Co-pyrolysis of Plastic-and-Biomass Waste: Current Insights into Chemical Recycling toward Fuel Generation in Latin America

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Pyrolysis and catalytic co-pyrolysis are promising technologies to transform plastic and biomass waste into low molecular-weight fuels such as hydrogen or methane in Latin America. They have shown outstanding potential to overcome waste pollution while generating energy and profit. Nevertheless, pyrolysis is underrepresented in projected low-carbon energy scenarios. Consequently, this review aims to identify the current trends in the use of pyrolysis-based processes for the transformation of biomass and plastics into energy and value-added products and its potential introduction in the circular value chain in Latin America. We made a bibliometric analysis to elucidate research trends in the area, resulting in 7 main pillars: production of biofuels, aromatics, and biochar; kinetic and thermo-economic analysis; and the application of artificial intelligence (AI) for predicting gas and bio-oil yields. Furthermore, it was found that scientific publications on catalytic co-pyrolysis in Latin America are scarce. Conversely, the countries dominating the literature in this area China, India, and the United States, contributing, respectively, to the 48%, 14%, and 11% of the global publications in the 2021–2025 period. Results also revealed a substantial increase in scientific production after 2022, reaching a peak of 123 publications in both 2024 and 2025. Despite this, their findings are useful for adapting processes in Latin America. Colombia and Brazil, for example, could benefit from this platform, since pyrolysis of biomass and plastic waste are already being implemented. Additionally, their policies regarding the management of biomass and plastic waste favor the adoption of this technology. Another positive finding is that Brazil and Mexico rank among the top ten countries in the world for plastic production, with 10.78 and 5.9 million metric tons, respectively, giving them high potential for generating energy using this technology. A thermo-kinetic analysis was presented, reflecting the main mathematical models (model-based and model-free methods along with reaction mechanism functions with master plots) used to determine relevant parameters for pyrolytic reactor design and to make decisions by determining the exergoeconomic factor (*f*). A thermoeconomic case study of co-pyrolysis

of empty fruit bunch with high density polyethylene (HDPE) adapted to the Latin American energetic context showed that the energy input required for catalytic co-pyrolysis is 303% greater than that required for pretreatment, demonstrating that catalytic co-pyrolysis is the primary contributor to the overall process energy demand. However, the energetic content of the pyrolysis products exceeds that of the untreated waste by more than 882 kWh/kg, which is attractive for the adoption of technology. Concerning computational tools, Aspen Plus and Computational Fluid Dynamics oriented COMSOL stands out as simulation software in this field. Among the AI tools used are convolutional neural networks, deep neural networks, and lightweight gradient boosting machines to predict product yields, with R^2 typically higher than 0.9 in the consulted works. However, real-time industrial applications in pyrolysis still face challenges due to the scarcity, heterogeneity, and poorly standardized data sets. The SWOT analysis applied gave us a broader view of the aspects that still need improvement such as catalyst recovery, reduction of heavy waxes generated during pyrolysis, and the reduction of plastic-and-biomass waste disposing in landfills. The key findings of the work are expected to support research and decision making of the academic/industrial/governmental stakeholders associated with the technology in Latin American countries.