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ABSTRACTS

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Effect of Roll Mill Mixing on AC Conductance of Polyisoprene/Nanostructured Carbon Composites

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Keywords **– polyisoprene, nanostructured carbon composite, two roll mill mixing.**

I. Introduction

Polyisoprene/Nanostructured carbon (PNC) composites have drawn their attention due to their pronounced piezoresistive properties which can be used for stress/strain sensor applications [1, 2]. To achieve optimal piezoresistive properties of PNC composite samples it is crucial to identify all the sensor-effect influencing factors during sample manufacturing process. It has already been shown that conductive nanoparticle network in the PNC composite largely forms during vulcanization process [3]. Our current work was done to find out an influence of two roll mill (TRM) mixing of a raw PNC composite on AC conductance of finalized (vulcanized) PNC composite samples.

II. Samples and Experiments

PNC samples are made as follows. Polyisoprene natural rubber SWR-3L (and curing ingredients) is used as a matrix. Degussa™ Printex™ EX-2 carbon black (CB) nanoparticles with the average particle size of 30 nm, surface area 950 m^2/g and DBP absorption 380 ml/100 g are used as an electroconductive filler. Polyisoprene is dissolved in chloroform, separately CB nanoparticles are mixed in chloroform and dispersed with ultrasound (1 W/ml, 5 min). Both solutions are blended together, chloroform is evaporated and obtained raw composite is processed with TRM to disperse nanoparticles additionally. Finally, the raw composite is vulcanized (Rondol™ hot press is used, curing temperature is 150 ^{0}C, vulcanization duration is 15 min, pressure is 3 MPa) and brass electrodes are attached during vulcanization process and, thus, samples are created (the diameter of samples is 18 mm, thickness is 1 mm).

The AC conductance of the PNC samples was measured using Agilent E4980A LCR meter.

III. Results and Discussion

The key point of our experiments was to find out how a number of roll mixing times (V) influences the conductance of finalized samples while all other sample preparation procedures are left unchanged. For each raw composite blend with different V four parallel samples were created and measured with the LCR meter.

Results for a composite containing six mass parts of CB are shown on Figure 1. It can be seen that when V=0 (the composite is not roll mixed at all) conductance of composite at 20 Hz is very high (over 10^{-2} S). Roll mixing only three times (V=3) reduces conductance by three orders of magnitude, but at V=30 the composite becomes a dielectric (reduction of conductance by over eight orders of magnitude). At 2 MHz the difference in conductance for samples with different V reduces, but it still is over three orders of magnitude large.

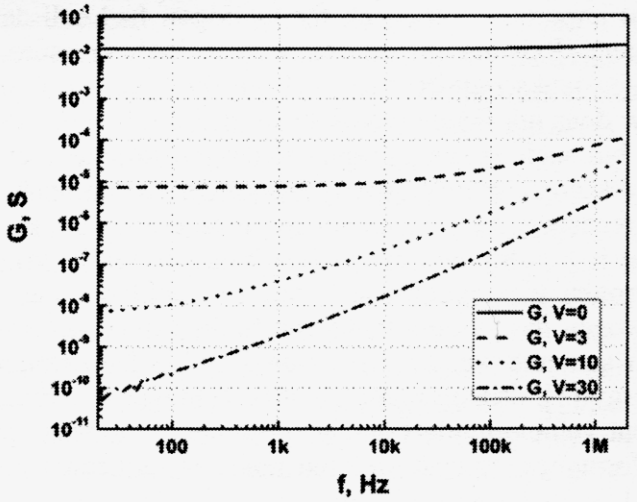

Figure 1. AC conductance of PNC samples containing six mass parts of CB with different number of composite blend TRM mixing times.

IV. Conclusions

TRM mixing of raw PNC composite blends has a huge influence on the conductance of finalized PNC samples, therefore a mode of roll mixing has to be considered very seriously while creating PNC composites.

References

[1] M.Knite, V. Teteris, A. Kiploka, J. Kaupuzs, Polyisoprene-carbon black nanocomposites as tensile strain and pressure sensor materials, Sensors and Actuators A: Phys., 110 (2004), p. 142.

[2] J. Zavickis, M. Knite, G. Podins, A. Linarts, R. Orlovs, Polyisoprene-nanostructured carbon composite – A soft alternative for pressure sensor application, Sensors and Actuators A 171 (2011) 38–42.

[3] J.Zavickis, M.Knite, K.Ozols, G.Malefan, Development of percolative electroconductive structure in piezoresistive polyisoprene-nanostructured carbon composite during vulcanisation, Materials Science & Engineering C, 2011, V31, p 472-476.