ABSTRACT

The doctoral thesis describes research on the production of environmentally friendly alkylphenol-furfural resins. Such resins belong to phenolic resins, known as phenoplasts, which have been known for over 100 years. These are materials which, after curing, have very good properties and are used in many areas of life, from the automotive, marine, furniture and foundry industries to the aerospace industry.

Classic phenolic resins are obtained from phenol and formaldehyde. Due to the toxicity of these compounds and increasingly restrictive regulations on their use, various ways are being sought to replace them with compounds that are less harmful to humans and the environment. In the research conducted as part of the doctoral thesis, phenol was completely replaced with o-cresol, and formaldehyde was partially replaced with furfural, an aldehyde obtained from biomass. This resulted in an o-cresol-furfural-formaldehyde resol resin with a volatile content of 2.2 % by weight of o-cresol, 0.2 % by weight of furfural and < 0.1 % by weight of formaldehyde. The resulting resin had favourable physicochemical properties and was environmentally and human-friendly. The unmodified resin was subjected to esterification with alcohols (n-butanol or 2-ethylhexanol) and esterification with fatty acids (oleic acid or linoleic acid) in order to modify its properties. The esterified and esterified resin samples were subjected to spectroscopic analyses: NMR, FTIR and ESI-MS. The obtained spectroscopic spectra confirmed the assumed structure of the resin and its modification in the etherification and esterification reaction. The modified resins had hydrophobic properties, unlike the unmodified resin, which was hydrophilic, and showed greater elasticity after curing. The obtained etherified and esterified resins were used to obtain thermally cross-linked polymer coatings and their physical and mechanical properties were tested. The obtained coatings had very good adhesion to the metal substrate. They showed very good elasticity and compressibility, while at the same time being hard and impact resistant. The o-cresol-furfural-formaldehyde resins obtained in this work, modified with alcohols or fatty acids, are suitable for use in the paint industry and can also be used as a substitute for phenol-formaldehyde resins in other applications. The high quality of the resins, low formaldehyde content and absence of phenol ensure safe processing and use.