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Formulation and characterization of floor tile composite derived from Polyethylene Terephthalate waste and sand

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Abstract

In Kenya, the cost of ceramic floor tiles has been increasing due to rapid population growth and urbanization. As a result, there has been significant research into developing affordable composite tiles made from plastics and sand to address this issue. Plastics, particularly PET, causes environmental pollution because they are nonbiodegradable and versatile. This study created a stain-resistant and flame-retardant floor tile composite using sand and PET plastic bottle waste as a binder to address this issue. The sand was collected from Ndondo, Isiolo County, while the PET plastic bottle waste was collected from the Nyeri County dump site in Kenya. The composite tile was formulated by varying the amount of sand and keeping the weight of PET plastic bottle waste

constant. ZnO was added to the mixture, then coated using a pigment containing TiO_2. The physiochemical properties of the composite tile were assessed according to ASTM standards. The sand used in the study was composed of 93.90% SiO_2, and the composite tile produced with 55.56% sand content had the optimum values for compression strength and tensile strength, and water absorption (104.17 N/mm^2, 12.22 N/mm^2, and 0.21%, respectively). Flame retardation ability improved with adding ZnO, while chemical resistivity depended on the amount of sand added. The composite tile was mainly made of SiO_2 (81.39%) and showed good resistance to acids, bases, swimming pool salts, and household chemicals. The floor tile had varying levels of viscoelasticity (flexible to brittle), depending on the storage modulus. Characterization of the composite revealed that PET and sand had good crosslinking, as evidenced by FTIR analysis. XRF characterization showed that the composite tile was mainly composed of SiO_2 (81.39%). In summary, PET waste bottles can be used as a sand binder to create floor tile composites that are stain-resistant, flame-retardant, and suitable for residential and commercial use.

Keywords: Composite tile, PET, characterization, formulation, waste, cross-linking, flame retardation and viscoelasticity.