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WATER RECOVERY ON SPACE STATIONS: SYSTEMS AND PROCESSES

Abstract

Implementation of promising orbital and interplanetary missions is associated with improvements in crew life support systems (LSS) including water supply systems. The sources of water aboard the space station are human products of life: sweat and breath moisture are collected in an air- conditioning system i.e. humidity condensate; urine; carbon dioxide; plant evaporated moisture; hygiene water and as well as water produced by engineering systems, for example, by fuel sells of an electrochemical generator. Water recovery systems installed on "Salut", "Mir" and International (ISS) space stations are based on physical/chemical processes. The systems use hydrodynamic, chemical and heat and mass transfer processes in single-phase and two-phase gas/liquid media. In the last case special methods for processes have to be used in space flight under microgravity conditions. The processes selected depend on the trace contaminant content in the feed liquid and the requirements for the water recovered: a sorption/catalytic and an ion-exchange processes for humidity condensate from the cabin and greenhouse atmosphere and water from carbon dioxide reduction; membrane filtration (ultra filtration and reverse osmosis) with an ion-exchange post-treatment of hygiene water; the distillation method accompanied by sorption/catalytic purification of urine. Used processes are as follows: filtration in a gas/liquid stream; heterogeneous catalytic oxidation of organic impurities in gas/liquid stream by oxygen of carrier air (at temperatures and pressure on a station); a direct-flow separation of a liquid through capillary-porous walls of pipes with suction by a membrane spring pump; pumping a liquid and gas/liquid flow; catalytic, ion-exchange and sorption purification of a liquid in a semi-static mode; the monitoring of water quality; contact injection of food salts and ions of silver; storage of liquids in containers with variable volume; separation of a liquid in the rotary pump-separator; heat recuperation by heat pumps; heat and mass transfer by condensation and evaporation of a liquid in gas/vapor stream; atmospheric and vacuum distillation in static and rotary distillers and so on. The paper reviews the processes of water recovery and methods of performing these processes in microgravity conditions.