ABSTRACT

Phenol-formaldehyde resins have, despite their long history, always played an important role in everyday life, as they are found in various branches of industry, where they are used as indispensable binding systems. The continuous improvement of specific properties in individual industries, the increasingly important concern for our envirnonment and fluctuations of prices and availability of raw materials lead to further research of materials with improved thermal and mechanical properties.

The purpose of the doctoral dissertation was to improve the synthesis path for the preparation of novel hybrid novolac resins. In one of the synthesis stages, we encountered the determination of free phenol content in the reaction mixture using a gas chromatography with flame ionization detector. We adapted the method, which is otherwise prescribed by the standard. Using colloidal dispersion, SiO_2 nanoparticles were incorporated into the novolac phenol-formaldehyde resin. By choosing the appropriate synthetic procedure, we managed to prepare a hybrid resin where nanoparticles did not have a tendency to aggregate. We also prepared a hybrid novolac resin with ZnAl double layered hydroxide, where the synthesis route was completely different due to the properties of double layered hydroxide itself. With the various instrumental techniques, we characterized novel hybrid novolac resins and compared their properties. The melt viscosity, flow distance and glass transition temperature of all hybrid resins changed compared to the base resin.

From the new hybrid novolac resins we prepared duroplastic granulated composite materials suitable for use in automotive industry. Crosslinker – hexamethylenetetramine, reinforcing agent – glass fibers, fillers, lubricant, pigments, additives and water were added to the hybrid resins. We measured the bulk density, the content of the volatile organic substances and some of the rheological properties. The crosslinking reaction time of duroplastic granulated composite materials did not change significantly compared to the resin without additives, only minimal viscosity of the material differed slightly.

In the last stage, a cylindrical test samples were prepared from granulated composite material, using a hot high-pressure pressing. A cylindrical test samples were additionally heat-treated according to a multi-stage temperature program. We measured the dimensional properties and density of heat-treated cylindrical samples before and after the heat treatment, as well as the tensile strength of the samples. The largest deviation in mechanical properties was shown in the case of cylindrical test sample, in which the granular composite material was made of hybrid resin with the addition of SiO_2 colloidal dispersion.

KEY WORDS: hybrid phenol-formaldehyde resin, granulated composite material, cylindrical test sample, gas chromatography with flame ionization detector