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Testing and Modeling of a Porous Axial-Injection, End-Burning Hybrid Motor

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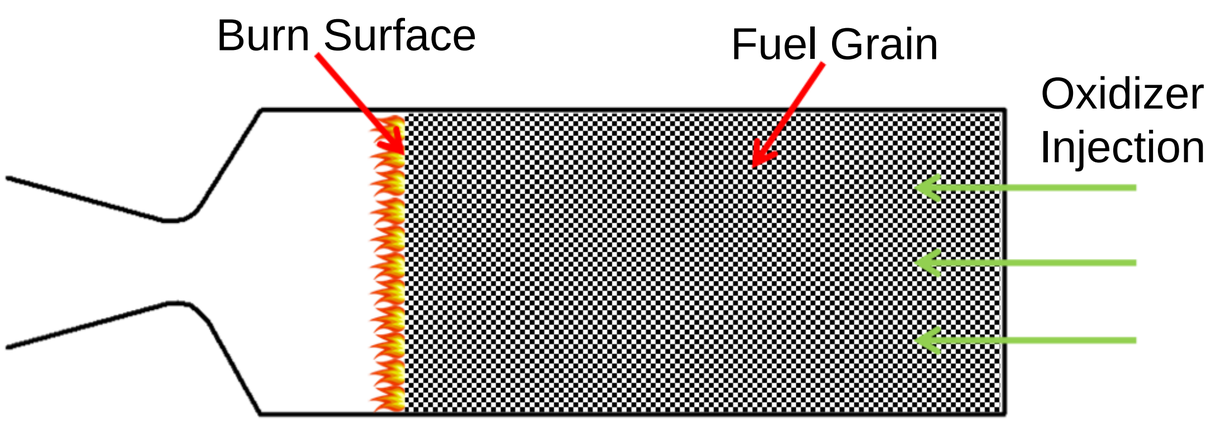
Overview

Hybrid rocket motors provide increased safety and lower costs than conventional systems but are limited by:

- Low propellant mass fractions
- Complicated fuel geometries

A porous solid fuel with oxygen flowing though it could overcome theses limitations.

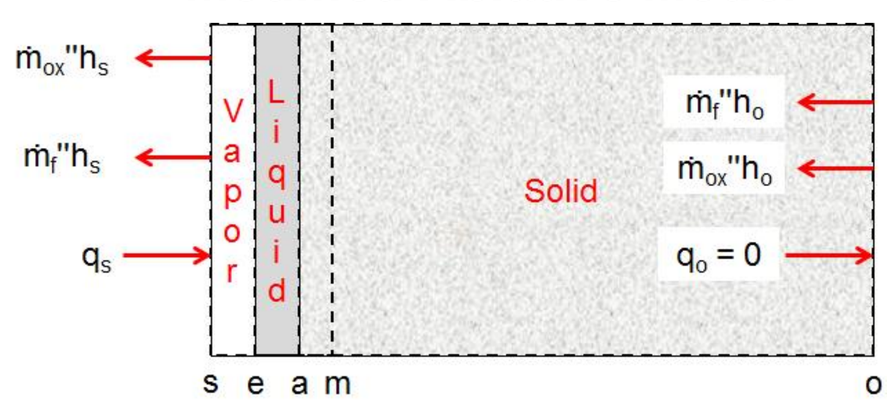


The project objective is to conduct regression rate experiments of an axial-injection, end-burning hybrid rocket motor and use a modified ablative model to describe the experimental results.

Explanation

This study provides an experimental evaluation of an undeveloped form of hybrid rocket propulsion. In addition, it proposes an analytical model to provide a physical explanation for the experimental results and to serve as a starting point for further studies.

