IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

Author: Mr. Giuseppe Oliva
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, giuseppe.oliva2017@gmail.com

Mr. Daniel Cantos Gálvez
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, danielcantosgalvez@gmail.com
Mr. Pietro Mondino
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, mondino.pietro@gmail.com
Mr. Gaston Champagne
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, gastoonchampagne@gmail.com
Mrs. Lisa Buxton
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, lisa.buxton@alpha-impulsion.com
Ms. Raquel Arrontes Quiroga
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, raquelarrontes00@gmail.com
Mr. Giulio Pelenghi
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France, giuliopelenghi@gmail.com

DESIGN AND TESTING OF THE COMBUSTION CHAMBER OF A H2O2/ABS STUDENT-DEVELOPED HYBRID ROCKET ENGINE

Abstract

This paper summarizes the design process and results from a hotfire test campaign of a student-researched and developed (SRAD) 2900 N hybrid rocket engine (HRE), using HTP and ABS. This campaign is to be carried out under the framework of the AEther project, which aims to design and produce a sounding rocket based on the HRE. This is one of the projects pursued by the Supaero Space Section team in the ISAE-SUPAERO university, where multinational teams of students develop experimental rockets in close partnership with French space research institutions such as the CNES and the ONERA.

This project is significant in its use of commercially available materials such as 3D-printed ABS, a green propellant like H2O2 and a less than noble catalyst, alumina pellets covered in sodium permanganate. This provides a cheap, green, simple and more efficient alternative to state of the art SRAD HREs. It's also worth noting that the systems are fully researched, manufactured and tested by the students themselves, with support of their partners and sponsors. The test campaign is set for June 2023 in the ONERA test center in Le Fauga-Mauzac, and follows in the success of a catalyst bed testing campaign in early February. It envisions 4 hotfire tests done with a wagon-wheel ABS grain at a mass flow of 1 kg/s of 87.5% HTP for 8 to 10 seconds.

The paper will first offer a brief introduction of the design and characteristics of the combustion chamber and the models used to assess its behavior, particularly GriffonSimulator, a software developed by the student team in the past which simulates engine performance via the Marxman model. Afterwards, it will present the results of the aforementioned test campaign, with a focus on bed exit temperature, delta-P used, chamber pressure, thrust and oxidizer mass flow. The data will be compared with multiple simulation runs to ascertain the precision of the models, notably the Marxman coefficients used. Finally, corrections to the models will be proposed, taking into consideration the obtained results.

This HRE represents a significant achievement in student rocketry and demonstrates the potential of commercially available materials and green propellants. The success of the test campaign would be a

critical step in the progress of the AEther rocket, and would pave the way to realize the most powerful student-designed rocket engine in France.