SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Technologies (5)

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LONG DURATION CRYOGENIC PROPELLANT IN-SPACE STORAGE TECHNOLOGY

Abstract

Lunar exploration missions that take advantage of the high Specific Impulse of LO2/LH2 propulsion for in-space transportation have initial mass-to-orbit launch requirements less than half of those using traditional storable propulsion stages. Therefore, the application of long-duration LO2/LH2 in-space propulsion technology will result in significant launch cost savings for space exploration.

The use of LO2/LH2 propulsion for the entire lunar exploration mission provides a 45% reduction in initial mass in Low Earth Orbit (LEO) relative to storable system. The efficientcy offered by LO2/LH2 propulsion offers even greater saving for Mars and outer planet missions. To realize the benefits enabled through the use of high Isp LO2/LH2 propulsion one must be able to efficiently store the cryogenic propellant for long durations. The required storage duration is driven by a combination of the planned mission duration and for multilaunch missions, the time required to assemble the mission components in orbit. Therefore, the long duration cryogenic propellant in-space technology has to be solved firstly.

This paper presents some research results on long duration cryogenic propellent in-space storage technology in China. A passive insulation system was design for a upperstage rocket. An outter foam substrate + variable multilayer insulation structure was used, and an inner liquid mixer was desinged to eliminate the heat stratification. And the heat environment of groud hold/ascent flight/on-orbit periods of the upperstage was analyzed and the LO2/LH2 boil-off rate was predicted. And several other methods to reduce the LO2/LH2 boil-off rate are also presented, e.g. using subcooling propellants.