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PREPARATION OF COMPOSITIONS BASED ON MODIFIED EPOXIDE OLIGOMER WITH GO AND INVESTIGATION OF THEIR PHYSICAL-MECHANICAL PROPERTIES

Abstract: *In the article, a study of modified GO with an epoxy oligomer was conducted and the physicomechanical properties of this composite for application in agriculture were studied. It is shown that the properties of the modified adhesive composition based on epoxy resin with a graphite oxide, we see that the number of air bubbles in the adhesive coating is less than the number of air bubbles in the unwanted adhesive coating. Since graphene oxide is uniformly dispersed in the epoxy oligomer and fills the cavity inside the oligomer, it creates air bubbles and reduces the number of bubbles in the coating.*

Key words: *graphene oxide, epoxy oligomer, agriculture, modification.*

Language: *English*

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Classifiers: *agriculture.*

Introduction

GO sheet of carbon atoms linked together by a canvas. This two-dimensional form of carbon is appreciated by many scientists for its flexibility, strength and high electrical conductivity. Graphene oxide (GO) is a monoatomic layered material with oxygen-containing groups, made from the oxidation of graphite, which is cheap and common. One of the

advantages of GO is its easy dispersibility in water and other organic solvents, as well as in various matrices, due to the presence of oxygen functional groups.

The functionalization of GO can significantly change the properties of GO. The material is already used in space, medicine and flexible electronics [1,2].

It turned out that graphene oxide, due to its long list of useful properties, can become an effective "container" for fertilizers. According to the developers, the most important property of the material is that it is able to slowly release nutrients necessary for plants to the soil.

We explain that graphene oxide has a high charge density, due to which it is able to bind with a large number of ions of nutrients that plants need [3].

And the strength of graphene oxide helps to preserve fertilizers and protect them from damage that may occur during transportation. According to experts, the problem of preservation of fertilizers consisting of granules is the most important problem for manufacturers .

But most importantly, thanks to the ability of graphene "containers", to slowly release the contents, fertilizers will flow into the soil almost "on schedule." According to Professor Mike McLaughlin, the fact that graphene oxide can release fertilizer slowly is a key factor for agriculture.

Mixing GO with various types of polymeric materials improves its other physical properties. GO is harmless to humans [4,5].

Experimental part

Materials

The natural lacquers of graphite were suggested by Aladdin Industrial Cooperation. Concentrate sodium nitrate ($NaNO_3$), sulfuric acid (H_2SO_4), hydrogen-peroxide (H_2O_2), and potassium permanganate ($KMnO_4$) were obtained. Epoxide resin E-51 was provided by Yisheng Resin Factory China. Diethanolamine (DEA) acetic acid was bought from Tianjin Guangcheng Chemical Reagent Corp. (China).

Preparation of modified epoxide oligomer

In the previous report the preparation of epoxide resin was noted. E-51 epoxide with DEA resin was reacted to 1 / 0.5, 1/1, 1 / 1.5, and 1/2 fractions of the substances (the ratio of ideal epoxide group is 25%, 50%, 75% və 100%).

Experimental procedure of GO production: 2g of graphite, 1 g of $NaNO_3$, 46 ml of H_2SO_4 has been mixed at 0°C in ice bath. After reaching at 0°C, 6g of $KMnO_4$ has been added periodically in 2 hours. During this procedure temperature has been controlled and stabilized between 20-25°C. During 4 hours we have stirred and kept temperature between 20-25°C. We have heated until 35°C for 30 minutes. After adding 92 ml distilled water we have put it in ice bath in order to decrease the temperature as temperature increases until 90°C after adding the water. We have stabilized the temperature at 70-75°C for 15 minutes. We have added 500 ml of 3% H_2O_2 and stirred during 10 minutes. We have let the mixture to cool down for 30 minutes. We have stirred our product 20-30 days in order to get pure GO.

GO layers were synthesized with illustrated modified Hummers method. Liquid suspension of GO (3 mg/ml) was added to epoxide emulsions. The content of GO was changed from 0% to 10% in order to measure resins. After mixing 15 minutes, it was placed through the last concentration.

Characterization

Morfology of GO was studied on FE QUANTA 250 area mission, SEM system and Dimension Icon type atomic force microscope (AFM) system.

In order to improve propertoes of adhesive composition we modified it mechanically by mixing in various ratios. Then, anti-oxidant is added and it is mixed vigorously at 50-70° C in 1-2 minutes and after adding packings it is mixed fastly. The samples are prepared from obtained adhesive composition for studying and physical-mechanical and chemical properties are given in Table 2.

3. Results and Discussion

After studying properties of adhesive composition modified with graphene oxide with epoxide bases, we see that the number of air bubbles in obtained adhesive composition are less than the number of air bubbles in not modified adhesive compisitions. When graphene oxide is distributed equally, oligomer fills voids in itself and take off the air bubbles and the number of bubbles are decreasing on the surface. However, it is seen from the table that the physical-mechanical properties of adhesive composition modified with graphene oxide with epoxide oligomers are less than the properties of not modified epoxide adhesive composition, but bending during solidification is decreasing.

Table 1.

№	Mixture code / Components	1	2	3	4	5
1	Epoxide oligomer (ED-20)	100	100	100	100	100
2	Packing (PEPA)	10	10	10	10	10
3	Filler (graphene oxide)	-	3.0	6.0	9.0	12.0

4	Antoxidant	1.5	1.5	1.5	1.5	1.5
Sum		111.5	114.5	117.5	120.5	123.5

Table 2.

№	Composition code / **Indicators**	**1**	**2**	**3**	**4**	**5**
1	Strength limit in crash, Mpa	22.3	22.5	20.2	19.8	18.7
2	Relative extension, %	35	37	32	28	18.9
3	Bendind during solidification, %	1.6	1.4	1.0	0.8	0.6
4	Adhesive resistance with metals about breakdown, MPa	7.9	7.0	6.0	4.9	3.5
5	Adhesiveness resistance with metals about sliding, MPa	8.2	7.2	6.1	5.0	3.7
6	Firmness about TM-2, ş.v	90.3	89.8	92.5	95.7	95.2
7	Elasticity V_0	9.5	8.5	7.9	7.0	6.0

Nowadays, use of GO is too significant in plane and ship industry, agricultural industry as well as technical devices which are used in agriculture and water reservoir. Additionally, after studying epoxide modified with GOm, we have found new physical-mechanical properties: Strength limit in crash, relative extension, bendind during solidification, adhesive resistance with metals about breakdown, adhesiveness resistance with metals about sliding, firmness about TM-2, elasticity.

The most interesting thing that GO has antibacterial properties and because of low price it is easy to get. Addition to them, the procedure of obtaining GO takes just 1 day. Therefore it is too agreable to use GO for modification.

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