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EFFECT OF PET FUNCTIONALIZATION IN COMPOSITES BASED ON TIRE RUBBER AND PLASTIC MATERIALS

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ABSTRACT

The rubber-PET-HDPE composites properties are strongly influenced by the components properties and by the interface between polycondensation (PET) and the polymeric components. By functionalizing polyethylene terephthalate (PET), adherence is controlled and the surface properties of composites materials fully based on recycled materials: tire rubber (as matrix), polyethylene terephthalate (PET) and high-density polyethylene (HDPE) (as fillers) can be tuned. PET functionalization was performed with *polyethylene glycol 400* (PEG) and sodium dodecyl sulfate (SDS) 1%.

Atomic Force Microscopy (AFM) was used to evaluate the surface morphology. Changes in surface hydrophilicity were monitored in water contact angle (WCA) measurements, while the crystalline structure was studied by X-ray diffraction (XRD). Fourier Transform Infrared spectroscopy (FTIR) was used to investigate the structural and conformational changes of the ethylene glycol and benzene moieties of PET. Significant spectral changes were observed by FTIR analysis in the spectral regions characteristic of the crystalline and amorphous PET domains. The improved interfacial adhesion, morphology and mechanical properties (stress-strain, compression and impact resistance) of the composites are believed to be the result of the functionalization PET with PEG and SDS.

Keywords: PET functionalization, polyethylene glycol, sodium dodecyl sulfate, composite.

INTRODUCTION

Rubber waste treatment is a significant problem nowadays. Millions of waste tires are produced worldwide per year. They are often trashed to landfills but this is both an ecologically and economically unacceptable way.

Conventional rubber products are thermosets, obtained in a manufacturing process that involves an irreversible reaction between the rubber, sulphur and other chemicals to produce crosslinking between the rubber chains. It is not possible to restore thermoset rubber to its virgin form by the use of heat or chemicals [1, 2]. Rubber regeneration is a common process with limited utilization of its product. Another way is to combust the tires but only the energetically potential of rubber can be exploited in this case.

A sustainable alternative is using rubber as second raw material in developing novel products. Blending recycled rubber with other materials (organic and inorganic compounds) is an alternative in waste rubber recycling [3, 4]. Efforts to develop recycled rubber/plastic blends have followed earlier blending research on pure polymers that produced both thermoplastic elastomers and rubber-toughened plastics [5]. PET functionalization and the matrix/filler

interaction are modifying the interface properties of PET - rubber composites. These results in a modified glass transition temperature [6] with strong influence on the further processing and on the mechanical properties.

Therefore, the main objective of the paper is to investigate the changes induced by functionalized polyethylene terephthalate (PET) with *polyethylene glycol 400* (PEG) and sodium dodecyl sulfate (SDS) 1% on the surface properties of composites materials.

RESULTS AND CONCLUSIONS

The results from the compression tests are summarized in Table 1 and Fig. 1.

Table 1 - Mechanical properties of composites

Sample	Temperatur obtained [°C]	F_{σ} [N]	σ [N/mm²]	ε [mm]	E [N/mm²]	F_c [N]
E – 5	220	140	1,40	5,75	0,24	540
E – 7	240	148	1,48	4,90	0,30	1100
E – 9	260	120	1,20	5,90	0,27	860
1D – 1	220	165	1,65	2,50	0,66	720
1D – 2	240	120	1,20	1,75	0,68	520
1D – 3	260	105	1,05	1,50	0,70	1150
2D – 1	220	134	1,34	3,20	0,41	678
2D – 2	240	157	1,57	2,80	0,56	966
2D – 3	260	174	1,74	3,70	0,47	1308
3D – 1	220	75	0,75	0,75	1,00	540
3D – 2	240	100	1,00	0,90	1,11	500
3D – 3	260	40	0,40	0,70	0,57	1900

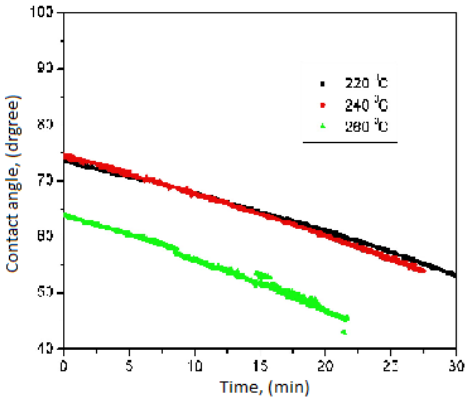

Fig. 1 - Contact angle of composites

The data showed that processing temperature strongly influences the properties of functionalized PET in the composite.

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