12th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

Author: Mr. vinayak malhotra
SRM University Chennai, India, vinn99@gmail.com

Mr. Pratik Tiwari
SRM University Chennai, India, ptpratiktiwari@gmail.com

ON THE ROLE OF SURFACE ORIENTATION IN RELATION TO REGRESSION RATE

Abstract

Space propulsion has played an unquestionable role in revolutionizing the world and practically is an issue of utmost operational and functional significance. The air borne propulsive systems mainly comprising of rockets, missiles, space vehicles and space-crafts affiliated to chemical propulsion maneuver at different orientations while in flight. The rate at which the fuel grain regresses plays quantitatively a vital role, which is reflected in performance parameters (viz., thrust, specific impulse). However during flight conditions, these fuel grains are subjected to various orientations and the regression rate at all these orientations is expected to change and cause significant impact on performance of these vehicles. The present study is an attempt to explore a farsighted physical insight into variation of regression rate with orientation. The work is carried out by adapting smoldering combustion as a contrivance. The work primarily investigates the regression rates of a cigarette burning at different orientations. An experimental setup is constructed and study is carried out under operating conditions of purely buoyant flow in normal gravity with fuel grain orientations varying from (0-360)degrees. The analysis of results is bifurcated into two sections with propulsive vehicles heading upward (0-180)degrees and derailing downward (180-360)degrees. It is expected that qualitatively the trend of regression rates for cigarette burning and airborne propulsive systems using solid propellants will match.

Results show that the regression rate exhibits a non-monotonic behavior with increasing surface orientation from horizontal (0 degrees) to vertical (90 degrees). The regression rates increases with increasing surface orientation towards a peak (here 45 degrees) and then drops drastically. However, an opposite trend is observed when the surface orientation varies from (90-180)degrees. The regression rates in this case shows a monotonic increment in regression rate with maximum at 180 degrees. At present system experimental study is carried out to understand the behavior of regression rates while heading down (180-360)degrees. The work is carried out with the primarily objective of fundamentally understanding the regression rate behavior with fuel surface orientation so that this work can be used for applications concerning space flights.