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THERMODYNAMIC ANALYSIS OF PERIODIC OPERATION AMMONIA-WATER ABSORPTION REFRIGERATION UNITS IN ATMOSPHERIC WATER GENERATION SYSTEMS

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It is a common knowledge that one of the most valuable resources in the future of our planet is going to be fresh water, and the demand for water resources is already one of the main factors in global logistics of contemporary world, and this trend will only grow in the foreseeable future.

One of the developments in water production technology is mechanical air dehumidification – condensation of water vapor on the surfaces with a temperature below the dew point. In this case, there are great prospects for the methods associated with the work of independent generators of cold – chillers that are guaranteed to provide the temperature below the dew point temperature. A necessary condition for operation of compression refrigeration machine is the availability of electrical energy. At the same time, the majority of countries facing water scarcity are limited in energy resources, too. Often the readily available source of energy in there is the sun.

In this regard there have been developed original schemes of absorption water-ammonia refrigeration units of periodic operation (AWRU PO) based on solar collectors, which differ with autonomy and independence from the sources of electrical energy, and unlike heat-analogues (steam jet and lithium-bromide absorption) can be operated with air cooling of their heat-dissipating elements.

The method of thermodynamic calculations and analysis of AWRU PO cycles and of the design for atmospheric water generation system. The dependencies between the refrigerating capacity of periodic operation AWRU and operating parameters (composition of water-ammonia solution, the temperature of the heating source and the ambient temperature of the environment).

It is shown, that:

1. Increase in the temperature of the heating source from 65°C to 95°C leads to minimum temperature in the cooling zone decrease from 7°C to minus 17°C;
2. By increasing the outside temperature, the refrigerating capacity of AWRU PO is decreased.
3. Low-temperature ambient air enables attaining the maximum value of refrigerating capacity of AWRU PO by increasing the amount of ammonia in the generation zone initial composition. Thus, better value of refrigerating capacity can be obtained at 25°C temperature of atmospheric air by increasing the proportion of ammonia from 0.3 to 0.5, and this also enables lowering of the heating temperature from 95°C to 65°C.

Conclusions. By increasing the temperature of heating source, the proportion of ammonia in the G-A zone is reduced, allowing to obtain higher potential capacity of absorption process during the cooling phase, i.e. to increase the specific cooling capacity of AWRU PO and the performance by water extraction from the air. Since the temperature rise of the heating source from 65°C to 95°C, minimal temperature in the cooling area decreases from 7°C to minus 17°C.

When the ambient air temperature increases, the specific cooling capacity of AWRU PO decreases, and this tendency is especially noticeable at higher ammonia fraction in the generation area.

The performed estimation of specific cooling capacity of the AWRU PO has shown that it increases along with the temperature of heating source, and at lower ambient air temperatures, this trend is more obvious.

At low ambient air temperature, the maximal values of specific cooling capacity of the AWRU PO can be obtained, by increasing the amount of ammonia in the generation area.