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METHOD OF CALCULATION OF MODES OF ABSORPTION WATER-AMMONIA REFRIGERATION MACHINES IN A WIDE RANGE OF WORKING TEMPERATURES

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Recent documents clearly regulate the specific refrigerants use for various types of refrigerators: for household and commercial refrigerators – propane; for medium-sized refrigerators – carbon dioxide; for large systems – ammonia.

Heat-using absorption water-ammonia refrigeration machines (AWARM) completely fit the modern trends in the transition to natural refrigerants. The refrigerant of AWARM is ammonia. Moreover, AWARM, unlike analogues – bromide lithium absorption refrigeration machines and steam ejector refrigeration machines in which refrigerant is water, have a wider range of applications, in particular in the conditions of negative temperatures up to minus 30°C.

Of particular interest are AWARM operating on renewable energy sources, in particular, solar energy. This interest is associated with the possibility of year-round use of solar collectors, which are currently widely used in heating and hot water systems. It is assumed that with an excess of solar energy in the warm season, part of it can be sent to the AWARM generator for the artificial cold production.

Widely known approaches to calculating AWARM for operation in solar-heated systems do not take into account the presence of three temperature levels in the absorption refrigeration cycle: maximum temperature in the generator (heating source) – average temperature in the absorber (environment) – minimum temperature (boiling point) in the evaporator. Then it is generally known that from these three temperatures only two can be selected relatively arbitrarily, and the third temperature is determined uniquely.

Relevance in conducting this kind of research is also associated with the active promotion in the market of heating equipment based on solar collectors with water as a heat transfer agent.

The problem of the scheme "solar collector on the water as heat transfer agent – AWARM" is associated with a limited temperature level of the heating source (not higher than 100°C).

Although, in the solar collectors market, there are also models of solar collectors on organic heat transfer agents with an operating temperature level of up to 250°C. However, they are of great cost.

To analyze the dependences of real AWARM, a calculation algorithm was compiled. The traditional simplest AWARM scheme is considered, including two regenerative heat exchangers – solutions and a refrigerant.

The algorithm for searching the operating modes of the AWARM was as follows. At the first stage, the temperatures of the cooling object were set from minus 30°C to minus 5°C.

For each numerical value of the temperature of the cooling object, a thermodynamic calculation of the AWARM cycle was carried out with a fixed value of the ambient temperature in the range 25-43°C in increments of 1°C. For the given values of the temperature of the cooling object and the ambient temperature, the circulation rate of the water-ammonia solution (WAS) was calculated with the temperature of the heat source being varied with a step of 1°C.

If the multiplicity of the WAS circulation is positive, it was concluded that the operation mode of the AWARM can be implemented, and in the opposite case, the operation mode is not implemented.

Analysis of the results shows that AWARM in a system with a solar collector on water as a heat transfer agent can be used only in air conditioning systems at cooling temperatures not exceeding 36-37°C. To work in cooling systems with temperatures up to minus 30°C, the temperature of the heating medium 140-150°C is needed.