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PERFORMANCE EVALUATION OF HYPERGOLIC IONIC LIQUID-BASED FUEL (ILETHCU01) WITH 95% HYDROGEN PEROXIDE OXIDIZER IN 50 N THRUSTER.

Abstract

Hydrazine-based hypergolic fuels have been used in liquid rocket engines for several years. However, they are toxic and carcinogenic and requiring expensive handling procedure. Hence, it is necessary to find a promising alternative for these conventional fuels. Recently, ionic liquids have emerged as hypergolic green fuel. However, their performance in rocket engines still needs to be evaluated to determine their acceptability for real applications. Thus, it is necessary to assess the combustion performance of ionic liquid fuels in rocket engine. With the goal of creating a new green hypergolic propellant, Space Solutions developed a green hypergolic fuel called ILethCu01 and studied its combustion performance with 95% H2O2 in a 50 N thruster. ILethCu01 is a blend of ionic liquid (EMIMBH3CN), biofuel (ethanol), and a copper complex additive. The drop test method showed that ILethCu01 auto-ignited with 95% H2O2, ignition time of 4.5 ms. Interestingly, this fuel has a low viscosity of approximately 5 mPas and a comparable density of 0.90 g/cm3. The theoretical performance, including characteristic velocity and vacuum-specific impulse of ILethCu01, was 1607 m/s and 317.4 s, respectively, at optimum O/F 3.9 by considering the Ae/At 100, chamber pressure (Pc) 10 bar, and assuming a frozen composition. Several hot firing tests were performed by using unlike triplet impinging injector at 10 bar chamber pressure; varying O/F and total propellant mass from 3.5 to 6 and from 12 to 20 g/s, respectively. The combustion efficiency of propellants was about 90%, which may indicate that the fuel and oxidizer reacted efficiently. Additionally, the instability was found to be less than 5%, suggesting that the propellant burns relatively stable. These findings demonstrate the potential of ILethCu01 fuel with hydrogen peroxide oxidizer as an environmentally friendly propellant for space propulsion research.