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Substitution of Formaldehyde in Phenolic Resins with Innovative and Bio-Based Vanillin Derived Compounds

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Abstract : Phenolic resins are industrially used in a wide range of applications from commodity and construction materials to high-technology aerospace industry. They are mainly produced from the reaction between phenolic compounds and formaldehyde. Nevertheless, formaldehyde is a highly volatile and hazardous compound, classified as a Carcinogenic, Mutagenic and Reprotoxic chemical (CMR). Vanillin is a bio-based and non-toxic aromatic aldehyde compound obtained from the abundant lignin resources. Also, its aromaticity is very interesting for the synthesis of phenolic resins with high thermal stability. However, because of the relatively low reactivity of its aldehyde function toward phenolic compounds, it has never been used to synthesize phenolic resins. We developed innovative functionalization reactions and designed new bio-based aromatic aldehyde compounds from vanillin. Those innovative compounds present improved reactivity toward phenolic compounds compared to vanillin. Moreover, they have target structures to synthesize highly cross-linked phenolic resins with high aromatic densities. We have obtained phenolic resins from substituted vanillin, thus without the use of any aldehyde compound classified as CMR. The analytical tests of the cured resins confirmed that those bio-based resins exhibit high levels of performance with high thermal stability and high rigidity properties

Keywords : phenolic resins, formaldehyde-free, vanillin, bio-based, non-toxic
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