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SURFACE ENERGY PRODUCTION ISSUES FOR THE REFUELING OF STARSHIPS

Abstract

We present a study of the various means of energy production on the Martian surface in order to produce a sufficient quantity of propellant for the return of a Starship (SpaceX) to Earth. We assume that the outward journey went well and that the material brought by the cargos Starships is available on the surface. Based on our estimates, there would be 540 days left to fill the propellant tanks of 2 Starship rockets (Musk scenario) before the arrival of the crew onboard another starship. The empty mass is estimated at 200 t per rocket. According to Nasa, the DeltaV to leave the Martian orbit and land on Earth is estimated at 7267 m/s. Considering an Isp of 361s for the CH4/O2 propellant and Tsiolkovsky equation, the mass of propellant required for the return is 1269 metric tons per Starship and therefore 2538 metric tons in total if 2 Starships have to be refueled as proposed by Musk. This is an average of approximately 4700 kg/day. Based on NASA data (NASA report DRM5.0), for an In Situ Resource Utilization, assuming a Martian soil composed of 3Musk wishes to use photovoltaic panels as a primary source of energy to meet this need. According to the work of Cooper et al, solar panels in conjunction with batteries or fuel cells are indeed very effective, perhaps even more than nuclear energy on the kW per kg basis. However, there are several drawbacks: The solar energy received on Mars is half that received on Earth due to the greater distance from the sun. By imagining an optimistic yield of 30