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UNDERSTANDING THE IMPACT PERFORMANCE OF INJECTION MOULDED LONG FIBRE REINFORCED POLYAMIDE

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ABSTRACT

Short fibre reinforced thermoplastics have been used in the automotive industry for many years and there has recently been a strong growth in the use of polyamide based materials in under-the-hood applications. More recently there has been an increasing growth in the use of long fibre thermoplastic composite systems in semi-structural and engineering applications. Glass fibre reinforced polyamides are excellent composite materials in terms of their high levels of mechanical performance and temperature resistance. However the mechanical properties of polyamide based composites decrease markedly upon the absorption of water and other polar fluids. There also exist a number of well documented differences in the structure performance relationships of short fibre reinforced polyamide and polypropylene composites and it can be expected that there will also be differences when we compare these resins reinforced with long fibres.

In this paper we present data on the mechanical performance of long fibre reinforced polyamide 6,6 which may be relevant to the above discussion. We have prepared injection moulded long fibre reinforced polyamide 6,6 samples with a range of glass contents (0-50 % wt) using glass fibres having average fibre diameters of 10, 14, and 17 μm. Mechanical performance has been determined for both “dry as moulded” state and after hydrolytic conditioning and compared with reference short fibre composites based on 10 μm diameter fibre in the same resin system. We will focus our discussion on the effects of fibre length, fibre diameter and fibre concentration on the impact performance of these composites. We will show how it is important to discriminate between notched (Figure 1) and unnotched (Figure 2) testing when discussing impact performance as these two properties show very different structure-performance relationships.

We conclude that both types of impact performance of these composites are strongly dependent on the fibre content. However, notched impact performance, which is linked to the energy required to propagate an existing crack, is insensitive to fibre diameter but strongly dependent on fibre length. Conversely, unnotched impact performance, which is more linked to the energy required to produce an initial critical flaw and its subsequent propagation, appears to be insensitive to the fibre length but strongly influenced by the fibre diameter. Interestingly, this unnotched impact dependence on fibre diameter disappears when the polyamide matrix has been plasticized by the absorption of water.

