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AUTOPHAGE CASELESS THROTTLEABLE SOLID MOTOR FOR SMALL SATELLITES

Abstract

Autophage propulsion has been proposed for small satellites and launch vehicles. This concept uses polymeric solid fuel and oxidizer in the form of a single propellant rod, with the fuel on the outside to provide structural stiffness. As there is no casing on the propellant rod except for the fuel itself, the concept may also be called the 'caseless' rocket.

To operate the system, the rod is driven into an engine unit which includes a vaporizer, combustion chamber, and nozzle. The vaporizer causes gasification of the propellants, which combust in the chamber, and then exit through the nozzle. However, some heat of combustion is recovered by the vaporizer, which uses it to maintain the gasification process and thus sustain the firing.

Throttling the engine by varying the feed pressure has been demonstrated, but this paper will focus on recent attempts to secure pulsed combustion by the use of valves in the propellant injection system. This process could reduce the required propellant feeding force and enable the use of the autophage system in smaller satellites and vehicles. This would, in turn, reduce the need for pressurized systems, turbopumps, and other mass penalties.

This paper will contrast the performance of flap or reed valves against a single annular ring valve. Both have the potential to trigger pulsed combustion, and thus enable the autophage motor in small flight applications, but naturally have different characteristics.

The paper will present very recent results related to firing both systems, and also provide an updated parametrical assessment of the advanced caseless solid motor in small satellite applications.