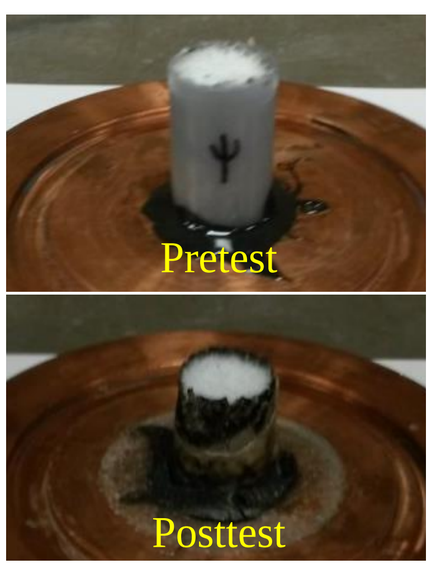
Modified Ablative Model

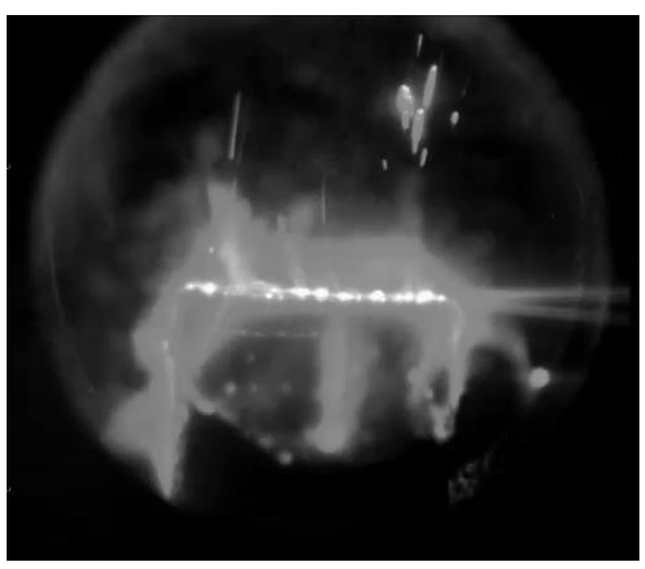


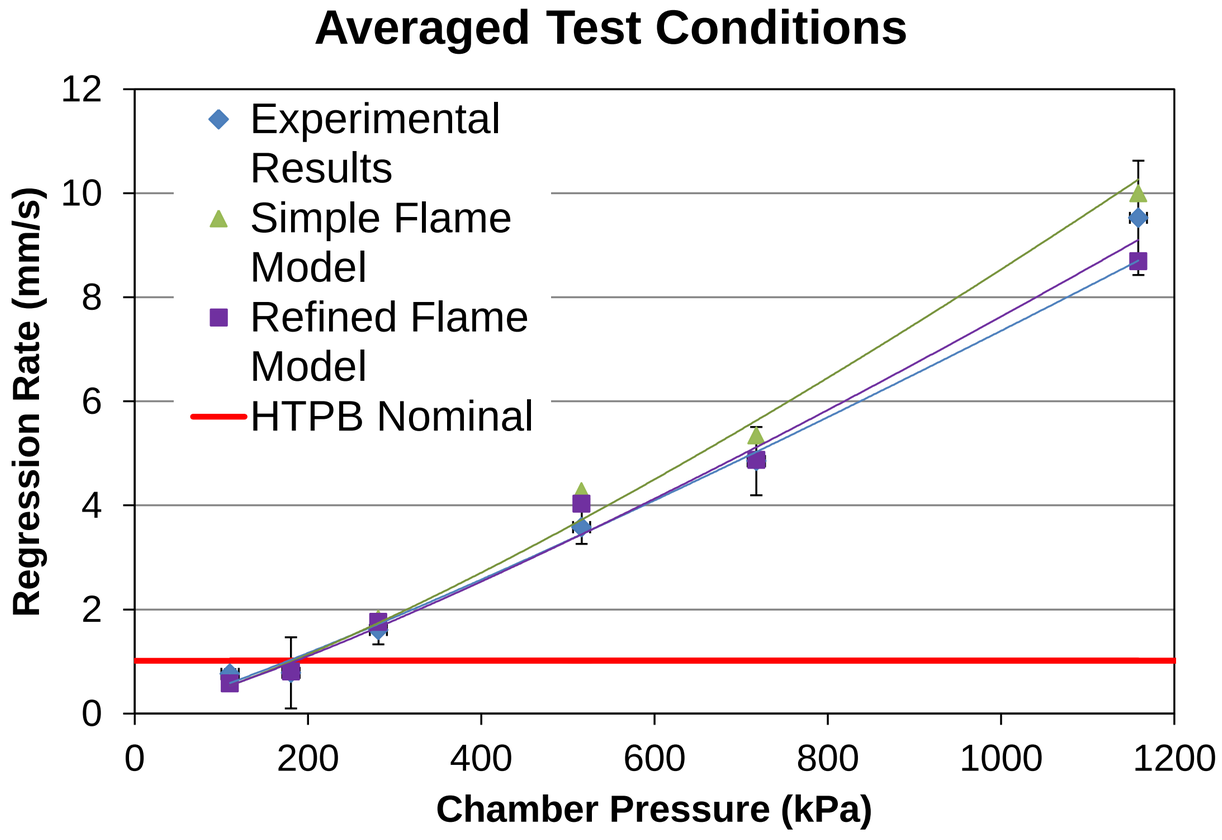
$$\dot{r}\rho_f = \frac{C_{fl}\left(T_{fl} - T_{dec}\right) - \dot{m}_{ox}''\left(h_{ox,s} - h_{ox,o}\right)}{\left(\Delta h_{tot} + c_{sol}\left(298K - T_o\right)\right)}$$

Key Findings

Results demonstrated that the regression rate was a function of pressure and could achieve an order of magnitude increase compared to that of a nominal HTPB motor. Additionally, the results could be modeled using a Granular Diffusion Flame estimate.







Impact

The burning rate improvements show initial viability for the porous hybrid concept to have practical application for lower cost space launch vehicles and nanosatellite propulsion units. This outcome will further the goal of space exploration.

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