CHARPY IMPACT RESISTANCE OF UV-CURED EPOXY-ACRYLATE INTERPENETRATING POLYMER NETWORKS WITH EPOXIDIZED SOYBEAN OIL

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Nowadays humanity faces the problems of environmental contamination, the depletion of fossil fuels and the accumulation of non-biodegradable plastic waste. Their solution requires a shift towards the formation of bio-based materials. However, it is often challenging to obtain such materials with proper operational characteristics. Therefore, partial substitution of synthetic constituents may be considered as an acceptable ecological alternative.

Modified vegetable oils are promising starting substances for numerous purposes, including the synthesis of polymers. Particularly, epoxidized triglycerides may serve as analogues of conventional epoxy resins with enhanced flexibility. The aim of this research is to form UV-cured epoxy-acrylate interpenetrating polymer networks (IPNs), in which synthetic diglycidyl ether of bisphenol-A (DGEBA) is partially substituted by epoxidized soybean oil (ESO), and to investigate the effect of ESO on the impact resistance of the samples. For this 100/0/0, 80/0/20, 90/10/20, 80/20/20 and 70/30/20 mixtures by weight of DGEBA/ESO/TEGDMA were prepared, where TEGDMA is triethylene glycol dimethacrylate. 3.0 wt% of triphenylsulfonium hexafluorophosphate salts as a photoinitiator were added. Formulations were for 60 min irradiated with a UV-lamp and then for 20 min subjected to treatment at 80 °C followed by post-polymerization at room temperature in the dark. Impact strength of the unnotched samples was investigated by Charpy method (Fig. 1).

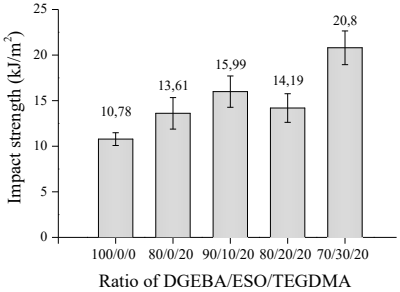

Fig. 1. Charpy impact strength of the samples

As it can be seen, the sample of neat DGEBA is the most brittle, while the impact strength of dual DGEBA/TEGDMA IPNs is 26 % higher. This may be due to micro-heterogeneous phase structure often intrinsic to IPNs and giving rise to effective absorption of energy. Still, for ternary systems Charpy resistance is the highest. ESO with long aliphatic chains acts as a plasticizer, decreases cross-linking density of a polymer network and provides easy chain segmental movement. Moreover, the introduction of soft segments into a rigid matrix leads to the strengthening of interphase interaction and the dissipation of internal stress. Interesting enough, impact resistance does not alter constantly with the augment in ESO amount: among triglyceride-containing samples it is the least for a 20 pbw (parts by weight) sample. It may be related to the smallest gel fraction in this case (investigated before) as a result of the formation of a defected network. Apart from that, the specimen with 30 pbw of ESO has the best impact strength, which is 93 % higher than that of neat aromatic epoxy.