DISTRIBUTION OF NANODIAMONDS IN ELASTOMERIC MIXTURES.

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Annotation: *In the present work the distribution of ND in standard mixtures of natural rubber without the use of stearin acid was studied.*
KEY WORDS: *NANODIAMOND (ND), ELASTOMER, RUBBER, COMPOSITE MATERIAL*

I. Introduction

Nowadays, polymeric materials are applied practically in all areas of human activity and replace the increasingly used traditional metals and alloys from the modern fields of engineering, machine building, etc. The dynamic development of nanotechnology in the field of the processing of elastomers, determines the great importance of studying the structure of the elastomeric material.

One of the important components of a composite material (CM) - an elastomeric mixture (EM) is the filler. The importance of fillers is related to the production of materials with specified properties necessary for certain branches of the economy, research, medicine, etc.

II. Experiment

As regards nanotechnologies and fillers for elastomeric mixtures, the influence of nanodiamants (ND) as an element of the nanoparticles on the EM must first be studied before the formation of the supermolecular structure of the mixture and the vulcanization process preceding the manufacture of the rubber article. The influence of ND on the EM should be focused on the interfacial processes and superficial phenomena of the elastomer - filler, because precisely the changes occurring in them determine the emergence of a new complex of properties of CM. The diamond modification of carbon has the highest values of free surface energy [1], which leads to a high activity of nanoparticles in the modified material but is found in a powdery state in air, ND tends to agglomeration, leading to a reduction in excess surface energy deactivation. In order to increase the ND's modifying effect on the NR, in order to preserve the values of free surface energy, NDs should be introduced together with their inert storage environment, as they fall into the EM to maintain their activity.

The problems with the NR with ND are:
- developing methods for introducing ND into the mixture;
- Achieving the even distribution of ND in the mixture.

The following embodiments of the inert environment in the mixture are shown Fig 1:
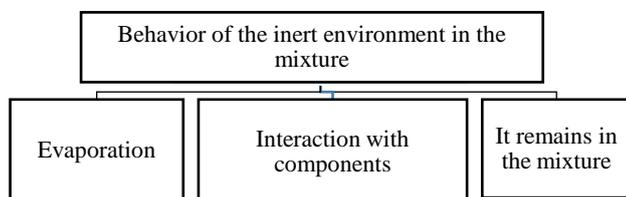
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│  Behavior of the inert environment   │
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Fig 1: *Behavior of the inert environment in the mixture*

Confirmation of the claim is the [2] found in the ND of connected and sorbed water. It is not even released when drying at 393 K.

Ideally, we accept:
- ND do not chemically react with the individual components of the mixture;
- The values of free surface energy remain unchanged.

On the other hand, the dimensions of ND and their surface hardness will contribute to the formation of their own hierarchy of supramolecular structures, averaging the density of the packings of the macromolecule chains over the entire volume of the polymer matrix (PM) [3].

According to [4] the matrix is modified under conditions that the particle of the modifier (ND in the present case) exhibits its activity in the adjacent layer of the polymer with a thickness,

$$L = r_3 \sqrt{\frac{\rho_{н}}{C_{н}\rho_{n}}}$$, where:

L – film thickness,
r-particle size,
pn-density filler,
pp - density polymer,
CH-density filler

The formula follows that the amount of carbon cloud particles is in the range of 30-50 nm.

A natural rubber (NR) was used to carry out the experiment as an elastomeric matrix.

The EU has been developed in options:
- not filled without stearin with ND - 1,5 weight fraction per 100 weight fraction NR (C-1);
- not filled without stearin with introduced ND - in 3 weight fraction per 100 weight fraction NR (C-2);

As a method for demonstrating the distribution of ND in the mixture based on their size, the X-ray diffraction analysis method is used to study the structure of the substance in the Delay-Sderder distribution space.

