Improving Environmental Sustainability: Solid Waste to Biofuel Generation Using Pyrolysis

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In its recent world energy outlook, International Energy Agency noted that over 1.3 billion people worldwide lack access to energy. Unstable political environment in oil producing countries, together with geopolitical risks due to strained relationship between Russia and west, demands renewed urgency to address world energy needs. My project aims to investigate the possibility of utilizing solid waste in the production of bio-oil and bio-gas. Oat-hull waste was obtained from a large food manufacturer and was placed under the fast microwave assisted pyrolysis process in a controlled laboratory setup. The temperature was varied between 400C and 650C in the increments of 50C, while 3 different loading rates between 1 g/min and 3 g/min were attempted. The effect of variations in the temperature and oat-hull loading rate were studied in order to maximize the efficiency. The change in oat-hull mass before and after the process, together with collected bio-oil, was utilized to compute the biofuel generation efficiency. Maximum efficiency of 54.21% was achieved at 550C and 1 g/min loading rate. Statistical analysis was conducted and it was determined that the efficiency at loading rate of 1 g/min was significantly greater than the 2 g/min ($P<.001$) and also the 3 g/min ($P<.001$). Finally, chemical composition of collected bio-oil was analyzed to establish suitability for use as alternate fuel. I conclude that industrial solid waste can be a viable source of biofuel generation, as it not only provides a clean energy alternative but also reduces the amount of waste disposed to the landfills.

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