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PRELIMINARY LIFE CYCLE ASSESSMENT AND ECO-DESIGN PROSPECTS FOR AUTOPHAGE LAUNCHERS: CASE STUDY OF THE COMBUSTIBLE FUSELAGE.

Abstract

This article presents the results obtained on the Life Cycle Analysis of a major component of autophage launchers as defined in the modern literature, the combustible fuselage assuming both the function of fuel and structural tank for the other propellantsof the launcher. It also presents the future steps of this prospective LCA for the full system.

Results specific to the fuselage a single-stage, hybrid autophage mini-launcher are presented and generalized. This architecture is at the basis of the commercial launcher Alpha Impulsion is developing. The sizing model for an SSTO trajectory assuming 1000kg payload is detailed. The life cycle is defined for a functional unit related to the full capacity of the mature product over one year of exploitation. The topics of material selection among thermoplastic materials and the definition of the production process are especially investigated.

A discussion on the relevance of applying these results to other autophage architectures found in state of the art literature is provided.

Recent literature investigates the contribution of soot, generated in upper atmosphere, to the impacts of launchers based on bi-liquid propulsion. The topic could not be considered mature due to lack of experimental proof on the life cycle of soot particles released in high altitude, and the lack of data on soot generation of hybrid rocket propulsion systems. A review of the available knowledge is nonetheless provided, and an estimation of the contribution of soot is produced in the autophage launcher's impact analysis.

Future works are presented to complete and improve the prospective LCA of autophage launchers, and translate its conclusions to eco-design actions in the development of the company's launcher. These include mainly the trade-off between an electromechanical system and turbomachinery in the feeding of propellants in this architecture.