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### The Mechanical Properties of Modified Attapulgite Reinforced Nature Rubber and Styrene-Butadiene Rubber Nanocomposites

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### First page example

## The mechanical properties of modified attapulgite reinforced nature rubber and styrene-butadiene rubber nanocomposites

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**Keywords:** attapulgite natural rubber styrene-butadiene rubber nanocomposites

**Abstract.** Attapulgite (AT)/natural rubber (NR)/ styrene-butadiene rubber (SBR) nanocomposites have been prepared after attapulgite was modified by different coupling agent. The treatment of AT caused the adhesion between AT nanorods and the nature rubber/styrene-butadiene rubber was improved, which enhanced the tensile properties of the matrix. The tensile strength of composites attained 15.6 MPa after AT was modified by 3%wt Si-69 coupling with addition of 20 phr.

### Introduction

Attapulgite (AT) has a fiber-like morphology with the diameter of a single rod less than 100 nm and the length of a rod from several hundred of nanometers to several micrometers. It has the ideal structural formula  $Mg_5Si_8O_{20}(OH)_2(OH_2)_4H_2O$ . The surface of attapulgite has hydrophilic group and the surface of rubber has lipophilic group. The high surface areas and the charges on the lattice make AT easy to be surface treated to further enhance the organic-inorganic adhesion. The nanostructure grants it with outstanding attributes as reinforcement to improve the mechanical properties of materials. In order to improve the compatibility between inorganic AT clay and organic polymer, different coupling agents were used to modify the surface of attapulgite [1-8].

In this paper, AT was treated by different coupling agents, and then filled to reinforce nature rubber and styrene-butadiene rubber according to different proportion. The objective was to investigate the mechanical properties of NR/SBR/AT nanocomposites.

### Experimental

#### Materials

Attapulgite sieved by 400 mesh sieve was provided by Jiangsu yuanda Co. Ltd., China. Nature rubber and styrene-butadiene rubber were bought from Hainan. Si-69, stearic acid (HST) and titanium esters were used as coupling agents. Common zinc oxide (ZnO), sulfur(S), 2-mercaptobenzothiazole (accelerator M), diphenyl guanidine (accelerator DM), tetramethylthiuram bisulfide (accelerator TMTD), N-phenyl-2-naphthylamine (anti-aging agent D) and other chemical agents were common chemicals.

#### Surface Modified Attapulgite and preparation

37% HCl acid was used to remove the impurities such as quartz and carbonate in AT. Attapulgite and coupling agent (Si-69, titanium esters, stearic acid, 3wt %) were mixed in the traditional Chinese medicine grinder (rate of agitation 25,000 per minute) for 2 minutes. Then, the modified attapulgite (MAT) can be obtained.

#### Preparation of nanocomposites

In accordance with the experimental formula presented in Table1, nanocomposites were prepared on a double roller plasticator operating at 20°C. During the optimum cure time, nanocompositions were vulcanized at 150°C under 15 MPa pressure on an electrically heated press. The sheeted compounds were then placed at 20°C for 24 h before testing.

Table 1 Formulations of NR/SBR/AT vulcanizates

components	(phr)	components	(phr)
nature rubber	70	diphenyl guanidine	0.3
styrene-butadiene rubber	30	tetramethylthiuram bisulfide	0.2
stearic acid	1	N-phenyl-2-naphthylamine	1
common zinc oxide	5	AT or MAT	10,20,30,40
2-mercaptobenzothiazole	1.2	sulfur	2.5

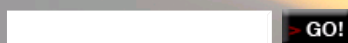
### Characterization

A Gatan transmission electron microscopy (TEM) was used to study the morphology of the untreated and treated AT. The powder was dispersed in dilute water and then deposited on a copper grid.

The mixture of powder AT and grade KBR was ground for 5min and pressed to a thin film which was analyzed by a Nicolet Fourier transform-infrared (FTIR) spectroscopy. The scan range was from 4 000  $cm^{-1}$  to 400  $cm^{-1}$  with a resolution of 2  $cm^{-1}$ .

The X-ray diffraction (XRD) study was carried out AT power diffractometer over the range  $2^\circ-70^\circ$  at a scanning rate of

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