# SPECTRAL ANALYSIS OF THE STRUCTURING PROCESS OF EPOXY-OLIGESTER COMPOSITIONS

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The combination of epoxy resins with oligoesters is carried out for two reasons: to reduce the cost of materials based on epoxies and to improve their properties.

Polyesters are primarily used as plasticisers in epoxy compositions and are therefore not chemically bonded to the epoxy oligomer polymer grid.

However, such plasticization of epoxy compositions, despite the fact that it allows reducing the fragility of products, in general, does not improve their operational properties. This is because polyester is not chemically bonded to epoxy resin molecules. During the polymerisation process, the polyester 'sweats', which leads to a deterioration in the polymer material's properties.

In this regard, this work has studied the possibility of forming epoxy-oligoester compositions based on industrial epoxy resin ED-20 and oligoester acrylate TGM-3 in the presence of ED-20P resin modified with tert-butyl hydroperoxide. The ED-20P resin molecule contains labile peroxide groups that are capable of decomposing when heated to 373K with free radicals formation. IR spectroscopic studies were carried out to analyse the formation of spatially crosslinked structures from the following composition: ED-20 – 70 wt. parts; peroxide resin ED-20P – 30 wt. parts; oligoester TGM-3 – 16 wt. parts and PEPA – 14 wt. parts.

By means of spectral analysis it was determined that the structuring of polymer compositions containing industrial epoxy resin ED-20, modified epoxy resin ED-20P, oligoester acrylate TGM-3 and polyethylene polyamine (PEPA) occurs due to the interaction of ED-20 and ED-20P resin groups with PEPA. The presence in such epoxy-oligoester composition of modified epoxy containing peroxide groups, which can serve as a source of free radicals, will cause the creation of a spatially cross-linked oligomer.

In order to identify the functional groups presented in the composition, the spectra of epoxy resin ED-20, peroxide resin ED-20P, oligoester TGM-3, and also PEPA were recorded separately. Absorption bands at 915 $cm^{-1}$ were found in the ED-20 resin spectrum, which correspond to stretching vibrations of the epoxy ring. The presence of a hydroxyl group was proven by the absorption band at 3501 $cm^{-1}$ . Existence of the $CH_3$-C-$CH_3$ fragment in the molecule was confirmed by absorption bands at 1455, 1429 $cm^{-1}$ , as well as deformation vibrations at 1385, 1362 $cm^{-1}$ , which characterize $R(CH_3)_2C$-. In the modified with tert-butyl hydroperoxide ED-20P epoxy resin, an absorption band at 916 $cm^{-1}$ was found, which, unlike the same band in the ED-20 resin, is of much lower intensity. Namely, this fact confirms the presence of residual epoxy bands in the modified ED-20P resin. Along with this, an intense absorption band appears at 3434 $cm^{-1}$ , which characterizes the stretching vibrations of the hydroxyl group. The formation of hydroxyl groups occurred due to the opening of the epoxy ring and the fragment of tert-butyl hydroperoxide binding to it.

The results obtained indicate the participation in the reactions of formation of three-dimensional structures, epoxy groups of resin ED-20 and ED-20P, and oligoester TGM-3 as well. A decrease in the intensity of the absorption bands at 1719-1718 $cm^{-1}$ and 1385-1363 $cm^{-1}$ in the structuring of the composition at room temperature indicates that the formation of crosslinks under these conditions occurs not only due to the interaction of epoxy groups with PEPA, but also as a result of the polymerization of double bonds in the oligoester. At elevated temperatures (403K), in addition to three-dimensional polymerisation of the oligoester, reactions occur that result in the formation of ether bonds, which increases the gel fraction content of this composition.