Year 5 Study of Developing a Novel, Eco-Friendly, and Economic Alternative to Construction Materials, Utilizing a Composite Prototype of Recycled Polyethylene Terephthalate (PET), Polycarbonate, and Agave sisalana Fibres

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Various factors, such as inflation, tariffs, deforestation, disease, and increasing manufacturing costs, have led to scarcity and high material costs in recent years. Annually, billions of pounds of harmful waste, such as plastics, are produced. This year-five study improves processing techniques, enhances composite formulation, and expands testing on a novel short-fibre reinforced polymer composite, composed mainly of polyethylene terephthalate (PET), polycarbonate (PC), and Agave sisalana (AS) fibres competing with industrial grade lumber, namely Quercus rubra and alba. Composite specimens were examined, following improvements to a predetermined proprietary formula of 63.53% PET, 31.71% PC, and 4.76% AS fibres (developed in year two) with the chain-extending copolymer Methylene Diphenyl Diisocyanate (MDI) and Cellulose Nanocrystals (CNC) fibre coating. MDI will make the polymers more miscible, increasing properties of strength, such as tensile strength by 47% (Wu et al.). CNC will increase fibre binding to the polymer matrix, temperature resistance, and strength by 35% (Zhang et al.). This year, the modified samples underwent compressive, three-point flexural, and tensile assessments, then were analyzed in comparison to past formulations' (year 4 for compressive, year 2 for three-point flexural, and year 3 for tensile testing) and lumber's performance. Testing demonstrated that the new formulation outperforms in 2 of 3 test types. With additional additives, more consistent formulation, and larger test pools, I believe a total outperformance can be achieved. The hypothesis states the composite can be comparable to lumber samples in durability whilst being more cost-effective and sustainable than available materials; these claims continue to be proven mostly correct.

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