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GELLED PROPELLANT ROCKET MOTOR AND GAS GENERATOR TECHNOLOGY IN GERMANY - AN OVERVIEW -

Abstract

The development of Gelled Propellant Rocket Motors (GRM) in Germany started with the requirement to develop a controllable rocket motor. Other key requirements were very low hazard potential in case of accidents, handling errors or impacts, storability at ambient pressure and temperature over at least 10 years and easy handling of the propulsion system like that of solid rocket motors. These requirements are met by the green GRM technology presented in this paper. Beginning with a short overview on GRM technology in general, the paper details on the development of GRM technology in Germany, a joint effort of Bayern-Chemie, DLR Institute of Space Propulsion and FhG Institute of Chemical Technology, funded by the German MoD. A demonstrator missile with a controllable monopropellant GRM was successfully flown in 2009 and subsequent activities extended the technology base in all respects. The technology is equally usable for GRM and Gelled Propellant Gas Generators (GGG).

A family of green and environmentally friendly Gelled Rocket Monopropellants (GRP) for the different applications has been tested. This is achieved by the appropriate selection of fluid mixtures, gelling agents, particles and additives. Green bi-propellants and green hypergolic bi-propellants are a topic of current research. GRM with nominal thrust from 300 N to 20 kN are tested and showed excellent scalability. A key asset is the very stable combustion and fast control of GRM and GGG. A highly controllable combustion chamber with variable injector and variable nozzle with a nominal propellant mass flow rate (PMFR) of 2.5 kg/s operated safely till a PMFR of 0.05 kg/s. Igniters with solid propellant and a gas lancet igniter work well. Whereas affordable design methods using steel shells with ablative heat shield are proven for operation times up to 80 s with potential for even longer duration, combustion chambers made of C/CSiC showed also very good durability.

The paper will give an overview on the development activities, the design methods of the various components, the ongoing activities and an outlook on future research work.