World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:12, No:10, 2018

A Spatial Perspective on the Metallized Combustion Aspect of Rockets

Authors : Chitresh Prasad, Arvind Ramesh, Aditya Virkar, Karan Dholkaria, Vinayak Malhotra

Abstract : Solid Propellant Rocket is a rocket that utilises a combination of a solid Oxidizer and a solid Fuel. Success in Solid Rocket Motor design and development depends significantly on knowledge of burning rate behaviour of the selected solid propellant under all motor operating conditions and design limit conditions. Most Solid Motor Rockets consist of the Main Engine, along with multiple Boosters that provide an additional thrust to the space-bound vehicle. Though widely used, they have been eclipsed by Liquid Propellant Rockets, because of their better performance characteristics. The addition of a catalyst such as Iron Oxide, on the other hand, can drastically enhance the performance of a Solid Rocket. This scientific investigation tries to emulate the working of a Solid Rocket using Sparklers and Energized Candles, with a central Energized Candle acting as the Main Engine and surrounding Sparklers acting as the Booster. The Energized Candle is made of Paraffin Wax, with Magnesium filings embedded in it's wick. The Sparkler is made up of 45% Barium Nitrate, 35% Iron, 9% Aluminium, 10% Dextrin and the remaining composition consists of Boric Acid. The Magnesium in the Energized Candle, and the combination of Iron and Aluminium in the Sparkler, act as catalysts and enhance the burn rates of both materials. This combustion of Metallized Propellants has an influence over the regression rate of the subject candle. The experimental parameters explored here are Separation Distance, Systematically varying Configuration and Layout Symmetry. The major performance parameter under observation is the Regression Rate of the Energized Candle. The rate of regression is significantly affected by the orientation and configuration of the sparklers, which usually act as heat sources for the energized candle. The Overall Efficiency of any engine is factorised by the thermal and propulsive efficiencies. Numerous efforts have been made to improve one or the other. This investigation focuses on the Orientation of Rocket Motor Design to maximize their Overall Efficiency. The primary objective is to analyse the Flame Spread Rate variations of the energized candle, which resembles the solid rocket propellant used in the first stage of rocket operation thereby affecting the Specific Impulse values in a Rocket, which in turn have a deciding impact on their Time of Flight. Another objective of this research venture is to determine the effectiveness of the key controlling parameters explored. This investigation also emulates the exhaust gas interactions of the Solid Rocket through concurrent ignition of the Energized Candle and Sparklers, and their behaviour is analysed. Modern space programmes intend to explore the universe outside our solar system. To accomplish these goals, it is necessary to design a launch vehicle which is capable of providing incessant propulsion along with better efficiency for vast durations. The main motivation of this study is to enhance Rocket performance and their Overall Efficiency through better designing and optimization techniques, which will play a crucial role in this human conquest for knowledge.

Keywords : design modifications, improving overall efficiency, metallized combustion, regression rate variations
Conference Title : ICAAE 2018 : International Conference on Aerospace and Aviation Engineering
Conference Location : Paris, France
Conference Dates : October 29-30, 2018