

## Abstract

Presently the majority of the research pursued, revolves around environmental sustainability. This includes developing various methods to reduce, reuse and recycle waste generated by domestic and industrial activities. Along with industrial and municipal wastages, the poultry sector is responsible for big quantities of poultry waste in the form of chicken feathers. Nowadays, the technologies used to reduce waste aims towards alternate use of the waste and convert it into useful products. Also, technologies are being developed to manufacture components from waste. With the increasing demand for complex shape manufacturing and application specific material requirement, additive manufacturing, and composites are the technologies being considered to manufacture components. The fused deposition technique of additive manufacturing is the most widely used technology. This technology is dependent on the availability of the filament. Preparation of the filaments of required material is the foremost challenge faced in using the technology. Currently, filaments made of composite material are being used for 3D printed products.

In the present research, a filament extruder is indigenously developed to manufacture composite filaments with short fiber reinforcement, to overcome the nozzle choking problem faced in conventional extruders. Further, the extruder is used to manufacture biocomposite filament with the short fiber of Chicken feathers and PLA. Investigations were carried out to develop biocomposite filaments with various weight proportions of CFF (CFF) and Poly-Lactic Acid (PLA). The developed biocomposite filament is investigated for its mechanical, physical, thermal, chemical, and electrical characteristics. The tests carried out to characterize the filament sample included the Tensile test (ASTM D3034), visual inspection using stereoscopic microscopy, Differential Scanning Calorimetry (ASTM D3418), Thermo-Gravimetric Analysis (ASTM E1131), Fourier Transform Infra-Red Spectroscopy (FT-IR), solubility in alkaline medium, and electrical resistance. The biocomposite filaments had better tensile strength compared to base materials. DSC and TGA curves indicate that the filament samples had better thermal stability at higher temperatures as compared to CFF and PLA. The crosslinking and chemical interactions at the interfaces are indicative of the FT-IR measurements. The interface exchanges resulted in enhanced physical properties.

To carry out a comparative study with samples prepared by other methods, samples were manufactured using the sandwich method. The biocomposite filaments exhibit better physical and mechanical properties as compared to the samples prepared by the sandwich method. The

interface exchanges in the samples prepared by the sandwich method are only by wetting and adsorption.

The research lays the foundation for preparing CFF/PLA biocomposite filaments that can be used in 3D printers working on the FDM technique.

**Keywords:** biocomposite filament, Chicken Feather Fiber, characterization, Filament extruder, Poly-Lactic Acid, sandwich method,