Conceptual Design of ISRU Propellant Storage Depots

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Abstract

To further humankind's knowledge and presence in space, the use of off-world propellant sources will provide the necessary stepping-stones to produce economically feasible space transportation and colonization systems. The use of these propellant supplies will also extend our endeavors into space, alleviating our dependence on earth-born materials. The manufacture of propellants from in-situ extraterrestrial sources, such as Mars and the Moon, will require production and storage facilities. These facilities, which may be required to store propellants for several months, are the key to long-term human colonization and exploration. The preliminary design of these propellant depots, which may lie both on the surface and in orbit, must take into account several factors. These factors include the required rates of the regolith mining, the propellant usage and storage by the transportation systems, and the technology base from which these facilities will be built.

The basis of the depots discussed in this paper assume the conversion of liquid water into gaseous hydrogen and oxygen, which are then liquefied and cryogenically stored for use. Current and near-future terrestrial and space specific technologies applicable to the processing and storage of the propellants is chosen and applied to the application. Using the assumptions of these chosen technologies, a basic system block flow diagram is developed, from which masses and component volumes can be obtained of the basic system components. From these calculated volumes and masses, sizing information is developed and used to produce first-order conceptual drawings and designs of the propellant production and storage facilities.