Paper ID: 61696
student

Space Transportation (6)
Space Transportation (2) (2)

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INVESTIGATION OF LIQUID OXYGEN PRESSURIZATION SYSTEM WITH COLD GAS HELIUM AND HYDROGEN PEROXIDE

Abstract

The research was carried out on the use of the oxygen tank pressurization system of launch vehicle (LV) with liquid rocket engine (LRE). Traditional pressurization systems on modern LV with LRE "Falcon-9", "Ariane 5", "Ariane 6", "Zenit", the family of LV "Soyuz", use heating of helium located in balloons in a cryogenic fuel tank (for example, in the liquid oxygen tank) in the LRE heat exchanger with further feeding of hot helium into the tanks (with temperature 250 degrees Celsius). The oxygen tank pressurization is performed with a steam-gas mixture obtained from mixing cold helium gas and hydrogen peroxide decomposition products. The chamber for mixing products of hydrogen peroxide decomposition products and cold helium is located in an oxidizer tank. Hydrogen peroxide is stored in a separate container outside the fuel tanks. Advantages of the proposed pressurization system:

- refusal to use a heat exchanger to heat helium in the composition of the LRE, thereby simplifying its composition, increase its reliability, the mass of the heat exchanger is 70 - 80 kg;
- refusal to use long high pressure feed lines from the oxygen tank, which stores balloons with helium, to the heat exchanger and back (mass of which reaches the first stage of the LV is 100 kg), thereby facilitating and simplifying the design of the stage LV;
- no use longitudinal vibrations dampers installed in the fuel feed line from the tank to the LRE due to regulation of the pressure in the tanks by an controlled supply of helium and hydrogen peroxide (up to 200 kg);
- decrease in quantity of evaporated fuel component in the tank (increase in quantity of unused fuel capacity up to 50- 100 kg) in the LV ascent phase at operation of LRE due to regulated temperature of steam-gas mixture supplied to the tanks;
- use of the proposed pressurization system as a part of an autonomous unit for realization of LV corner maneuvers and provision of conditions for LRE launch of the separated first stage for realization of soft landing;
- reduction of anthropogenic impact on the environment during the LRE emergency shutdown by controlling the emergency stage descent into the impact areas with minimal environmental damage.