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EFFECT OF CORROSION PROCESSES ON THE PERFORMANCE OF SCREEN PHASE SEPARATORS IN REUSABLE SPACE SYSTEMS WITH LONG SERVICE LIFE

Abstract

The progress of space exploration largely depends on creation and launch of new reusable spacecraft, extension of service life of the functioning artificial Earth telecommunication satellites in GEO orbit, expansion of the existing one (International Space Station) and development in the future of the new space infrastructure for their maintenance and operation. Enhancing range of space activities and its increasingly commercial orientation put forward special requirements for the spacecraft, determining the development process in this field. This is a possibility for reusability and long-term service of the spacecraft. When designing reusable space systems, one of the factors that should be taken into account is the effect of chemically aggressive fuels: the oxidizer is nitrogen tetroxide (NT), the fuel is unsymmetrical dimethylhydrazine (UDMH) and their vapors on the operating parameters of screen phase separators (SPS) of liquid acquisition devices (LADs), which ensure multiple starting of engines in zero-gravity. The author analyzed the results of long-term experimental and theoretical studies of the effect of long-term exposure (more than 30 years) of the structural material of the SPS in the liquid rocket propellants - NT and UDMH, and established the presence, type and rate of corrosion of SPS structural material. Obtained are dependences of the change in corrosion rate versus time, which indicate the influence of the SPS location in the tank and type of environment (liquid phase / gas phase) they are found in. Corrosion rate coefficients have been derived, application of which improves the engineering methods of SPS main parameters of calculation. The dependence of change in the SPS of the capillary retention capacity (CRC) on the period of their operation and type of rocket fuel has been determined. Main factors that affected the change in the CRC have been analyzed: corrosion of the SPS structural material and the consequences of corrosion processes, which include critical clogging of the screen cells with corrosion products in NT and change in the value of the wetting contact angle of the UDMH with material of the screen. The physical model for calculating the critical Bond number has been further developed. The physical model for calculating the static CRC has been improved. The obtained results make possible the acceptably accurate prediction of the LADs SPS operational efficiency preservation in the reusable space systems with long service life, enabling the accident-free multiple engines starts in zero-gravity.