

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

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EXPAND OF CAPABILITIES OF ROCKET AND SPACE COMPLEXES WITH HIGH-MOLECULAR
ADDITIVES TO LIQUID PROPELLANT COMPONENTS**Abstract**

To increase thrust-to-weight ratio of LV an augmentation of flight LPRE with turbopump propellant supply system was used repeatedly as alternative for new engines development. However, LPRE augmentation increases MTU energy intensity that decreases engine reliability and lifetime. Energy intensity buildup can be limited with decrease of pressure losses in the engine hydraulic lines, increase of the pumps and turbines efficiency, and improvement of cavitation characteristics of the propellants supply system. For the period of the development of rocket propulsion engineering the most engineering solutions in these directions were realized. Therefore, task of further improvement of LPRE supply system elements is transferring now into a serious problem for solving of which qualitatively new approaches are required. Research activities carried out by NPO Energomash show that considerable increase of power effectiveness of the flight LPRE and LV can be reached using modified rocket propellants with enhanced rheology. Positive effect lies in better propellant component yielding. It can be made by introducing micro quantity (hundredth parts of propellant component mass) of a high-molecular additive into high-temperature propellant component. As for LOX-kerosene engines, high-molecular polyisobutylene (PIB) polymer is additive to kerosene. Introduction of PIB polymeric additive into kerosene significantly decreases hydraulic losses at friction in fuel lines. Operability of LPRE with PIB polymeric additive and effectiveness of its use have been verified by hot fire tests of engines of various types with thrust of 8 tf to 800 tf. In particular, the following results have been obtained. Fuel pumps head increase was 5.5As for LPRE with generator gas afterburning, generator gas temperature reduces on 50-60 °C what gives possibility, if necessary, of engine thrust throttling in "smooth mode". As for engine without afterburning, working medium flowrate to turbine actuator reduces that improves LV ballistic parameters on the whole. By rough estimate for Souyz LV it allows to increase weight of payload by 110 to 115 kg.