HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
How Can We Best Apply Our Experience to Future Human Missions? (2)

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IS IT NECESSARY TO HAVE THE CLOSED BIO-REGENERATIVE LIFE SUPPORT SYSTEM FOR IMPLEMENTING THE FIRST MARS MANNED MISSION?

Abstract

An approach to significantly reduce the cost of implementing the first long-term manned interplanetary missions is proposed. The main idea is to eject waste generated by the life support system (LSS) of a manned spacecraft for increasing the thrust of rocket engine. In so doing it is possible to reduce needful supply of rocket fuel and initial mass of spacecraft on low earth orbit (B.N.Kiforenko, I.Yu.Vasil'ev, 1995). The mathematical model of LSS used for the purpose of our study is improved in the light of information about contemporary LSS and available estimates of hypothetical bio regenerative ones. These models assume the coefficient of regeneration η (the ratio of waste mass that can be regenerated to the total mass of LSS working substances (water, food supply etc.)) to be the main LSS optimization parameter. For the purpose of our study, mathematical models of both the chemical liquid and nuclear thermal propulsion systems with inert mass ejection capabilities were developed. Efficiency of waste active jettisoning in interaction with different systems of regeneration was evaluated when solving variation problem of minimum of expeditionary complex initial mass. Mars manned mission using the safest all-rocket scheme is investigated. Use of LSS waste eject reduces the optimal value of LSS regeneration coefficient. In case of so called "opposition type" mission with nuclear thermal propulsion the efficiency of our approach with open LSS regenerative subsystem (η=0) is comparable to expected efficiency of perspective closed "biological" LSS without waste ejection. Acceptability of this approach within the framework of such projects as "Space Rover" and Project M3 (manned Mars mission in 2031) is discussed.