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Effect of Different Organic Modifiers on the Tensile Properties of PVC/EVA/Montmorillonite Composites

Chao Ying WAN*, Yong ZHANG, Yin Xi ZHANG

Research Institute of Polymer Materials, Shanghai Jiao Tong University, Shanghai 200240

Abstract: Poly (vinyl chloride)/ethylene-vinyl acetate/montmorillonite (PVC/EVA/OMMT) composites were prepared by melt blending method. Two kinds of montmorillonites were organically modified by trimethyloctadecyl ammonium and dimethyl bis (hydrogenated tallow) ammonium, respectively. The morphology and tensile properties of the resultant composites were discussed in terms of the modifier type and OMMT content. The PVC/EVA/OMMT composites have intercalated structure, which is independent of the polarity of the modifiers, while the tensile properties show strong dependence on the modifier type. The OMMT modified by polar modifier gives higher tensile ductile and strength of PVC/EVA/OMMT composites.

Keywords: Poly (vinyl chloride), ethylene-vinyl acetate copolymer, montmorillonite, organic modifier.

Rigid poly (vinyl chloride) (PVC) has relatively low toughness and is often modified by the incorporation of a rubbery phase[1]. Rubber-modified PVC-layered silicate nanocomposites are expected to achieve synergistically enhanced strength and toughness[2]. The morphology of PVC-layered silicate nanocomposites mainly depends on the interactions between the silicate layers and the matrix, which sequentially influences the properties of the resultant composites[3]. In this paper, ethylene-vinyl acetate copolymer (EVA, VA50%) and two kinds of OMMT (N1 and N2) were melting blended with PVC. The N1 is referred to the OMMT treated by trimethyloctadecyl ammonium, and N2 is treated by dimethyl bis (hydrogenated tallow) ammonium. The effects of OMMT type on the morphology and tensile properties of the EVA toughened PVC/OMMT composites were investigated.

Figure 1 is the X-ray diffraction patterns of PVC/EVA/N1 and PVC/EVA/N2 composites, in which the contents of EVA and OMMT are kept at 10 phr and 3 phr, respectively. The (001) characteristic diffraction peaks of N1 and N2 all shift to low angles and decrease in intensity after compounding with PVC and EVA. The shift extent of N2 is larger than that of N1, indicating that the polar hydroxyl groups in N2 have a stronger interaction with PVC and EVA than N1. Consequently, more polymer chains are confined in the interlayers during the melt process, which may result in

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* E-mail: cyw@sjtu.edu.cn

effective reinforcement of OMMT on PVC/EVA matrix. TEM shows that both of the composites have intercalated structures, and the silicate layers of N2 are dispersed more uniformly than that of N1.

The tensile properties of PVC/EVA/N1 and PVC/EVA/N2 composites are shown in **Figure 2**. The tensile strength and elongation at break of the two composites show the similar trend that increase with increasing OMMT content and decrease above 1 phr OMMT content. The PVC/EVA/N2 composites show higher tensile strength and elongation at break than PVC/EVA/N1. As analyzed above, more intercalated PVC or EVA chains are confined between the N2 layers and interact with the silicate layers through hydrogen bonds, which are stronger than the dipolar-dipolar interactions between N1 and PVC or EVA. Such effects can account for the improved tensile strength of the PVC blends. With increasing OMMT content, some poorly dispersed OMMT particles act as stress concentration sites and decrease the tensile strength, which can be demonstrated by TEM micrographs.

Figure 1 X-ray diffraction patterns of PVC/EVA/N1 and PVC/EVA/N2 composites.

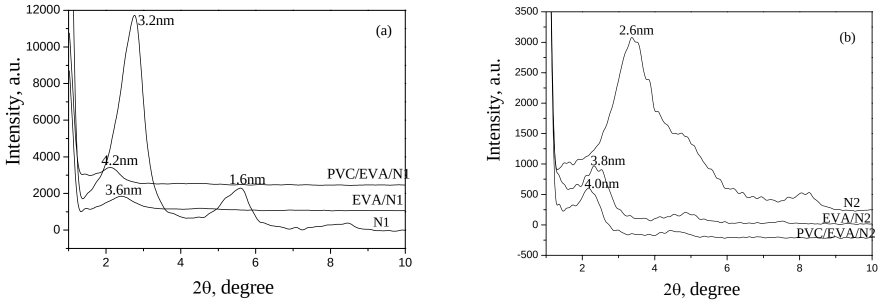
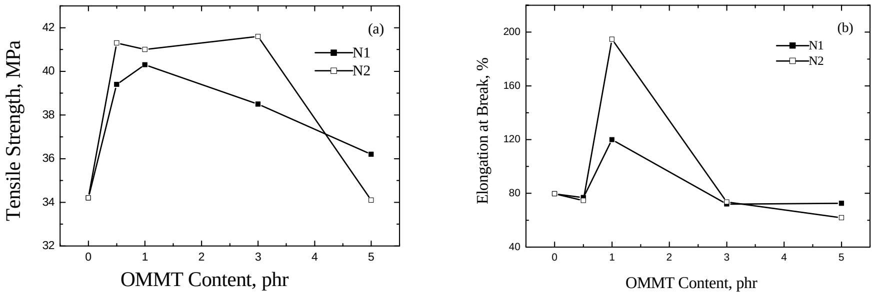


Figure 2 Tensile properties of PVC/EVA/N1 and PVC/EVA/N2 composites



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