Functional Polyethylene as a Compatibilizer in Blends of Recycled Polyethylenes and Polyamides

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Background

The recycling of polymeric materials consisting of multiple different polymer types is complex as most of the common thermoplastics are immiscible with each other [1]. The reactive compatibilization, that is, the in situ formation of block or graft copolymer at the phase interface of immiscible polymer blends with functionalized reactive polymers is a well-known method for stabilizing the morphology, optimizing the interfacial tension and increasing the adhesion between the blend components [2]. In this thesis the same method is utilized in blending of recycled polymer material with virgin polyethylene.

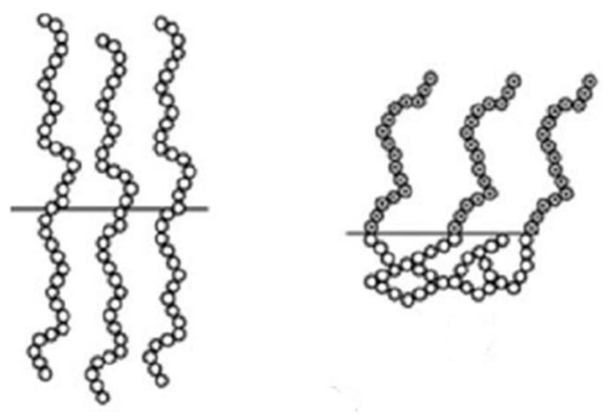

Fig. 1. Block and graft copolymers as compatibilizers at phase interphase. Adapted from [3]

Objectives

Evaluate the behaviour of Borstar® polyethylene, PE as a matrix material for neat polyamide, PA by using a maleic anhydride, MA grafted polyethylene, PE-g-MA as compatibilizer precursor, CP.

Evaluate Borstar® polyethylene, PE as a matrix material for recycled material with and without a maleic anhydride, MA grafted polyethylene, PE-g-MA as compatibilizer precursor, CP.

Experimental

A set of compounds was prepared by reactive compounding. In the compounds polyethylene was used as a matrix material with and without added PE-g-MA CP in it. The minor phase in the compounds was either polyamide or a blend of recycled material known to contain at least polyethylene and polyamide. The CP can, thus, form PE-g-PA graft copolymers with the amine end groups of PA. The blend composition was varied by altering the content of CP and the minor phase. The effects of the compound compositions on the behaviour of the matrix material and the compatibilization efficiency was evaluated by characterisation of the mechanical, morphological, thermal and melt flow properties.

