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ASSESSMENT OF VARIOUS FUEL ADDITIVES FOR RELIABLE HYPERGOLIC IGNITION WITH 98+ HTP

Abstract

Highly concentrated solution (98%+) of hydrogen peroxide of HTP class (High Test Peroxide) is an important alternative candidate oxidiser for green propulsion applications. Therefore, 98%+ hydrogen peroxide of high purity is under extensive research in many space propulsion research centres as a potential replacement for currently used highly toxic rocket hypergolic propellants (NTO, hydrazines). It is well know fact that HTP has been utilized for a wide range of rocket propulsion applications since the beginning of modern rocket technology. However, HTP is still rather little know on its practical potential in true hypergolic systems. Thus, a special focus is addressed on the experimental approach to investigate the influence of a numerous of catalytic or/and reactive energetic fuel additives on the phenomena of hypergolic ignition with 98%+ HTP. The widest group of considered and tested fuel additives(primarily salts of transition metals) within this study were miscible with fuel candidates. However, a few example of inherent reactive fuel compositions(the mixture or a fuel that has ability to directly chemically react with HTP) have been tested too. A number of screen (drop) tests have been performed in order to do pre-eliminary selection of candidate fuel additives. The most promising additives for the selected fuels have been experimentally investigated via direct reaction between them and a drop of 98%+ HTP. The rough ignition delay times (IDT) for the positive systems have been evaluated. The selected fuel mixtures have been also subjected to a series of more advance experiments, included impinging injectors with pattern 4-on-1, in a special cylindrical combustion device where the influence of inert atmosphere at different conditions upon the IDT can be observed and determined. . The ignition delay times under various initial chamber pressures have been recorded. The analysis of experimental data in respect of physical conditions as well as the amount and type of fuel additive systems has been performed too. The demonstrative fuel compositions that are characterised by hypergolicity with 98%+ HTP (low IDT) and possess the most promising values (in terms of simple storability, specific impulse, temperature range applicability, toxicity, etc.) have been identified.