"Nanotechnology and nanomaterials"

High performance nanocomposites based on recycled polyolefins and rubbers

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Waste plastics, especially polyolefins and rubbers, including ground tire rubber (GTR), have caused a series of environmental problems. Many approaches have been proposed to reuse the huge amount of polymers waste. The standard use is a replacement of a part of virgin polyolefin, *e.g.* high- or low-density polyethylene (HDPE or LDPE, respectively), by some recycled grades. Similarly, part of virgin rubber is replaced by post-consumer rubbers, *e.g.* GTR, in tire formulations. The problem is to obtain polymer composites of suitable propertie,s preferably, not inferior to traditional thermoplastics in main properties.

In this work the high performance nanocomposites of thermoplastic dynamic vulcanizates (TDVs) type have been created based on recycled polyolefins ($HDPE_R$ or $LDPE_R$) and GTR by using as reactive compatibilizer EPDM – ethylene/propylene/diene monomer, as well as using natural Bitumen as multifunctional reactive agent, *i.e.* rubber devulcanizer, nanofiller and compatibilizer for TDV components. Recently it was shown, that petroleum Bitumen is a multicomponent colloidal system where the dispersed phase mainly consists of nanoaggregates of asphaltenes (asphaltenes - tightly packed stacks of planar polar molecules with $M_w \sim 1000 \div 6000$, aggregate size ~1÷2.5 nm, stacking distance ~0.4 nm) is distributed in the dispersion medium – maltenes. Structure-property relationships of the nanocomposites produced were investigated using different methods, *i.e.* thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), dynamic mechanical thermal analysis (DMTA) mechanical testing *etc*.

The outstanding mechanical properties (*i.e.* tensile strength, *TS* 12-13 MPa and elongation at break, *EB* 720-820 %) of post-consumer polyolefin/rubber based nanocomposites have been reached due to effective using Bitumen as multifunctional reactive agent and nanofiller. The nanocomposites obtained in this work can be effectively used as polymer modifiers of asphalt concrete in road surfaces.