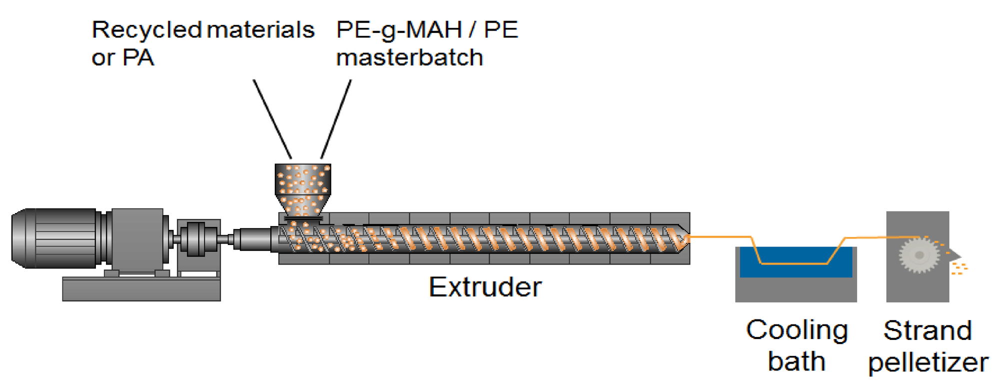

Fig. 2. Compounding and pelletizing process

Results

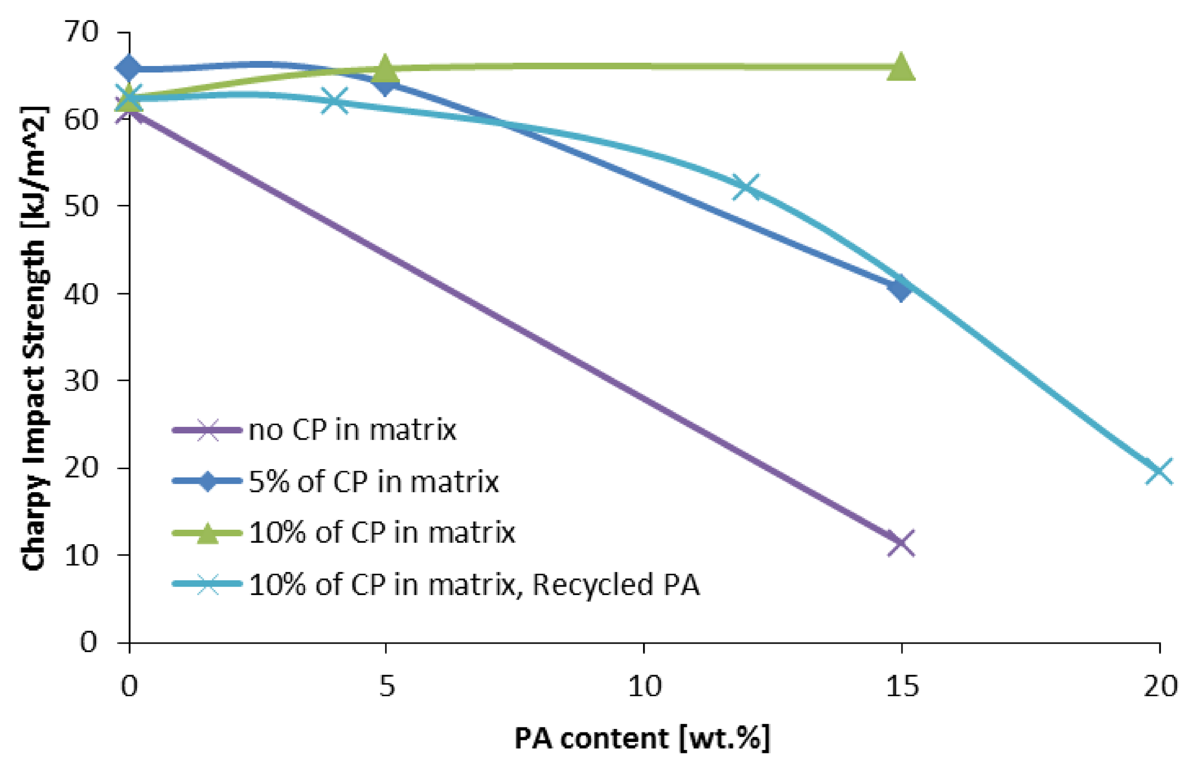

Fig. 3. Charpy Impact strength as a function of PA content

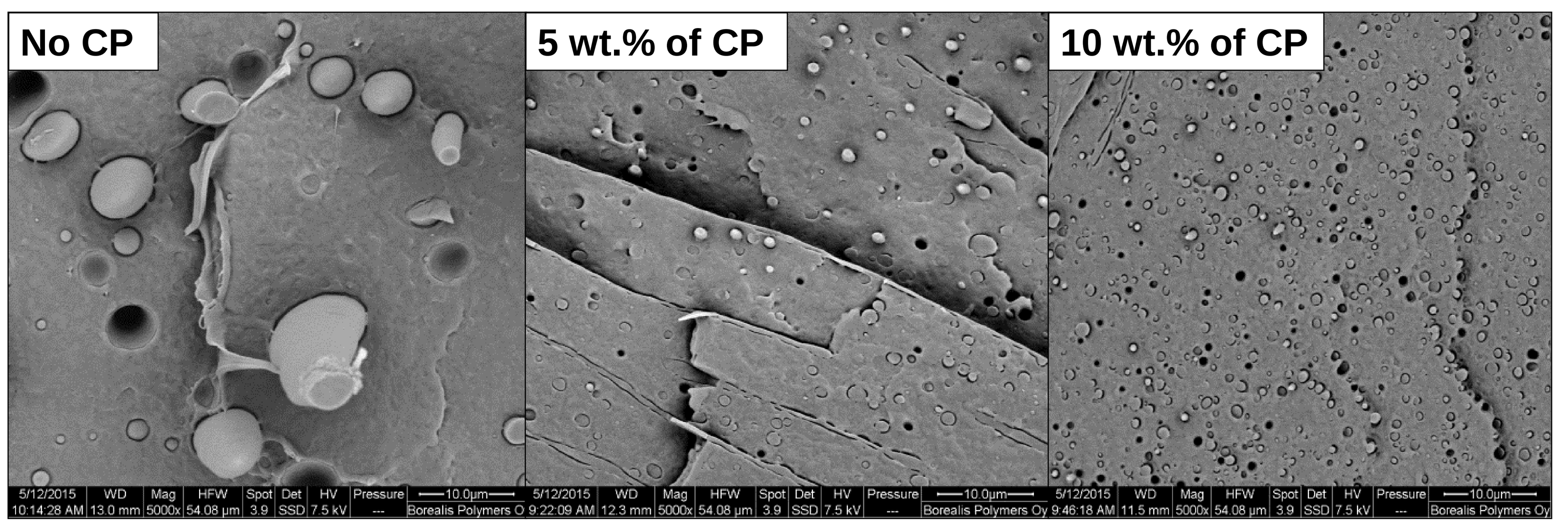

Fig. 4. Effect of CP addition on the morphology in 85/15 PE/PA blends

Conclusions

PE-g-MA CP showed a strong compatibilizing efficiency towards virgin blends of PE and PA:

- Enhanced mechanical properties
- Finer morphology

Effect in blends with recycled materials was not as pronounced as the recycled material already contained an adhesive tie layer material which most likely has already adapted the role of CP.

References:
[1] K. Khait, Recycling, Plastics, in: Encyclopedia of Polymer Science and Technology, John Wiley & Sons, Inc., 2002.
[2] L.A. Utracki, Compatibilization of Polymer Blends, The Canadian Journal of Chemical Engineering, Vol. 80, No. 6, 2002, pp. 1008-1016
[3] Z. Horák, I. Fortelný, J. Kolařík, D. Hlavatá, A. Sikora, Polymer Blends, in: H.F. Mark (ed.), Encyclopedia of Polymer Science and Technology, 3rd ed., John Wiley & Sons, Inc., 2005.