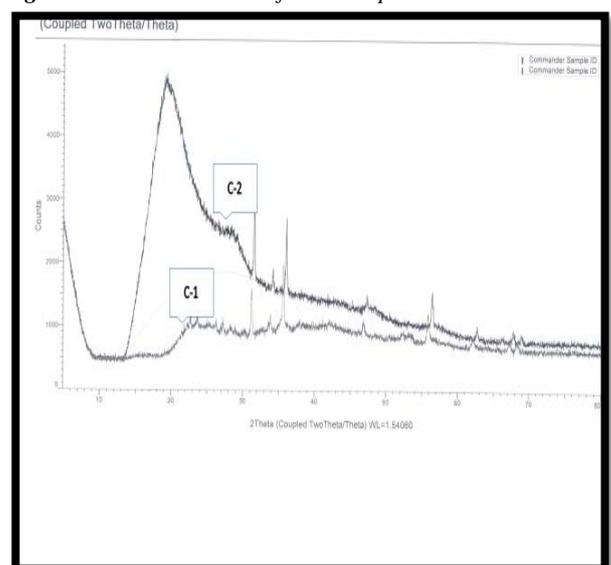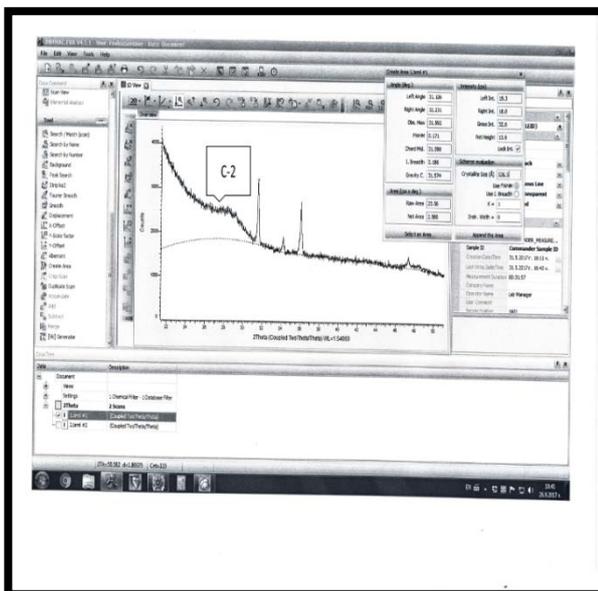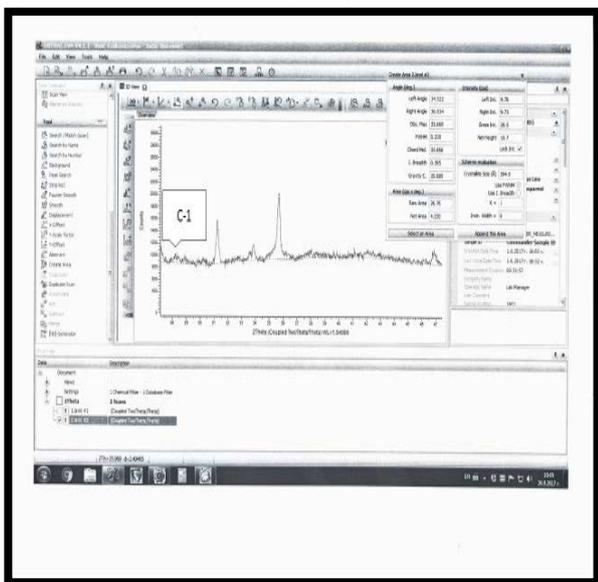*Figure 2 shows the results of both samples.*

Fig. 3 and 4 show the results of samples C-1 and C-2

From the sample results shown, it can be seen that the size of the crystals is within the range, respectively:

-      For sample C-1 at 1.5 weight fraction ND per 100 weight fraction NR, the crystals have a size of 394 Ä-39 nm

- For C-2 sample at 3 weight fraction ND, per 100 weight fraction NR, the crystals have a size of 536 nm - 54 nm

III.Conclusion

By using the above-mentioned composition and method of ND introduction into the EM together with the inert storage medium, a uniform distribution of ND is achieved by forming an own hierarchy of supramolecular structures with dimensions of 39-54 nm by:

- averaging the packing density of the macromolecule chains over the entire polymer matrix volume:

- uniform distribution of ND in the polymer mixture;

- enhancing the modifying effect of ND.

IV.References:

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