Application Of Oil And Fat Industrial Wastes For Modification Of The Fillers

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***Abstract* – After the execution of this work were derived polymer composite materials (PCM) based on polystyrene and PVC. In the course of this work were obtained with PCM modified and unmodified fillers: chalk, kaolin, aerosil, titanium dioxide, aluminum oxide.**

It kinetics modifications fat-containing waste mineral fillers of "Novovolyns`ky oil and fat factory", thermomechanical properties, tensile strength and toughness obtained of PCM. The synthesized composites can be used in various industries, such as engineering, aviation, production of packaging materials and more.

Keywords – polymer composites, polystyrene, polyvinyl chloride, modified mineral filler.

I. Introduction

Oil and fat industry of Ukraine produces a wide range of edible fats and oils for various purposes. In this case, fat contained wastes are formed that can not be used for food purposes. Because of this, the problem of finding new ways to use such wastes is relevant. At the same time, modern industry requires the appearance of new ones, including polymer, composite materials. The generally accepted approach for creating such materials is the use of modified mineral fillers. An interesting attempt is made to jointly address these two problems, that is, the study of the possibility of using the waste oils of the fat and oil industry to modify the surface of dispersion mineral fillers, which can be used with their subsequent use to create new polymer composite materials.

The aim of the work is finding the possibility of fat and oil production waste using for the modification of dispersed mineral fillers and studying the influence of such fillers on the physical and mechanical properties of polymer composite materials.

II. Experimental part

In the present work, fat-containing wastes of «Novovolynskyi oil and fat industrial complex» have been used for modification of mineral fillers: chalk, kaolin, titanium dioxide, aerosil, aluminum oxide

In a 150 ml glass, filler and fat in a ratio of 10:1 and distilled water in a ratio of 25:1 against filler were placed. The suspension was constantly stirred with a magnetic stirrer to a temperature of 50°C and held for a certain time (0.5; 1; 1.5; 2 hours). The resulting mixture was filtered using filter paper and dried at 80°C for 4-5 hours. The degree of modification of the filler was determined by gravimetric method, after burning the modified samples at a temperature of 500˚C to constant weight. Previously, unconfined samples determined the moisture content that was not evaporated at a temperature of 80°C.

Styrene, which was purified by distillation under vacuum, was used to make polymer by polymer filling. A mixture of styrene with a filler (in the ratio of styrene: filler = 1:2.5) was loaded into a glass vial, which, after cooling, was sealed. The composite was obtained by thermal polymerization of styrene at a temperature of 120°C for 3 days, after which the ampule was broken down and the composite was extracted. In order to determine the influence of the modification of fillers on the properties of composites, rods with modified and unmodified fillers were produced in parallel.

When performing thermomechanical tests, parts of the rods were used in the form of tablets 3-4 mm in length and 6 mm in diameter. The thermomechanical investigations were performed on a FVW R7/90 apparatus.

III. Main material

The modification process can be managed by changing the modification time. In this case, fillers with varying degrees of modification are obtained. At the same time, by increasing the speed of modification fillers can be placed in a row: aerosil – kaolin – titanium dioxide – aluminum oxide – chalk. Such a difference in the rates of modification probably can be explained by the influence of the surface of the filler.

Composites with the same degree of filling were filled with modified and unmodified fillers. Degree of modification of the filler is 5%. The thermomechanical curves of the resulting composites are shown in Fig. 1,2.

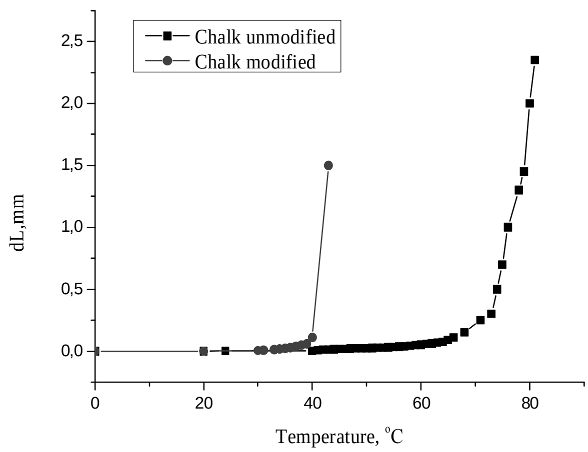


Fig. 1. Thermomechanical curves of polymer composite based on polystyrene filled with unmodified and modified chalk.

In order to compare the properties of samples of materials based on polyvinyl chloride with modified and non-modified fillers, thermomechanical studies were conducted.

Fig. 3. Thermomechanical curves of modified and unmodified by titanium dioxide PVC-based composites.

