PYROLYSIS OF AGRICULTURAL RESIDUES AND PLASTIC WASTE: CHARACTERIZATION OF LIQUID FRACTION AND FEEDSTOCK COMPOSITION INFLUENCE

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Abstract

Pyrolysis, as a process of thermal degradation of waste materials in an oxygen-free environment, is an efficient method for converting waste into valuable products. This technology helps reduce the accumulation of agricultural and plastic waste, whose improper disposal poses an environmental problem. At the same time, pyrolysis produces potential energy carriers, whose properties improve when biomass and plastic are pyrolyzed together rather than separately. Corn biomass waste, a widely available agricultural byproduct, and polypropylene, one of the most commonly used plastics, were selected for this study due to their increasing waste generation. Corn biomass is rich in cellulose, hemicellulose, and lignin, while polypropylene consists of long hydrocarbon chains, making their combination particularly interesting for thermochemical conversion. Standard polypropylene, corn biomass waste, and mixture of corn biomass and plastic waste in a mass ratio of 90:10 were pyrolyzed at 500°C in a nitrogen atmosphere. The collected liquid fraction was analyzed, showing a 38% increase in yield for the mixture compared to biomass alone. Additionally, the bio-oil's moisture content decreased by 94%, while its calorific value increased by 19.6%. A GC-MS analysis was performed on the liquid fractions obtained from the pyrolysis of standard polypropylene, corn biomass waste, and the mixture of biomass and plastic waste. The results showed that the characteristic peak ratio of polypropylene increased by 8% in the mixture, while the biomass peak ratio decreased by 7.3%. This suggests that plastic presence promotes the formation of more stable, energy-rich hydrocarbons, while altering biomass decomposition and reducing oxygen-containing compounds. These findings indicate a synergistic effect between biomass and plastic during pyrolysis, enhancing the energy properties of the final product while minimizing undesirable components. Overall, combining plastic and agricultural waste improves the pyrolysis process by increasing liquid yield and optimizing key parameters. This method not only offers an alternative way to manage plastic and agricultural waste but also contributes to the production of higher-quality biofuels. Further research should focus on product quantification and potential catalyst applications to enhance efficiency and selectivity, ensuring a more effective and environmentally friendly approach to waste conversion.

Keywords: *corn, polypropylene, co-pyrolysis, GC-MS analysis, bio-oil, waste valorization.*

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