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Co-Carbonisation of Biomass-Plastic Wastes in an Integrated Thermochemical Process

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***Abstract*— The aim of this study was to convert different biomass/agricultural wastes and LDPE to hybrid biochar in a thermochemical reactor. The LDPE was added in doping amount (4%) in all processes considered. The conversion was a hybrid one involving the simultaneous carbonisation process. The yield of hybrid biochar was in the range of 27.8 wt% and 71.43 wt%, higher than convention biochar yield. The products were characterised using SEM-EDS, and BET analyses. The specific surface areas of the hybrid biochar were all above 300 m^2/g. It was observed that the quantity and quality of were higher for hybrid conversion process than for biomass conversion alone. The study has been able to successfully achieve the twin goal of solid waste management and product development.**

I. INTRODUCTION

The continuous and connecting increment in global population, energy demand and waste generation are jointly interwoven and evidently proportional! A remarkable indication of this increase and associated impact are experienced in developing countries, where diverse economic and technological growth are ongoing (Joshua O. Ighalo & Adeniyi, 2021; Nejat, Jomehzadeh, Taheri, Gohari, & Majid, 2015). On its part, the increase in energy demand is pressing for a more sustainable source of energy (Ranganatham, 2018). Coming along the energy sustainability is the subject of its environmental effects with the human population increase as a major controller of the effects. Along with these increasing global change pressures coupled with existing non-sustainability factors, it is becoming evident that cities in developing countries are most likely to experience difficulties in efficiently managing municipal solid wastes. This leads to increasing quantities and complexity of the generated wastes (Amuda, Adebisi, Jimoda, & Alade, 2014).

Given the call to reach energy and environmental sustainability, renewable (such as biomass) and waste (such as plastics) materials are been investigated as energy sources (Oyedun, Gebreegziabher, Ng, & Hui, 2014). Thermochemical processes (such as gasification, pyrolysis and carbonisation) are efficient routes of harnessing the energetic content of these renewable and waste materials. Biomass and plastics can be co-converted for the generation of value-added products(Block et al., 2019). Due to the large volumes of biomass and plastic in municipal solid waste content, they have been identified as waste materials that can be harnessed for other more valuable products (Adeniyi et al 2020). Thermochemical processes can be used to process these environmental mixed waste materials. Low density Polyethylene (LDPE) is a plastic used for developing packaging bags and is a major constituent of the solid waste stream.

In recent years, plastic products have gained popularity for alternative uses such as packaging of edible products, water etc. Plastics like polyethylene, polystyrene and polypropylene find their applications in the food and beverage industry (Barnes, 2019). Plastics are long-chain organic polymers synthesized through chemical processes like polymerization and poly-condensation and are often preferred to other means of packaging due to their ease of production and versatility (Zalasiewicz, Gabbott, & Waters, 2019). Across Nigeria states including the FCT, the commoneset plastic pollutants is polyethylene sachets, which are used for packaging items like water (Ajala, Ighalo, Adeniyi, Ogunniyi, & Adeyanju, 2020; Nwachukwu, Obidi, & Odocha, 2010) and other common commodities for sale. Owing to the absence of efficient waste management systems and non-biodegradable nature, polyethylene wastes from packaged goods have become a nuisance to environment in Nigeria (Nwachukwu et al., 2010). The quest to find alternative means of reprocess polyethylene wastes cannot be overstressed (Olubanjo, 2019).

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