Internship assignment

Study on the effect of additives on the printing performance and properties of filled materials

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BASF Forward AM – Innovating Additive Manufacturing

BASF 3D-Printing Solutions (B3DPS) focuses on the development of innovative engineering materials used in additive manufacturing (AM). B3DPS offers a wide portfolio of materials organized in four different business lines, targeting different AM techniques and services in:

- Powder Bed Fusion (PBF): thermoplastic polymers in powder form used in selective laser sintering (SLS)
- Liquid Formulations & Systems (LFS): resins for stereolithography techniques (SLA)
- Additive Extrusion Solutions (AES): thermoplastic polymer and metal filaments for fused filament fabrication (FFF)
- Additive Manufacturing Services: printing support, design optimization, simulation for industrial customers

The B3DPS location on the site GETEC PARK.EMMEN industry and business park in Emmen is the main location for AES where everything from R&D and production to sales and marketing is concentrated. Direct customer support for AES is organized via so-called "Application Technology Centers (ATC) located in Emmen, Heidelberg (DE), Wyandotte (US), and Shanghai (CH). Each ATC location has access to different printers to test the materials.

R&D focuses on the development of new materials, additives, and compounds. In Emmen, the ATC and R&D work closely together on the optimization and characterization of products.

Assignment

Fiber reinforced polymers are exploited as feedstock for FFF in various fields, related to aerospace, automotive and sports appliances industries, allowing to produce lightweight components with high mechanical strength. However, the mechanical performance of the 3D printed parts is highly dependent on the layer adhesion strength, which depends on factors as viscosity, crystallinity, etc.

Fillers act as a reinforcement, but they can also affect other properties of the matrix, for example increasing the viscosity and hindering the coalescence between the printed layers.

This internship aims to study the effect of additives, for example flow modifiers, on the printing performance and on the final properties of the printed part of a fiber reinforced polymer.

The project is divided in four main topics:

- Definition of the optimal processing settings and of the kind and concentration of the additives.
  - Preparation of the additive modified fiber reinforced polymers using a lab-scale extruder.

- Analysis of the physical-chemical properties of the filament e.g., Differential Scanning Calorimetry (DSC) and Melt Flow Index (MFI) measurements.

- Study on the printability of the produced filaments:
  - Effect of the flow modifiers on the printing parameters, e.g., printing speed.
  - Extrusion accuracy test.
  - Layer strength test.

- Characterization of the properties of the printed part:
  - Mechanical properties (Tensile, flexural and impact testing).
  - Thermal properties (heat deflection temperature and coefficient of thermal expansion measurement).