EFFECT OF PAINT CONTAMINANT ON THE RECYCLING OF AUTOMOTIVE BUMPERS

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Introduction

According to the European directive 2000/53/EC, the automotive industry will have to meet recycling targets of 95% by an average weight per vehicle and year for all end-of-life vehicles (ELV) by January 2015. As plastic components are increasingly being used to replace metal, the problem of their recycling is raised[1]. Among automotive parts, bumpers are easily to remove because of their size and relatively simple composition (mainly polypropylene) but the paint covering some of these bumpers is detrimental to their recycling. In fact, the presence of paint leads to the formation of surface defects and to the decrease of the mechanical properties of the recycled material compared to conventional bumpers. In particular, evaluation of painted bumpers coming from ELV have shown that the main change in the properties compared to newly produced bumpers was due to a decrease of the elongation at break[2]. Thus, the aim of the work is to understand the influence of the paint on the mechanical properties of the recycled material and then to find an additive which could compatibilize the paint particles and the polymeric matrix.

Results and discussion

The paint coating deposited on the bumpers is composed of three layers: a primer, a base and a varnish[2]. To understand the influence of each ingredient of the paint on the mechanical properties of the recycled material, blends composed of polypropylene (PP) and of one selected component of the paint have been done and tensile tests have been carried out using an Instron 4466 universal testing machine at a speed of 50mm/min. Figure 1 shows the elongation at break (EAB) obtained for the three samples compared to the value of PP alone and of PP + the whole paint including the three components.

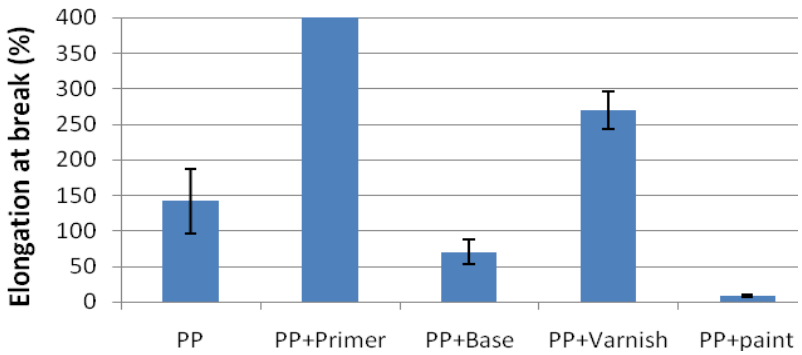

Figure 1. Elongation at break of PP and PP containing the different components of the paint at a speed of 50mm/min.

If a comparison is made between the behavior of the blends containing only one component of the paint and PP alone, it can be seen that two components, namely the primer and the varnish, lead to a huge increase in the EAB of the polymer. It has to be noted that the samples containing only the primer did not break which means that the EAB is higher than 400% in that case. On the contrary, a decrease of the EAB is observed when the base is added to the PP matrix. When the three components of the paint are added simultaneously, a sharp decrease in the mechanical properties is obtained showing that the behavior of the whole system was governed by the base.

On the other hand, SEM analyses on samples coming from ELV have shown that the failure during the tensile tests occurred precisely at the interface between the paint particles and the polymeric matrix. Thus, the compatibility between the two has to be improved.

Conclusion

Tensile tests on the different components of the paint have shown that the fragile behavior of the blend containing the whole paint is mainly due to the base. Moreover, there is no compatibility between the paint particles and the polymer. Thus, different additives have been tested in the PP matrix to improve the compatibility between those two phases. One of them has proved to be very efficient to improve the EAB of the blend and SEM analysis has shown that this additive surrounded the paint particles.

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2. Ohori N., Suyama T., Yamamoto N., Yagi N., JSAE Review 17: 401-416, 1996.