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## ELECTRICAL AND MECHANICAL PROPERTIES OF POLYURETHANE COMPOSITES BASED ON VEGETABLE OILS WITH CARBON NANOTUBES FOR TEXTILE

**Purpose.** Synthesis of polyurethane composites based vegetable oils with carbon nanotubes and investigate of their properties.

**Keywords:** hybrid polymer composites, carbon nanotubes, electrical properties, mechanical properties, textile..

**Objectives.** The creation of polymer composites with such functional characteristics, as electrical conductivity, is an actual problem. The polyurethane composites with carbon nanotubes (CNTs) has already shown the increased level of conductivity, improved (high) physical and mechanical properties, including tensile strength and flexibility, the thermal stability and other exploitative properties [1]. However, the standard components to polyurethane obtaining are relatively expensive and toxic. Therefore, it is expedient to change them by the cheaper, renewable, natural and safer reagents. The main task of this work is the synthesis and research of polyurethane composites based vegetable oils with carbon nanotubes, since they are becoming more and more widespread in global science, which is connected with the development of new technologies that require the creation of materials with high physical and mechanical properties.

**Methodology.** The conductivity of the composites was measured by dielectric relaxation spectroscopy.

**Research results.** We obtained the polyurethanes composites materials, based on oligourethanes vegetable oil (as amine modifier), which were synthesized by the non-isocyanate method. Also, the epoxy resin DER331 (23.2 % of epoxy groups) and 1,4-butanediol diglycidyl ether were used as the components of such polyurethanes. The multi-walled CNTs («Spetsmash» Ltd., Ukraine) were used as filler. Specific surface area of CNTs was 190 m<sup>2</sup>/g, external diameter was 20 nm, and length was 5–

10  $\mu\text{m}$ . The amount of the CNTs was from 0 to 5 % of weight. Figure 1 shows the dependences of conductivity at the direct current ( $\sigma_{\text{DC}}$ ) vs. carbon nanotubes concentration. The electrical conductivity for investigated composites has a percolation behavior. The conductivity increases with the enhancement of CNTs concentration. The leap of conductivity (percolation threshold) is observed at 1.5 % of CNTs. The total level of composites conductivity increases by almost three orders of magnitude. The conductivity reaches the value of  $7 \cdot 10^{-6}$  S/cm at the 5 % filler contents.

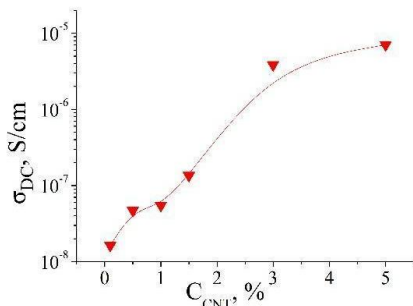


Fig. 1. Dependency of  $\sigma_{\text{DC}}$  vs. CNTs concentration

Additions of CNTs also influence on the segmental relaxation of the macromolecules, slightly increasing the tensile strength, and decreasing the elongation at a break of composites.

**Conclusion.** Thus, as a result of the conducted research, it is shown that the use of polyurethane composites based on vegetable oils allows to regulate the physical and mechanical properties of synthesized composites using carbon nanotubes. The developed hybrid composites have the prospect of application for impregnation of textiles or filling compositions with fibers for textile products with a wide range of functional characteristics.

## References

1. Y. Yakovlev, Z. Gagolkina, Eu. Lobko et all., *Composites Sciences and Technology*, 2017, 144, 208-214.