Impact behavior of PP/nanoclay injection moldings

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There is an interest in polymer/layered silicate nanocomposites in research in spite of the fact that a real breakthrough has not been achieved yet. Polypropylene (PP), as an important commodity polymer, when filled with less than 5% clay could find ample applications, with additional advantages, in industries where performance similar to engineering plastics is necessary. By using masterbatches (MB) the final injection moulded part can be easily obtained by mixing the MB with the polymer matrix. Experience unfortunately often shows that the industrial reality is quite different. Moreover, if the moulded products have weldlines, things become more complicated. This work attempts to contribute to narrow the gap between scientific challenges and industrial stakes in PP/nanoclay composites. Nanocomposites were obtained by injection of PP mixed with a commercial MB of PP and 50% of organoclay. They were processed in a double-gated hot runner mould. The microstructures of moldings with various amounts of nanoclay were assessed by optical microscopy, while nanoclay distribution and exfoliation level were evaluated by SEM, TEM and XRD. A typical skin-core structure was found, with skin in the bulk (B) wider than in the weldline (WL) zones. Intercalated and exfoliated structures of the nanoclay platelets were obtained. The impact properties at room temperature were assessed by tensile and biaxial tests. Properties were monitored at different sites of the moldings to evaluate the effect of the the WL. An optimum in impact performance was found in moldings with 6% MB (corresponding to 3% of nanoclay). As expected, at WL the amount of consumed energy is lower than at B under tensile conditions. However, WL exhibited higher apparent impact toughness than B under biaxial conditions. Visual and SEM inspection of biaxially impacted samples confirmed a larger fracture surface in the fracture of WL specimens. Forming a larger fracture surface requires higher energy absorption.