SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support and EVA Systems (6)

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HEAT-AND-MASS TRANSFER DURING EVAPORATION AND CONDENSATION IN THE ROTARY DISTILLER OF A SYSTEM FOR WATER RECLAMATION FROM URINE FOR SPACE STATIONS.

Abstract

Promising orbital and interplanetary missions depend on improvements in life support systems. Water supply systems are basic components of life support systems. The major sources of recovered water on a space station are humidity condensate and urine. A high content of contaminants in urine makes it impossible for their removal by adsorption. The main method of water reclamation from urine for space stations is distillation which provides the high water recovery efficiency and condensate purification. Urine is an unstable, thermolabile solution liable to decomposition with gas release and sediment formation. Consequently urine is distilled with pretreatment chemicals which prevent bacteria from breeding and contain the components contributing to fixing decomposition products of unstable substances. In this case the process shall be conducted at reduced pressure and temperature below 55C. The problem of engineering implementation of this method lies in the development of reliable heat-and-mass transfer equipment, i.e. an evaporator and a condenser designed to operate under zero-g conditions and at reduced pressure in the system. The most reliable and promising options are equipment enabling phase separation and transfer by centrifugal force. Evaporation and condensation are carried out very intensively in thin films on rotating surfaces under centrifugal force. At JSC NIICHIMMASH a rotary multistage vacuum distiller which is an integral part of the system for water reclamation from urine and is based on this recovery method has been developed and is currently under test. The distiller is responsible for urine and condensate circulation with vapor condensation heat recovery. Circulation and liquid make up are carried out by built-in pitot pumps and liquid level is maintained automatically. The vapor condensation heat of the running stage is used for liquid evaporation on the other side of the rotation surface in the next stage. This paper deals with the results of analysis of the factors influencing the intensity of heat-and-mass transfer during evaporation and condensation in the rotary multistage vacuum distiller.