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Agricultural Waste Fiber High-Density Polyethylene Bio-composites Towards Sustainability and Advanced Utilization

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The agricultural waste fibers are of notable economic and cultural importance all over the world are used for building materials, as a decorative product and as a versatile raw material. Agricultural waste fibers have significant potential in composite due to its high strength, eco-friendly nature, low cost, availability and sustainability. The agricultural waste is one of the most important problems that must be resolved for the conservation of global environment. The potential properties of agricultural waste fibers have triggered a lot of research to use these fibers as a material to replace man-made fibers for safe and environmentally friendly products. Agricultural waste is seen as one potential source of renewable energy. Their availability is obtained from oil palm plantations and some other agricultural industries such as rice husk, rice straw, sugarcane, pineapple, banana and coconut. Agricultural waste produces large amounts of biomass that are classified as natural fibers which until now only 10% are used as alternative raw materials for several industries, such as bio-composites, automotive components, biomedical and others. Characterization and comparison of the flexural, impact, water absorption and thickness swelling properties of corncob fiber, rice hull fiber, walnut shell fiber and flax shive fiber reinforced high density polyethylene (HDPE) bio-composites was studied. The composites were compounded by extrusion processing technique and results indicated that the corncob composites showed higher diffusion coefficient of 8.57 x $10^{-12}m^2s^{-1}$ while the flax shive composites showed least diffusion coefficient of 3.14 x $10^{-12}m^2s^{-1}$compared to the rice hull and walnut shell composites. The rice hull composites showed higher values of thickness swelling of 12 %, while the flax shive composites showed the lowest value of thickness swelling of 0.5 % compared to the other composites. The flexural modulus and un-notched Izod impact strength increased with a decrease in flexural strength of the composites compared to the neat HDPE. Rice hull composites showed superior flexural strength of 22.5MPa. Flax shive composites gave superior flexural modulus of 3.0 GPa and walnut shell composites exhibited superior un-notched Izod impact strength of 52.5 J/m. The study showed that agro fiber sample load of 65 wt. % could be used in composite formulation with good result.

Keywords: Agricultural waste, Bio-composites, Sustainability, Mechanical properties, Water absorption.