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SYNTHESIS AND CHARACTERIZATION OF PECTIN FROM FOOD WASTE FOR ELECTROLYTE GELATION AND CO2 REDUCTION

Abstract

Purpose: The utilization of in-situ resources such as food waste or plants grown on Mars combined with the available Martian regolith and atmosphere presents a path towards battery separators with increased sustainability, energy density, and durability. Separators that focus on CO2 reduction take advantage of both a highly relevant source of materials on Mars and a solution to an increasingly relevant problem of the increase of atmospheric CO2 on Earth.

Methodology: Testing the most efficient extraction methods of soybean hull and tomato pectins from inedible biomass to determine yield and efficiency through a system of acid dissolution. Effectiveness of filtration, cycles of centrifugation, and alcohol washing are examined for their impact on the final pectin yield as well as quality and purity. Cross-linking and ionic activity of the pectin-based polymer gels are determined by integration of a monovalent (Na or K) and divalent (Ca) cation in different trials. Chemicals and metal ions used in this process have the potential to be extracted from Martian regolith, while soy and tomato are chosen for their designation as "plants of interest" for NASA deep space missions.

Results: Well-defined extraction products and method, as well as a gel with reproducible characteristics are synthesized and characterized. A high yield of good quality pectin and an electrolyte with higher energy conductivity are expected. While exact pectin yield varies widely on the makeup of the biomass used, the relevance and effectiveness of established methods will be tested, and a more ideal extraction process determined. Ion integration and overall gelation with characteristic viscosity and conductivity for battery integration. This study lays the groundwork for application to different extraction processes, ionic solutions, and chemical conversions.

Conclusions: A biomass-based polymer electrolyte provides a novel method of using in-situ resources for chemical conversion and energy storage that is critical for long-term space travel. While this project is still in the testing stages, the benefits in sustainability, durability, and energy density that it could provide are substantial. Pectin has been extracted using a variety of methods in literature that are being refined and has also been shown to provide polymer gels with different ions that have a competitive conductivity.

Areas for discussion: At what point does the availability of resources and chemical conversion efficiency outweigh previous high performing methods with more circumstantially rare components or complex processes.