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DEVELOPMENT OF ENERGY-SAVING METHODS OF ABSORPTION REFRIGERATION UNITS' CONTROL

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Modern requirements for refrigerants in terms of ozone safety and minimization of the contribution to the greenhouse effect have opened up great opportunities for absorption-type refrigeration units or devices with absorption-diffusion refrigeration units (ARU) working with ammonia-water solution as a working medium. The main disadvantage of ARU, which holds their wide distribution back, is low energy efficiency. This factor not only determines increased costs compared to compression analogues, but also the corresponding contribution to the greenhouse effect.

Studies results of experimental and serial models of refrigeration devices with ARU showed that their increased level of energy consumption is predetermined by the existing calculation methodology and by the method of control during operation.

As shown by the exergy analysis of the ARU cycle, the greatest success in energy saving can be achieved by optimizing the thermosiphon (TS), in which the exergy loss reaches 60% of the total.

Analysis of the main areas of energy saving showed that the greatest success with a minimum of costs can be achieved through the use of optimal control systems for devices with ARU. In particular, due to a change in the amount of heat supply to TS depending on the temperature conditions at the characteristic points of the refrigeration chamber and ARU.

Energy saving problems in TS are connected with partial condensation of vapors in the lifting part of the dephlegmator. It can be solved by distributing the heat input to TS depending on the ambient temperature and the temperature in the refrigeration chamber. The energy-saving effect in this case is 15-16%.

The development of this direction was associated with the installation of an additional heat-insulating cover on the ARU dephlegmator. The energy-saving effect in this case amounted to: 21% (Kiev-410); 12% ("Crystal-408"); 17% ("Stugna-101"). To implement such energy-saving modes, it is necessary to control the steam temperature at the exit of the dephlegmator – it should not exceed the saturation temperature of ammonia at a working pressure in ARU (about 50°C).

When developing energy-saving methods of control, it was supposed that in the non-working period the temperature of the ARU drive circuit elements (thermosiphon, rectifier, dephlegmator), due to heat losses to the environment, decreases.

This is accompanied not only by cooling strong and weak WAS, but also by partial condensation of the vapor in the dephlegmator and the ARU condenser. In the case of vapor condensation, inert gas, which is previously located in the natural circulation circuit (NCC), takes its place. Obviously, the longer the non-working period, the lower the temperature will drop and the greater the volume of inert gas in the ARU deflegmator.

When a thermal load is supplied, inert gas is pushed into the NCC by the dynamic pressure of the vapor stream, the value of which will depend on the amount of the vapor phase. When it is ARU starting moments, a certain amount of steam generated in TS will be spent on heating the structural elements of the rectifier, deflegmator and condenser. Other conditions being equal, the transit time of the steam flow to the condenser will be determined by the degree of cooling of the drive circuit elements in the non-working period, i.e. by the non-working period. This suggests that the well-known position – "the longer the non-working period, the greater the economy", is not always applicable for household and commercial absorption refrigeration units.

To increase efficiency, it is necessary to prevent significant overcooling of structural elements of the ARU drive circuit.

It is possible to reduce the degree of overcooling of transport elements of the ARU drive circuit both by increasing the thermal resistance of the thermal insulation of the generator unit and by partially heating them during the non-working period.