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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and Development (3)

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LOW-TEMPERATURE CATALYTIC GASIFICATION ROUTES TO SUSTAINABLE WASTE MANAGEMENT AND FUEL GENERATION IN SPACE EXPLORATION

Abstract

Waste management alternatives for space exploration beyond low earth orbit (LEO) are under consideration. One such alternative is the use of Wet Thermal Catalytic Oxidation (WTCO) processes. These processes promote the conversion of long polymeric chains into synthetic or "supply" gas (syngas) at temperatures lower than those required by more traditional gasification technologies. The presence of a catalyst is known to lower the energy required to promote gasification reactions, making WTCO processes an attractive route for waste management and biomass to energy strategies. This technology was examined using Low, Medium and High-Fidelity Waste Simulants (different combinations of polyethylene (PE), polyethylene terephthalate (PET), cellulose, nylon). The conversion of these polymeric chains through catalytic oxidation was studied for two different catalysts (Ru and Pt on Al2O3) combined in a slurry of water and waste polymers. Thermal characterization of simulants and catalytic slurries complemented the WTCO experiments. Data collected in a research-grade laboratory reactor has been characterized by gas chromatography, and used for the mathematical modeling of the reactions under observation. A simple kinetics characterization of the reactions, from preliminary experimental runs of low/high fidelity simulants, was determined to formulate a phenomenological model of a multi-phase gasification process. Such model is anticipated to enable the optimization of process configurations for continuous waste management in space exploration environments. Potential extensions to related scenarios, such as municipal waste management initiatives, is also being considered.