Fused Deposition Manufacturing of Multiple Materials (FD3M)

PROJECT ID: C3-19

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The dynamic co-extrusion of the multiple material streams has been enabled with integration with 3D printers. The research is investigating hot end designs with miniaturized spiral-flow manifolds having thermal isolation of the input materials (see Figure 1). The material streams are fed at pressure with the inner material flowing within the core of the outer spiraling material(s). The flows are combined in situ to produce extrudates having core-shell, tri-clover, multi-layer, and mixed flows into the downstream nozzle. A conversion software has been developed to support the printing of multiple materials using standard pre-processors (such as Cura). The approach is to use Cura's multiple extruder support to define a palette of meta-materials, wherein each meta-material is defined as a virtual tool with its own vector of material loadings. The approach is quite robust, allowing use of standard geometry (STL files) to output the revised g-code as shown in Figure 2 for printing of a graduated tensile bar. Validation parts have been created including graduated tensile bars (Figure 3, left) and flexible hinges (Figure 3, right). Ongoing research is investigating process constraints related to extrudate stability and transition time to develop reference machine designs as well as product design and processing guidelines for Fused Deposition Manufacturing of Multiple Materials (FD3M).

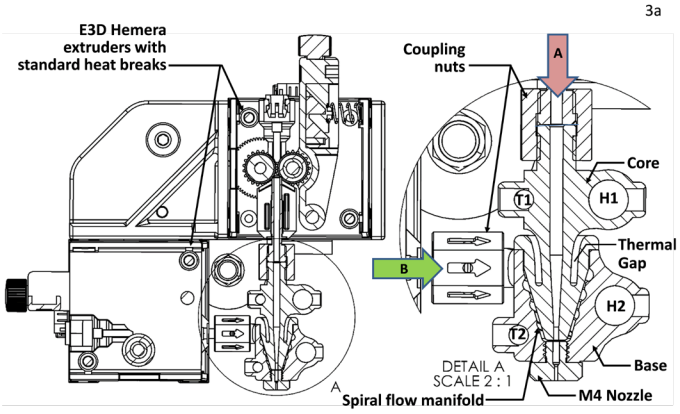

Figure 1. Balance valve with programmed orifices

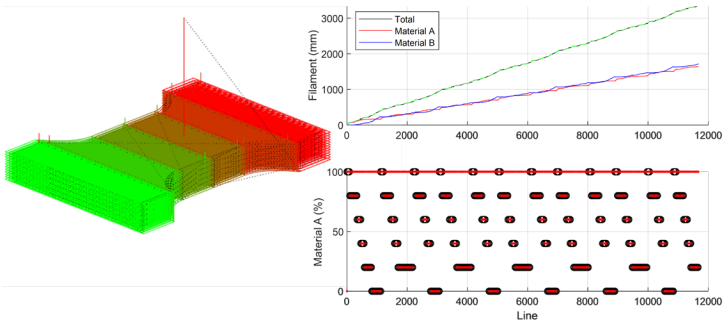

Figure 2. Matlab Interpreter for Multiple Material

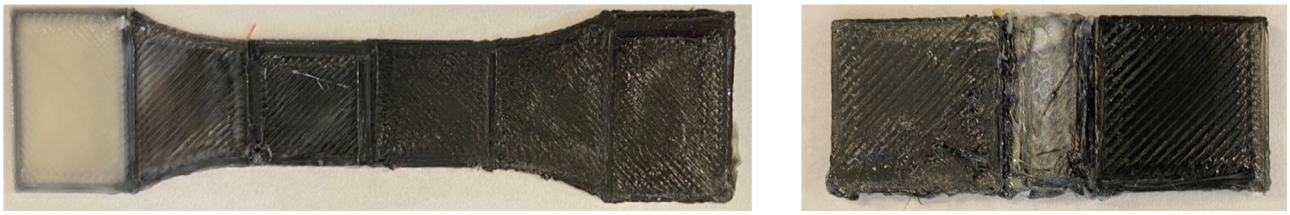

Figure 3. (left) Graduated tensile bar, and (right) Flexible hinge with TPU transitioning to PLA