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Experimental Analysis of Catalytic Gasification of Waste Polymers

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Catalytic Gasification: A Sustainable Waste Management Alternative

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Abstract

This research focuses on advancing the current knowledge of a catalytic gasification process as a potential in-situ resource utilization and waste management system. This research has significance in a variety of engineering applications, but is of particular relevance towards municipal waste management and advancing space exploration. In this technology, typically referred to as Trash to Supply Gas (TtSG), liquid phase oxidation reactions produce carbon monoxide, carbon dioxide, and water. The oxidation reactions are complemented by two gas-phase reactions: the Water Gas Shift (WGS) and the Sabatier (or methanation) reaction, the main stages in the pathway of producing hydrogen and methane in this technology.

A research grade laboratory reactor is currently being used to study the catalytic gasification mechanism with two model substrates: cellulose and polyethylene. Cellulose and polyethylene exhibit marked differences under the conditions being studied. Cellulose remains solid during catalytic gasification experiments, while polyethylene melts prior to reaction conditions. Following the reaction phase, the reaction products are collected and analyzed with Gas Chromatography (GC), Differential Scanning Calorimetry (DSC) and Scanning Electron Microscopy (SEM).

The current focus of this research is the formulation of the liquid phase oxidation kinetics. The study connects the gas phase kinetics with experimental results, aiming to elucidate the chemical pathway for the liquid phase oxidation. Efforts include the connection of transport phenomena with gas phase kinetics for the formulation of an overall model. The results clearly demonstrate the potential of catalytic gasification as a sustainable waste management alternative.