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HYBRID ROCKET ENGINE, THEORETICAL MODEL AND EXPERIMENT

Abstract

In the first part of the presentation, we focus on theoretical models for hybrid rocket motors and on comparison with already available experimental data from other research groups. A primary computation model is presented together with results from a numerical algorithm based on the computation model. We present theoretical predictions for several commercial hybrid rocket motors and compare the theoretical predictions with experimental measurements on those hybrid rocket motors. We also present several regression models to be used in hybrid rocket motors and evaluate each of them against experimental data provided by research groups worldwide. First section of the presentation focuses on hybrid/tribrid rocket motor development with the following sub-research categories: combustion inefficiencies, increasing regression speed for various fuel-oxidizer pairs, combustion instabilities. In addition, a secondary computation model using a new approach is presented for the prediction of the regression speed of fuel doped with solid oxidant in hybrid rocket motors. Combustion instabilities are evaluated both for low and for high frequency regime. Theoretical approaches involving resident time for burning products in burning chamber are presented as potential prediction methods for volume fraction needed for post-combustion chamber. In the second part of the presentation we present our own experimental results with PVC-N2O and Acrylic-N2O hybrid rocket motors with a thrust of approx. 60 kgf and a burn time of approx. 20 seconds. We present the test stand and equipment and show experimental data that we have obtained so far. We compare experimental results obtained from these test burns with theoretical predictions offered by our computation model for hybrid rocket motors presented in the first part of the presentation. Several frozen-fuel burn surfaces are presented and analysis is done for various post-combustion fractions of the chamber. Various methods of fitting the experimental data on theoretical curves provide various regression speed coefficients for PVC and Acrylic fuels useful in future research endeavors.