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SABATIER REACTOR OPERATION USING SOLAR POWERED ELECTROLYSIS

Abstract

It is generally agreed that return trip fuel must be generated on Mars. Our NASA Space Grant Consortium group experimented with optimization of methane (CH4) gas production as return fuel using the available carbon dioxide gas in the Martian atmosphere along with Earth-supplied (initially) hydrogen gas. Although not a new idea, we built a portable reactor out of stainless steel pipe (38 x 3 cm) on a frame (57 x 68 x 37 cm) to experiment with this process. Ruthenium is used as the catalyst. The unit also includes various controllers and gas-mixing chambers. Multiple trials of our Sabatier reaction were performed with favorable production of methane and hydrogen demonstrated. The byproduct of the Sabatier reaction, H2O, is used in the classic electrolysis process using NaOH as electrolyte for production of hydrogen and oxygen gases. The hydrogen can be recycled back into the Sabatier reaction. For this purpose, we built a fish tank based electrolysis unit frame (51 x 25 x 56 cm). The electrical energy required for electrolysis is collected by six 46 x 46 cm parallel connected solar panels located on the roof near the Sabatier reactor and electrolysis frames and stored in two serially connected 6 volt marine batteries to provide constant voltage. The water byproduct of the Sabatier reaction is fed to this unit with two (7.62 x 15.2 cm) perforated (to maximize surface area) stainless steel electrodes within cylindrical 14 cm diameter gas collecting acrylic tubes. Electrodes are welded to ends of 38.1 x 0.635 cm insulated copper rods within the tubes. Hydrogen gas from this system will be returned to the Sabatier reaction for generation of additional methane. Recycling all of the water byproduct into the electrolysis cell yields 50Confirmation of accessible near-surface water on Mars would make electrolytic generation of additional hydrogen and oxygen much easier to fully supply the requirements for generation and combustion of methane. Work is continuing to optimize both reactions and combine them into a single self-sustaining and near closed-loop system. We plan to present the details of design and operation of both units and the results.