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OPTIMIZATION OF COMPRESSION PARAMETERS IN PELLETIZATION OF EMPTY FRUIT BRUNCH (EFB) AND HIGH-DENSITY POLYETHYLYNE (HDPE) CHAR FOR ENHANCED SOLID FUEL APPLICATIONS

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ABSTRACT

OPTIMIZATION OF COMPRESSION PARAMETERS IN PELLETIZATION OF EMPTY FRUIT BRUNCH (EFB) AND HIGH-DENSITY POLYETHYLYNE (HDPE) CHAR FOR ENHANCED SOLID FUEL APPLICATIONS

This paper investigates the optimization of pelletization parameters for char waste derived from the co-pyrolysis of Empty Fruit Bunches (EFB) and High-Density Polyethylene (HDPE) to produce durable and energy-efficient fuel pellets. The research focused on varying the HDPE content at 0, 25, 50 and 75% and compression pressure at 100, 200 and 300 MPa using a One-Factor-At-a-Time (OFAT). Using a One-Factor-At-a-Time (OFAT) approach, the physical properties like density and mechanical durability were evaluated. The optimum condition was found at 75% of the HDPE content and at 300 MPa, yielding pellets with a high density of 1150.2 kg/m³ and mechanical durability of 99.71%. Combustion performance of the optimized pellet was assessed through proximate analysis and higher heating value (HHV) analysis. It revealed a low in moisture content (0.89%), low in ash content (0.86%) but high in volatile matter (98.09). Furthermore, fixed carbon content of just 0.16% indicates that the fuel's ability to maintain long burning performance is limited. This is reflected in the moderate higher heating value (HHV) of 15.34 MJ/kg, which, while usable, it falls short compared to other biomass-based fuels that typically exhibit HHVs ranging from 18 to 25 MJ/kg (Anshariah et al., 2020). The suitable potential applications for this pellet is in gasification or as lightweight fillers rather than direct solid fuel. Therefore, the limitation in fixed carbon and moderate energy yield suggest further study focusing to improve this parameter such as perhaps through feedstock selection or thermal treatment to enhance the fuel's overall performance. Overall, the study demonstrate the feasibility of converting EFB and plastic (HDPE) waste into valuable energy products such as pellets, contributing to waste valorization and sustainable fuel development.

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