SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)
Small Launchers: Concepts and Operations (7)

Author: Dr. Vitaly Yemets
Dniepropetrovsk National University, Ukraine

COMBUSTIBLE CASE, MOBILE ENGINE AND NO FEED DEVICE: THE CONCEPT OF A PICO LAUNCH VEHICLE

Abstract

The modern design and manufacturing methods of launch vehicles fit ideally for large launchers with an initial masses of 10E5...10E6 kg which are economically sound for putting into low Earth orbits 10E3...10E4 kg in the framework of the transport programme equals 10E2 launches per year.

It is obviously that using such large launch vehicles to orbit small satellites (10E-1...10E1 kg) would be too expensive. At the same time the conventional technology is unacceptable to make special-purpose small launchers suitable for small satellites because a scale effect causes increasing the structure mass fraction of a launcher while its initial mass decreases. So, new approaches are necessary to design the launchers of nano and pico satellites.

The first approach to the problem that would be desirable to consider is making the case of a small launcher of solid propellant to eliminate the case structure as useless mass. The case consisted of a gasifiable polymeric shell and solid oxidizer core can be gasified with a special gasification chamber and then combusted as main propellant. While the case shortens the launch vehicle main engine moves along the case by means of the engine force. The second approach supposes the absolute simplification of the launch vehicle engine structure up to absence of any feed devices: inertial forces deliver the case into the gasification chamber and then into the combustion chamber. It is like a ramjet: inlet pressure is higher than combustion chamber pressure. Very small structure mass fraction characterises this design. This can enable developing a really small quasi single-stage pico launch vehicle (several hundred kilograms of initial mass) capable of putting a pico satellite (about 1kg) into a low Earth orbit. The launcher has an extremely simple structure. Perhaps, small university or amateur teams will serve it, which can solve the problem of affordable space access for individuals.

Current experimental investigations pursue developing the laboratory-scale rocket engine moving by means of its own thrust along a consumable rocket case attached to a test bench. The theoretical and experimental results as well the plan of further investigating to prove engineering feasibility of the technology and find out whether it is enabling for affordable space access up to the project of a flying model will be displayed. The implemented first stage of the experiments including a laboratory-scale engine consuming a polyethylene rod forced by a hydraulic cylinder will be presented as additional information.