IAF SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (9)

Author: Mr. Connor Geiman
Orbit Fab Ltd, United States

Mr. James Bultitude
Orbit Fab Ltd, United States
Mr. Daniel Faber
Orbit Fab Ltd, United States
Mr. Zachary Burkhardt
Orbit Fab Ltd, United States
Mr. Grant Kendall-Bell
Orbit Fab Ltd, United States
Mr. Aiden O'Leary
Orbit Fab Ltd, United States
Mr. Alexander Deuitch
Orbit Fab Ltd, United States
Mr. Ethan Spessert
Orbit Fab Ltd, United States

SMALL BODY ASCENT ENABLED BY IN SPACE RESOURCE DERIVED AND PRODUCED HYDROGEN PEROXIDE

Abstract

Current research trends in In Situ Resource Utilization (ISRU) and In Space Manufacturing of propellant are heavily focused on the production of cryogenic propellants such as liquid hydrogen and oxygen. The authors have been studying an alternative approach: the manufacture of a storable monopropellant, High Test Peroxide (HTP).

Previous work by John S. Lewis [NIAC Phase I Final Report for NNX15AL85G (2016)] explored the feasibility of In Space Production of Storable Propellants from resources available on asteroids, Mars and the Moon. Dimethyl ether (DME) and HTP were identified as the preferred storable bipropellant combination for deep-space missions and retrieval of space-derived resources to Earth orbit. However, difficulties producing DME indicated a need to first develop systems that extract only water for production of storable hydrogen/oxygen-based propellants.

A simplified architecture, which was not explored, involves the extraction of water and production of HTP for use as a monopropellant for multi-target missions. While monopropellant HTP specific impulse is lower, system complexity is significantly reduced.

As such, the authors have begun to study an innovative "Grand, Landed Tour" multi-target exploration mission taking advantage of ISRU HTP production to explore and land on asteroids in the outer belt. This concept could similarly enable multiple-landing tours of the icy moons of any of the outer planets, of the Jupiter Trojan asteroids, or of other water-rich objects, such as Earth's Moon. Such an architecture could enable a low cost sample return mission from the lunar surface with significantly smaller landed mass on the moon and increased cost effectiveness.

The missions study assumes delivery to a Ceres rendezvous trajectory, which is not the emphasis of the work being undertaken, although efforts will be made to minimize initial system mass. At Ceres, as at all

destinations, we will make science measurements and generate enough propellant to launch and proceed to the next target. The outer belt offers a series of intriguing objects, including the Hilda asteroids in a 3:2 orbital resonance with Jupiter.

This paper discusses the initial mission objectives and requirements of this study, the major trades undertaken and details the technical path forward in the industrial chemistry work needed to understand the size, weight, power and cost of a conversion system capable of taking in water and producing propellant grade HTP. It concludes with a discussion of the future work being undertaken by the interdisciplinary team across industry and academia.