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# Revolutionizing Manufacturing: Embracing Additive Manufacturing with Eggshell Polylactide (PLA) Polymer

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**Abstract :** This abstract presents an exploration into the creation of a sustainable bio-polymer compound for additive manufacturing, specifically 3D printing, with a focus on eggshells and polylactide (PLA) polymer. The project initially conducted experiments using a variety of food by-products to create bio-polymers, and promising results were obtained when combining eggshells with PLA polymer. The research journey involved precise measurements, drying of PLA to remove moisture, and the utilization of a filament-making machine to produce 3D printable filaments. The project began with exploratory research and experiments, testing various combinations of food by-products to create bio-polymers. After careful evaluation, it was discovered that eggshells and PLA polymer produced promising results. The initial mixing of the two materials involved heating them just above the melting point. To make the compound 3D printable, the research focused on finding the optimal formulation and production process. The process started with precise measurements of the PLA and eggshell materials. The PLA was placed in a heating oven to remove any absorbed moisture. Handmade testing samples were created to guide the planning for 3D-printed versions. The scrap PLA was recycled and ground into a powdered state. The drying process involved gradual moisture evaporation, which required several hours. The PLA and eggshell materials were then placed into the hopper of a filament-making machine. The machine's four heating elements controlled the temperature of the melted compound mixture, allowing for optimal filament production with accurate and consistent thickness. The filament-making machine extruded the compound, producing filament that could be wound on a wheel. During the testing phase, trials were conducted with different percentages of eggshell in the PLA mixture, including a high percentage (20%). However, poor extrusion results were observed for high eggshell percentage mixtures. Samples were created, and continuous improvement and optimization were pursued to achieve filaments with good performance. To test the 3D printability of the DIY filament, a 3D printer was utilized, set to print the DIY filament smoothly and consistently. Samples were printed and mechanically tested using a universal testing machine to determine their mechanical properties. This testing process allowed for the evaluation of the filament's performance and suitability for additive manufacturing applications. In conclusion, the project explores the creation of a sustainable bio-polymer compound using eggshells and PLA polymer for 3D printing. The research journey involved precise measurements, drying of PLA, and the utilization of a filament-making machine to produce 3D printable filaments. Continuous improvement and optimization were pursued to achieve filaments with good performance. The project's findings contribute to the advancement of additive manufacturing, offering opportunities for design innovation, carbon footprint reduction, supply chain optimization, and collaborative potential. The utilization of eggshell PLA polymer in additive manufacturing has the potential to revolutionize the manufacturing industry, providing a sustainable alternative and enabling the production of intricate and customized products.

**Keywords :** additive manufacturing, 3D printing, eggshell PLA polymer, design innovation, carbon footprint reduction, supply chain optimization, collaborative potential
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