

Flame retardancy of injection moulded self-reinforced polypropylene composites

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In my work, the flame retardancy of self-reinforced polypropylene composites, composed of polypropylene based thermoplastic elastomer matrix and highly stretched, isotactic polypropylene fibres, is considered.

0, 10 and 15 wt% ammonium polyphosphate type flame retardant was added to the matrix material and injection moulded to form non-reinforced elastomer sheets. The fibre reinforced composites sheets were manufactured according to a multi-step process. The fibre containing granules were obtained by cutting and granulating the unidirectionally reinforced all-polypropylene composites prepared by film-stacking of flame retarded matrix foils and reinforcing polypropylene fibres. 50% reinforcement containing injection moulded composites were prepared with 0, 10 and 15 wt% total flame retardant content.

In my experimental work, the injection moulded products were comprehensively characterized by morphological (optical microscopy, SEM), thermoanalytical (TGA, DSC), mechanical (DMA, tensile test and instrumented falling weight impact test) and flammability (UL-94, LOI, cone calorimetry) test methods. A 4-fold increase in the tensile strength and also 5-6 times higher Young's modulus values were measured for the self-reinforced composites when compared to the non-reinforced reference sheets. The

increasing flame retardant content resulted, however, in decreased mechanical properties, the tensile strength of the 15 wt% flame retardant containing self-reinforced composite is not more than two times higher than that of the reference. According to the UL-94 test results, the V-0 (i.e. self-extinguishing) rating was almost achieved. When compared with the limiting oxygen index of 18 characteristic for the additive-free reference, limiting oxygen index value as high as 29 was reached at flame retardant loading of 15 wt%. Also the heat release rates measured during cone calorimeter tests were remarkably reduced in the case of the flame retarded samples, furthermore the self-reinforced composites slightly outperformed the non-reinforced sheets.

In my experiments, the feasibility of self-reinforced polypropylene composite manufacturing by injection moulding technique is demonstrated, even in flame retardant form. By this means, besides the conventional 2D processing methods of all-PP sheets, the preparation of 3D products becomes also realizable. Such products can meet the requirements of the increasingly strict safety regulations, both from mechanical and flame retardancy aspects, furthermore, such end-of-life products are easily recyclable.

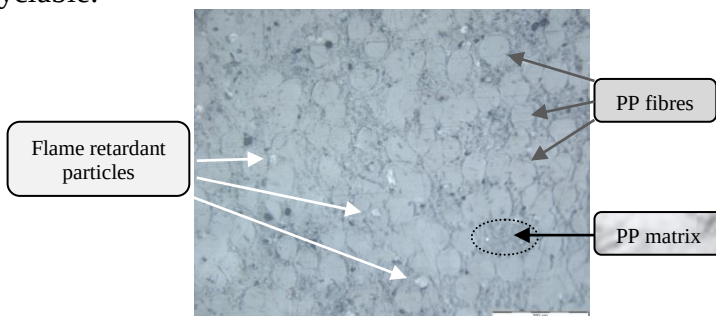


Figure 1: Optical microscope image of flame retarded,
self reinforced PP composite