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REDMARS - LOWERING THE PERCHLORATE FOR AGRICULTURE ON MARS AND IN-SITU RESOURCE UTILIZATION

Abstract

One of the main technological challenges for enabling human colonization on Mars is the development of large-scale agriculture. Water, Carbon, and Oxygen, needed for plants development, are already present mostly in the form of ice below the surface and CO2 in the atmosphere. On the other hand, the Mars Odyssey space probe discovered that the Martian soils, due to their formation process, contain high amounts of chlorine and harmful minerals for the growth of plants. Perchlorate salts were found in the Phoenix Mars Lander landing zone (values from 0.5 to 1% percent in mass) and at two landing sites of The Viking mission. Considering the global distribution of chlorine in the soil, perchlorate salts are expected to be present throughout the Martian soil at high concentrations, and it is conjectured to exist as a mixture of salts distributed by their mass in: 48% of Calcium perchlorate, 32% of Magnesium Perchlorate and 20% of ammonium perchlorate.

The developed experiment is a method that eliminates 90% of perchlorate from Martian soil, with minimal water consumption. This experiment, denominated REDMARS, was carried out during the Asclepios analog space mission in Switzerland and based on the mining and hydro-metallurgical techniques. Briefly, the soil's perchlorate salts are rst dissolved by washing in an acid pH medium using a soil: water ratio of 1:3. Then, the soil and water are separated in the solid-liquid by a filtration stage. Finally, the water is treated by ionic exchange, where the Resin captures the perchlorate. The water may then be reused. Asclepios analog astronauts performed this method using a Martian analog soil sample extracted from the Pampas de La Joya desert in Peru, with mineralogical features similar to the expected in the Martian low latitudes.

The reduction of perchlorate with REDMARS methodology is eective, safe, and simple to use. This method, applied to the Martian soil, is a potential rst step in enabling the use of Martian regolith in agricultural activities and could be an alternative method for treating water deposits on Mars for human use. Furthermore, in the future, the stored perchlorate could be used as an important source of oxygen and propellant, which could make it an attractive mining resource on Mars for its extraction and processing.