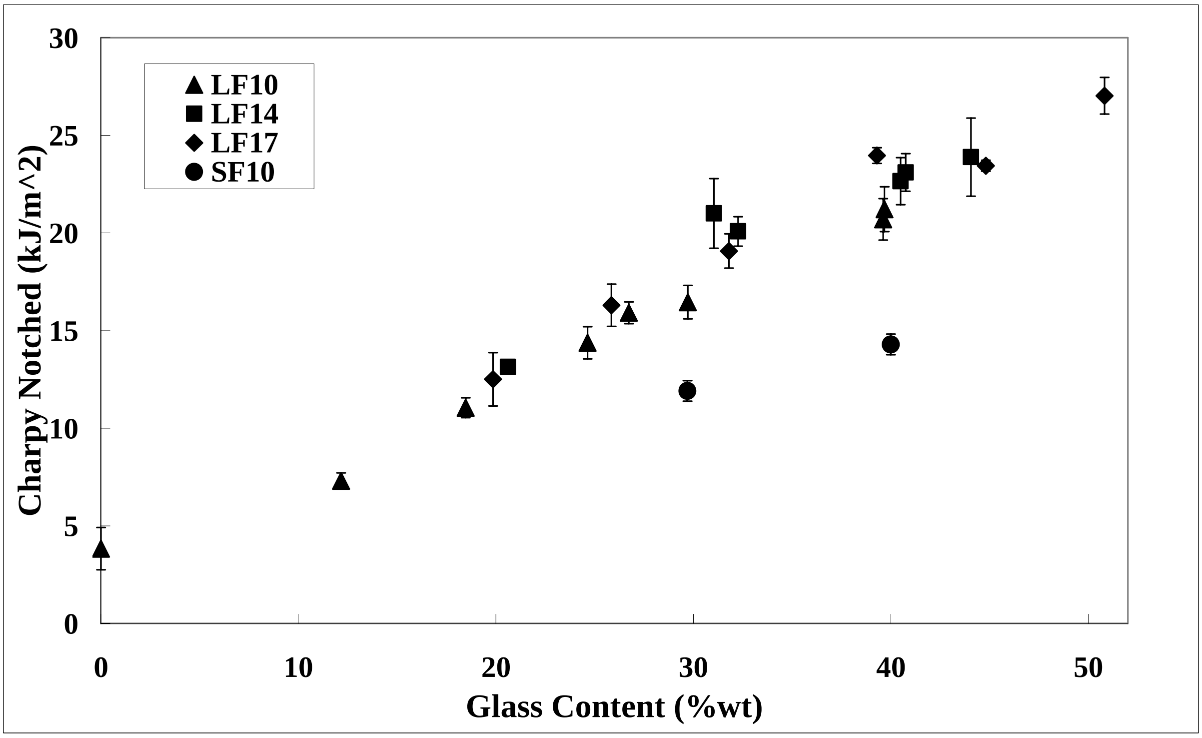

Fig. 1: Residual radial compressive stress at the interface in polypropylene composites

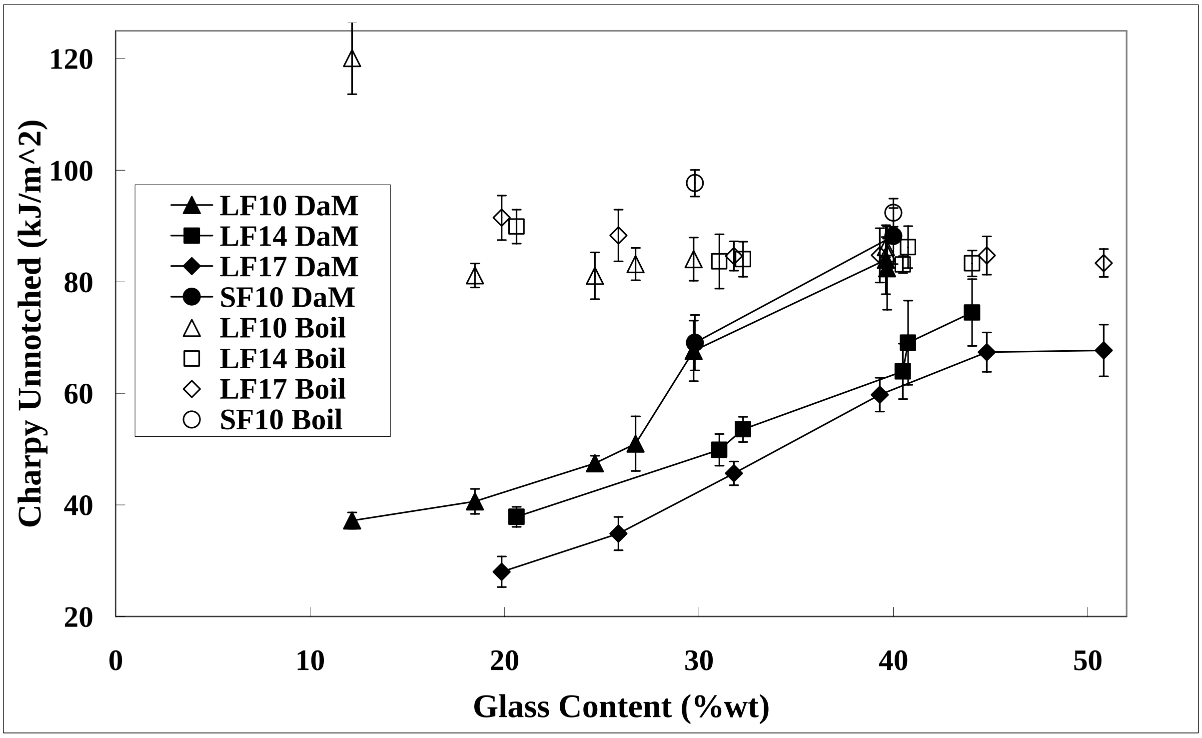

Fig. 2: Residual radial compressive stress at the interface in polypropylene composites