Multi-phase technical polymers in additive manufacturing: a business reason for science backed solutions

B.C. Okolo[*], U.W. Popp

Indmatec GmbH, Willy Andreas Allee, 19, Karlsruhe 76131 - Germany

Literature reports and practice based experiences clearly indicate that the engineering value of polymeric materials lies in reinforcing them with components which have relatively higher mechanical stiffness. This fact is corroborated by the market performance of filled polymers relative to unfilled/neat polymers where for instance glass or carbon fibre filled polymers record year on year sales growth driven especially by applications in the automobile and aerospace industries. Most of the parts produced from filled polymers are manufactured using either injection moulding methods or CNC milling methods.

With the advent of new manufacturing technologies such as Additive Manufacturing (AM) or so-called 3D printing technologies, industrial requirements have in recent times been extended to explore rapid-manufacturing approaches and also the exercise of freedom to produce and deploy parts which have geometries of higher complexities. There are technical challenges inherent to 3D printing technologies associated with the processing of reinforced polymers. These challenges border on (i) the abrasive wear of drive gears at the extruder as well as the printer nozzle leading to offsets in the tolerances expected from the machine (ii) the composition of the fibre filled polymer filament material since this affects the layer-on-layer adhesion as well as the density of the printed parts.

To mitigate these challenges it is essential to (i) construct machine elements in dynamic contact with fibre reinforce filament materials using abrasive wear resistant materials (ii) design fibre reinforced filament materials for 3D printing applications because current commercially available filled polymers are conditioned for injection moulding processing. Figure 1a shows the effect of abrasive wear by ABS filled carbon fibre material on a FFF 3D printer brass nozzle after printing about 750 g of the filament material. In Figure 1b a highly porous 3D printed 30% glass fibre PA12 with poor layer-on-layer adhesion [1].

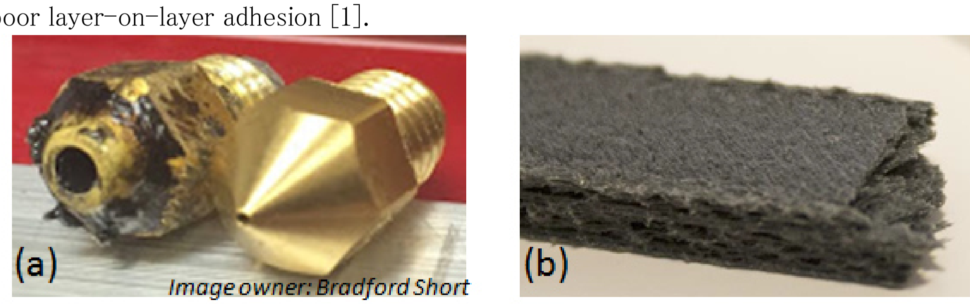

Figure 1: (a) Brass nozzle wear effect, (b) 3D printed Polyamide with 30% glass fibre

References

[1] U. Popp, B. Okolo; Optimization considerations for FDM 3D Printing of Fibre Reinforced Polymeric Materials; in proceeding of the Fraunhofer Direct Digital Manufacturing Conference (Berlin - DDMC 2016).

* brando.okolo@indmatec.com