Cure and mechanical properties of styrene butadiene rubber-organomontmorillonite nanocomposites

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In recent years, rubber/clay nanocomposites have attracted much attention from researchers, because they show remarkable improvements in physical and chemical properties when they are compared with the pure rubbers or conventional filled rubbers [1, 2]. In fact, reinforcement can be achieved even at lower filler concentrations if the clay layers are able to disperse into the polymer matrix at nanoscale level.

This study is focused on the effect of octadecylamine-modified montmorillonite (OMMT) on the curing process, mechanical properties, hardness and viscoelastic properties of SBR vulcanizates. Organoclay was compounded with SBR using an internal mixer and cured by conventional sulphur curing system. The organoclay content was increased from 0 to 15 phr.

In presence of organoclay, the optimum cure time (t_{97}) is considerably reduced decreasing by almost 17 minutes for nanocomposite containing 15 phr of nanoclay. This accelerating effect has already been reported and traced to a transition complex formation with amines and sulphur-containing compounds, which facilitates the development of elemental sulphur [3]. Both minimum torque (ML) and maximum torque (MH) of the rheometer curves are increased by the presence of nanoclay (Figure 1). The values of the torque differences increases as the amount of added nanoclay is increased. Because the torque differences can be considered as a measure of crosslinking density and/or the interaction between organoclay and rubber, the results show that the crosslink density increased by the addition of nanoclay.

A sensible increase in the mechanical properties is obtained by adding organoclay, even at low percentages. The tensile strength and elongation at break values change from 1.75 to 2.85 MPa and from 189 to 347%, respectively, when 5 phr modified clay was added to unfilled SBR. Remarkably, the tensile strength and elongation at break of the 15 phr clay-filled SBR vulcanizates was 5.97 MPa and 516%, respectively. In addition, modulus at the elongation at 100% (M100) increases with the filler content and the maximum enhancement in modulus is shown by OMMT at 15 phr. The increase of tensile properties is related with the degree of dispersion of clay layers into the polymer matrix.

There is a significant change in Shore A hardness values with increasing the filler dosage. Improved hardness is also in concordance with tensile results.

On the other hand, the glass transition temperature of nanocomposites remains relatively unchanged with clay addition.

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References:

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Figures:

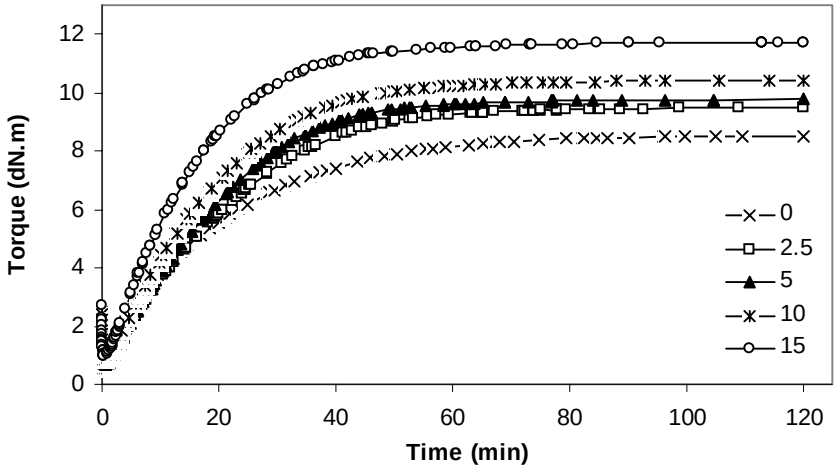

Figure 1. Cure curves of SBR/OMMT nanocomposites.

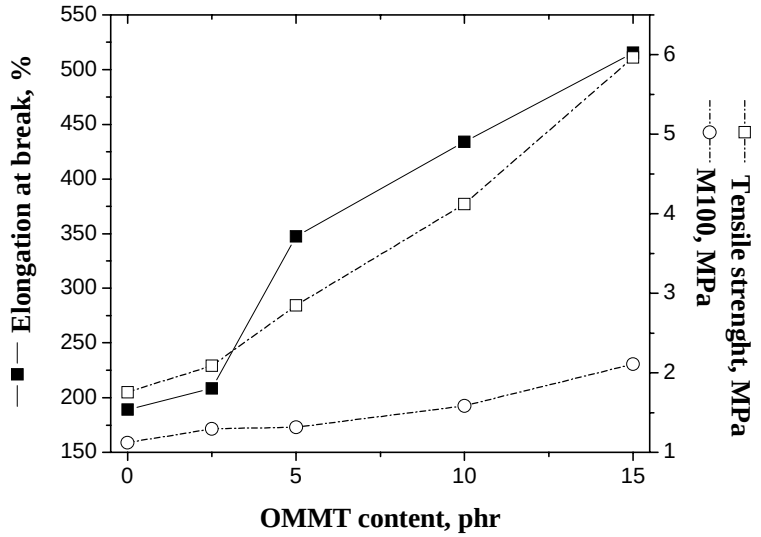

Figure 2. Variation of tensile strength, elongation at break and modulus at 100% elongation with filler content.