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A process for the production of useful materials to sustain manned space missions on Mars through in-situ resources utilization

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Summary

Space colonization and exploitation of extra-terrestrial natural resources could help humanity in facing various Earth problems. In this regard, production of energy and materials starting from Mars natural resources as well as the transportation of humans in space could be considered the long term remedy to issues such as overpopulation, depletion of fossil fuels, climate change as well as reduction of available natural resources. Along these lines, the technologies related to a recently filed patent concerning their use for the in situ exploitation of natural resources available on Mars are addressed.

Main Results

The developed technologies refer to a specific ISRU (In-Situ Resource Utilization technologies) process synergistically coupled with a regenerative ECLSS (Environmental Control and Life Support System).

The invented ISRU plant is conceptually divided into two interacting sections: the chemical-physical one and the biological one. In the first section, the combination and juxtaposition of different plant units specifically designed to operate under Martian conditions, allows for the production of water, oxygen, and propellants needed by a crew of up to six members as well as suitable amounts of fertilizers to be used in the biological section. The set-up of the optimal values of operating parameters has been identified through appropriate mathematical models.

Briefly, the main plant units involved in the chemical physical section are geodetic domes, water adsorption reactors, solid state compressors, temperature swing adsorbers , water and CO2 electrolyzers, electrosynthesis reactors, magnetrons, absorption mini-towers and catalytic reactors as well as photovoltaic panels for energy supply.

The biological section receives, as inputs, either natural resources (CO2 from atmosphere and regolith) and synthetic products from the chemical physical section to produce edible biomass and photosynthetic oxygen by using photobioreactors and greenhouses.