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SUSTAINABLE PROPELLANTS: REDUCING THE CARBON FOOTPRINT OF ROCKET LAUNCHES

Abstract

The space does has grown rapidly during recent decade, giving rise to the launch of many satellites, and crewed missions, and exploratory space, resulting in growing concerns over the impact of the environment of rocket launches. While chemical rocket propellants serve the purpose of propelling spacecraft into space, they are also responsible for causing a lot of carbon footprint and discharging harmful gases into the atmosphere. However, with the growing space missions, the demand for sustainable and environmentally friendly alternatives of conventional propellants is growing as well. This thesis investigates whether sustainable propellants could be sufficient as a method to decrease the environment impact of rocket launches while keeping the performance and safety standards. Fuels and oxidizers that leave minimal or no carbon emissions, decrease their contribution to the pollution in the atmosphere, and overall minimal ecological footprint for the space suffers launches are known as sustainable propellants. These alternatives tend to involve green chemistry, biofuels, or chemical product that spits out less toxic waste when burned. There has been growth in the field and work has been done in the research of biofuels, liquid hydrogen, and non-toxic chemical compounds to replace hydrazine and kerosene. Green propellants, like "LMP 103S and LUNAR", shown by studies to do less environmental damage than other propellants and equal to or better than others out of thrust chamber volume, are another possible alternate and suggest performance at least equal to and often superior in applications including satellite propulsion and deep space missions. The goal of this research is mainly to evaluate the efficiency of the sustainable propellants in cutting down the carbon footprint and damaging emissions produced by the rocket launches. The study examines the environmental impact, efficiency and economic cost-effectiveness and feasibility of several green propellants for use on current and future space missions. This research looks for possible advantages of biofuels, liquid methane, and other potential alternative propellants to the traditional space exploration conventional propellants. This study will be conducted using the methodology using both experimental and computational approaches. Combustion properties, energy output and emissions of sustainable propellants and their performance will be tested in laboratory experiments and compared with their conventional counterparts. Next, computational simulations with state-of-the-art software will be used to determine and predict the performance of these green propellants for various launch conditions, as well as long term impact on their environment.