PERFORMANCE OF A 2500 LBF HYDROGEN PEROXIDE – POLYETHYLENE HYBRID
6/30/00
Overview

- Introduction
- Test Schematic
- Hybrid Chamber Configuration
- Test Data
  - Video
  - Measured Mean Chamber Pressure
  - Waterfall Plot
  - Reduced Motor Data
- Comparison of Fuel Regression vs Mass Flux with Subscale Data
- Conclusions
Introduction

- Single 4 Second Burn of 2500 lbf Class Hybrid
  - 85% H2O2 – Ultra High Molecular Weight PE Hybrid
  - H2O2 Decomposed by Catalyst Bed
  - Fuel Grain 4 Port ~ 40” Long
  - Fuel Ports are Circular

- Designed, Fabricated and Tested by General Kinetics Internal Funding

- Design Scaled from 50 lbf Class Hybrid Data of Same Propellants
Hybrid Chamber Configuration

- 9 Inch Diam Al Housing Not Shown
- Initial Port Total Mass Flux ~ 0.7 lbm/(in\(^2\)-s)
- Fuel Grain Design is for LDPE
- Ignition via Decomposed Hydrogen Peroxide

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Hybrid Chamber Catalyst Bed

- 8 Inch Gas Generator
- Silver Plated Screens

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Test Data - Video

- Clear Plume
- Set up Stand in Remote Area and Tested in Single Day
Test Data – Measured Pc

- Sample Rate 10k Hz, Low Pass Filter 2.5k Hz
- Ignition Transient ~ 400 ms Long

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Test Data – Waterfall Plot

- Low Amplitude AC Noise
- 3% Zero-to-Peak of Mean 10-15 Hz

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Test Data - Reduced

- Action Time ~ 4 sec
- Ave Chamber Pressure 380 psia
- Oxidizer to Fuel Ratio 9.5 – Above Optimum of 8.5
- L-Star 80 Inches
- C-Star Efficiency 98%
- Oxidizer Mass Flow Rate ~ 10.8 lbm/s
- Fuel Flow Rate ~ 1.14 lbm/s
- Lower Fuel Regression Rate and Higher OF Result of using UHMW
- Smooth Fuel Regression Surface
- Test Duration Limited by Aft Paper Phenolic

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Fuel Regression Comparison

- Subscale Data is Single Port Device using 85% H2O2
- No Direct Sub-Scale Data at Similar Pc and Polymer Type (UHMW)
- Data Suggests Use of LDPE Would Produce Operation at Optimum OF
- Appears Data in Scaleable and Multi-Port Has Minor Influence

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Conclusions

• Successfully Design, Fabricated and Tested 2500 lbf Hybrid Engine

• High Combustion Efficiency Was Achieved (98%)

• Appears that Performance Scalable from 50 lbf Sub-Scale Data

• Smooth Operation ~ 3% Zero-to-Peak Oscillations (10-15 Hz)

• Higher Than Optimum OF (9.5) Operation Due to use of UHMWPE