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INVESTIGATIONS OF THE COUPLED HEAT SOURCE AND HEAT SINK EFFECT ON COMBUSTIBLE SURFACES IN SPACE PROPULSION: IMPLICATION AND APPLICATIONS

Abstract

Safety of the space missions has been an active area of research and the most prevalent issue. Appreciable work had been done but complexity of the problem has prevented thorough understanding due to heterogeneous energy transfer. The problem has led to severe issues amounting to irreplaceable loss of mankind, instruments, facilities, and huge amount of money being invested every year. Propulsion is an application of the combustion phenomenon which is always assisted by the energy interactions in form of heat sources and heat sinks. The Coupled effect of an external heat source and heat sink on the burning process is an aspect yet to be comprehensively articulated. Better understanding of this coupled phenomenon will provide insight to higher safety standards, efficient missions, reduced hazards risks, with better designing, validation and testing. Present work attempts to fundamentally understand the controlling mechanism through systematic lab scale experimentation. The work primarily investigates the coupled heat source and heat sink effect on the material burning. The experimentation comprises of spread rate calculations of combustible pilot fuel setup in presence of selected number of external energy source(s) for different configurations to gain the true replication. Different Linear and Non-Linear configurations of external energy sources will be experimented and changes in the spreading rates will be measured. The work is motivated by the need to have enhanced fire safety and better rocket efficiency. The specific objective of the work are to understand the coupled effect of external heat source and sink on propellant burning and to investigate the role of key controlling parameters. Preliminary results indicates that there exists a singularity in the coupled effect. The experiment will help in understanding the coupled effect of an external heat sink and heat source on the burning process, contributing in better combustion and fire safety, which are very important for efficient and safer rocket flights and space missions. The results are likely to help in: (a)Understanding the effect of core engines efficiency on the primary boosters if considered as source (b) Choosing suitable heat sink materials for space missions so as to vary the efficiency of the solid rocket depending on the mission (c) Giving useful insight about how the preheating of the successive stage due to previous stage acting as a source may affect the mission.