

RHEOLOGICAL PROPERTIES OF HIGHLY FILLED EPOXY COMPOSITES**Pomirko O., Kucherenko A., Pokhmurska A., Moravskiy V.***Lviv Polytechnic National University, Ukraine**volodymyr.s.moravskiy@lpnu.ua*

A systematic study was carried out to investigate the influence of the binder modifier nature and the type of inorganic and polymer fillers on the rheological properties of epoxy composites based on ED-20 resin. Epoxidized soybean oil (ESO) and a mixture of polyvinyl butyral with epoxidized soybean oil (PVB:ESO) were used as binder modifiers, while copper-coated polyvinyl chloride (PVC), aluminum oxide (Al_2O_3), and their mixtures in different ratios served as fillers. The aim of the study was to establish the regularities of rheological behavior of epoxy systems depending on the composition and structure of their components.

Rheological measurements were performed using a Rheomat-30 rotational viscometer in the shear rate range of 0.0231-224.3 s^{-1} . The results were presented as flow curves - shear stress vs. shear rate - which allow for more precise identification of the system's rheological behavior type. It was found that even the base ED-20 + PEPA compositions exhibit pseudoplastic properties. The introduction of fillers leads to changes in the shape of the flow curves: for medium concentrations (20-50 phr), shear stress increases with shear rate, whereas for high concentrations (100 phr), stabilization or a decrease in shear stress is observed after a certain critical shear rate. These effects are associated with the destruction of the internal structure and wall slip phenomena near the rotor surface.

A comparison of filler types showed that PVC leads to a more predictable increase in shear stress, while aluminum oxide at high loadings causes a decrease due to the lack of adhesive interaction with the organic matrix. The addition of binder modifiers affects the deformation behavior: ESO increases shear stress when PVC is used as a filler, whereas the PVB:ESO mixture improves shear transfer within the material when aluminum oxide is used. For composites with mixed fillers, atypical behavior was observed, in particular, stress stabilization or reduction regardless of concentration.

Microscopic analysis of the cured sample surfaces revealed a uniform distribution of the filler within the epoxy matrix, especially in modified systems, indicating improved wettability and component compatibility. The obtained results demonstrate the possibility of controlling the rheological behavior of epoxy composites by varying the binder nature, filler type, and loading level. This has important practical implications for optimizing the composition of composites used as structural, casting, and functional materials, including those with enhanced thermal conductivity or antimicrobial properties.