Mechanical anisotropy of ABS specimens 3D printed by FDM

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Additive manufacturing (AM) has been developed as a technique for fast fabrication of component parts through 3D printing, using a process of adding successive layers, one after another.

The Fused Deposition Modeling (FDM) technique is a 3D printing process that generally uses a thermoplastic filament as the printing base material. The material is fed by a coil and the head of the extruder performing the process is heated. Printing can be done in several directions, depending on the purpose of the component part.

In this work mechanical tests were done on ABS (Acrylonitrile-Butadiene-Styrene) tensile specimens built by FDM, in different orientations, to analyze its properties and to make a correlation between these properties and the influence of the printing direction in the final product.

The tensile specimens in dog bone shaped were tested according to the ASTM D638 standards. The experiments were done at room temperature. The horizontal built specimens (H-specimens), fabricated in the z-direction, while the beads were layered along the x and y direction, parallel to the build table, showed the maximum resistance of 30 MPa. The specimens built with their gage length out of x-y plane (V-specimen and D-specimen, vertical and diagonal specimens respectively) presented lower ultimate strength, for instance 14 MPa for the V-specimen.

Additional investigation is on the way to understand the presence of defects (cavities and crazes) in the ABS microstructure since the literature points that the ability to manipulate it is the key to an improved performance of this type of structural material.