UNIVERSITI TEKNOLOGI MARA

MODIFICATION OF UREA FORMALDEHYDE RESINS WITH SUGAR DERIVED FROM OIL PALM TRUNK PEELER CORE

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ABSTRACT

Oil palm trunk (OPT), a non-woody raw material with low cost and renewable, abundance had been established. Instead of polluting, conversion of the sugar in OPT, to make bio-based adhesive is an option. Lack of research articles on conversion of OPT material to bio-based adhesive, triggered the study to modify and evaluate urea-formaldehyde (UF) resins with free sugars from OPT peeler core that is biodegradable and environmentally friendly. The moisture content (MC) and density of OPT increases from bottom to top, owing to high proportion of parenchyma in the top part of OPT. Meanwhile, the density of OPT shows that the top part has higher density than those of bottom and middle part. The highest extractives content was obtained from sodium hydroxide followed by cold water, hot water and acetone extractions. The lowest extractives content was found at the bottom section of the OPT, whereas the middle and top portion contained a higher extractive content, regardless of the type of solvent used. The dominant free sugars in the oil palm sap glucose, xylose, mannose and arabinose. Therefore, these carbohydrates in the sap of OTP whole trunk are promising feedstock for bio-based resin production. In this study, different amounts of these free sugars were added to the synthesis of urea-formaldehyde (UF) resins with different formaldehyde/urea (F/U) molar ratios (1.0, 1.2, and 1.4). Fourier transform infra-red (FTIR) spectra of UF resins with 1.0 and 1.2 molar ratio shows that the amide group disappears after the addition of free sugars, and there are changes in intensity due to the sugar content added in the resin. The results of differential scanning calorimetry (DSC) showed that the onset and peak temperature (Tp) of all F/U molar ratio increased as the free sugar content increased, addition of free sugars into UF resins took longer time to cure due to a decrease in the resin reactivity. Thermogravimetric analysis (TGA) was also used to compare thermal stability of the modified UF resins with free sugars. TGA results showed that the 1.4 molar ratio UF resins modified with 10% free sugars were the most thermally stable when compared with other resins. MOE and MOR of plywood were acceptable. As a conclusion, the free sugars in the sap of OPT showed a great potential for the modification of UF resins and improved the adhesion in the future. However, the modified UF resins with the sugars could be acceptable for the interior application of wood composite such as particleboard, plywood or packaging paper.

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