Experimental studies of the ARU generator-thermosiphon showed a significant (up to 7°C) non-uniformity of the temperature field along the length of its lifting section, which is associated with heat loss to the environment. In such a situation, there is a partial condensation of the steam stream and additional energy consumption during steam generation.

To eliminate heat loss, an additional electric heater was installed on the lifting section of the generator-thermosyphon. In this case, heat was supplied to WAS in a sequential manner – first in the main heater zone, and then in the additional heater zone, i.e. solution passes through, sort of, the first cascade of heat exposure and then the second. The value of the thermal power of the additional electric heater in experimental studies did not exceed 20% of the thermal power of the main electric heater. The total power of the main and additional heaters did not exceed the rated power of heat supply to the ARU generator-thermosyphon. Due to the lack of generally accepted terminology, we have called the proposed method for supplying heat to the ARU generator-thermosiphon as “cascading”.

Reduction in energy consumption in cascade mode of heat supply was 10-12%.