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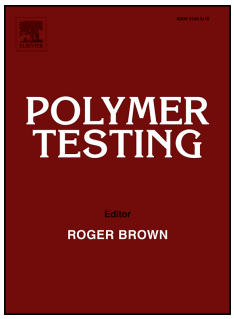

Influence of machining process on the mechanical behaviour of injection-moulded specimens of talc-filled Polypropylene

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Influence of machining process on the mechanical behaviour of injection-moulded specimens of talc-filled Polypropylene

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Abstract

The mechanical properties of injection-moulded components are usually obtained by conducting uniaxial tensile tests on dog bone specimens. Current standards do not regulate the machining process used to make the coupons and do not quantify an acceptance limit of the surface roughness. The surface qualities of milling, laser cutting and water jet cutting were examined in this study for 18% talc-filled Polypropylene using optical measurements. It shows that the machining processes influence the surface roughness of the specimen, leading to different strengths at failure of the same thermoplastic material. The specimens machined by the water jet technology produced the roughest sample edges and exhibited the lowest resistance to failure in tensile tests. On the contrary, the milling process generated the best edge quality, which showed repeatable testing results.

Keywords: Surface Roughness, Failure Strain, Tensile Test Specimens, Water Jet Cutting, Laser Cutting, Milling

1. Introduction

The injection moulding process has been widely used in the automotive industry to manufacture thermoplastic components because it generates final products in one process. However, for the determination of the mechanical properties of thermoplastic materials, it is necessary to prepare specimens from injection-moulded plaques by cutting them into required geometries according to the testing standards for tensile, compression and shear tests.

When experimental tests are conducted on polymers, scientists usually refer to ISO 2818 (Plastics – Preparation of test specimens by machining) where the selection of methods to machine notched specimens is limited to milling and stamping. After this standard has been published in 1996, other machining technologies have been adopted in industrial workshops, such as laser and water jet cutting to reduce manufacturing time and costs. No scientific study has been conducted to understand if these new technologies influence the mechanical testing results.

Since a machining process removes part of the material and generates a new surface finish, the quality of the surface finish is usually checked for the compliance with engineering standards. For polymer materials, ISO 2818 prescribes that “the machined surface and edges of the finished specimens shall be free of visible flaws, scratches or other imperfections when view with a low-power magnifying glass (approximatively x5 magnification)”.[1] This statement leads to personal interpretations of the meaning of imperfections but it clearly remarks that in some cases the surface quality of the test specimens might influence the mechanical responses of the specimens made from the same material.

Few studies have been conducted to assess the influence of the surface quality on the mechanical behaviour of reinforced polymer materials. Persson et al. [2] and Tagliaferri et al. [3] examined the effect of the hole quality on the mechanical strength of specimens made from fibre-reinforced plastics.