Figures 3, 4 shows comparative curves of modified and unmodified samples of aluminum oxide and titanium dioxide.

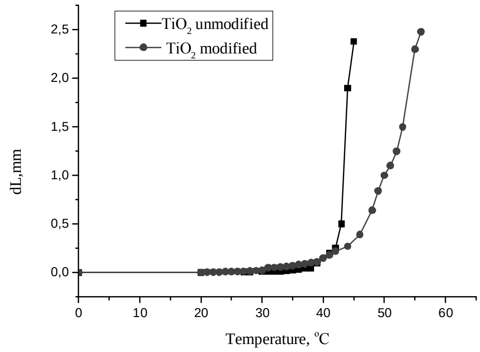
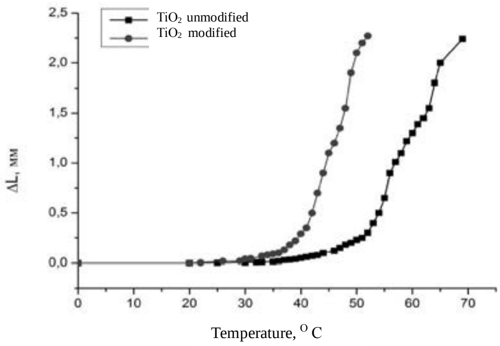


Fig. 2. Thermomechanical curves of polymer composite based on styrene filled with unmodified and modified titanium dioxide.



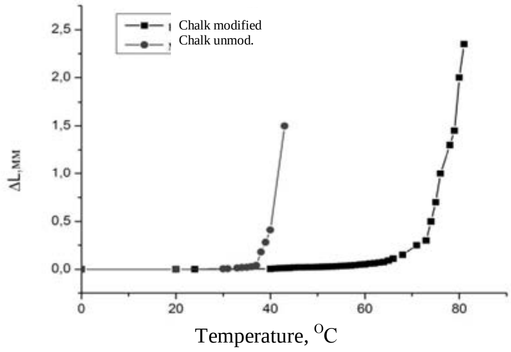


Fig. 4. Thermomechanical curves of modified and unmodified by chalk PVC-based composites.

PVC-based composites with modified and non-modified fillers were investigated on the Tira Test 2200 apparatus. Their breaking strength and relative elongation were determined. The results are shown in Table 1.

As can be seen from the data given in Table 1, the use of modified fillers leads to a significant improvement in the strength of composites. The breaking strength in the application of various fillers increases by 34 – 214%.

Determination of impact strength was carried out for polystyrene-based composites with the following mineral fillers: chalk, aerosil, aluminum oxide. The results of the studies are presented in Table 2.

TABLE 1

TENSILE STRENGTH OF POLYVINYL CHLORIDE COMPOSITE

Filler	Breaking strength, kH/m^2	Strength increase, %	Relative elongation, %
Chalk unmodified	267	-	25
Chalk modified	838	214	26
kaolin unmodified	447	-	10
kaolin modified	943	122	37
Titanium dioxide unmodified	706	-	29
Titanium dioxide modified	943	34	50
Aluminum oxide unmodified	396	-	16
Aluminum oxide modified	783	97	34
Aerosil unmodified	1141	-	23
Aerosil modified	2123	86	32

TABLE 2.

IMPACT STRENGTH OF POLYSTYRENE COMPOSITE

Filler	Impact strength, kJ/m^2	Increase, %
Chalk unmodified	0.0073	-
Chalk modified	0.0150	109
aerosil unmodified	0.0069	-
aerosil modified	0.0074	6.2
Al_2O_3 unmodified	0.0121	-
Al_2O_3 modified	0.0154	26

As can be seen from Table 2, the highest impact strength indicators was shown by samples of composites filled with modified chalk and modified aluminum oxide. Toughening is greatest in chalk, and the smallest in aerosil.

Conclusion

Thus, as a result of the performed research, the possibility of modification of dispersed mineral fillers was first explored: chalk, aerosil, kaolin, titanium dioxide and aluminum oxide with fat contained waste from the fatand oil industry, for the use of modified fillers for polymer composite materials. In the study of kinetics of modification it has been shown that complete sorption of fat on the filler at a temperature of 50°C occurs in 2-3 hours. The degree of updating of the filler can be adjusted by changing the time of the process. Thermochemical studies show the difference in the properties of polymer composite materials based on polystyrene and polyvinyl chloride filled with modified fillers compared to unmodified ones. For a number of polymer compositions, the thermomechanical curves are shifted toward higher temperatures, i. e., products made from such composites can be used at higher temperatures without losing their mechanical properties. It has been shown that the use of such modified fillers improves the physical and mechanical properties of composites, by increasing their impact strength, relative elongation and breaking strength