Technical lignins modified by hydroxymethylation for the production of decorative laminates: Synthesis, characterization and mathematical modelling

**M.E. Taverna**(1)(2)**, V.V. Nicolau**(1)(2)and **D.A. Estenoz**(2)

(1)UTN Regional San Francisco, Av. de la Universidad 501, (2400) San Francisco, Córdoba, Argentina.

(2)INTEC (UNL-CONICET), Güemes 3450, (3000) Santa Fe, Argentina.

Technical lignins are natural and renewable poly-phenolic polymers obtained mainly as a subproduct from the pulp industry. It presents a complex structure that depends on the wood type and the pulping process adopted to separate cellulose.

Nowadays, lignins are used as a partial replacement of phenol (P) -non renewable resource, expensive and toxic- in the formulation of phenolic resins (PF). However, lignins must be chemically-modified in order to increase their reactivity toward formaldehyde (F).

In the literature there is a lot of information about the use of PF resins modified with lignins (LPF) as adhesives for the production of particleboard. However, the use of LPF resols for paper impregnation to obtained laminates has been scarcely studied. A decorative laminate comprises a decorative surface and a substrate of papers.

In this work, technical lignins (sodium lignosulfonate and kraft lignin) were activated by hidroxymethylation and used to replace P in PF resins. The resins obtained were employed to produce decorative laminates.

The work involved: i) the modification of sodium lignosulfonate and kraft lignin from hardwood, by hydroxymethylation at different temperatures (40, 50 and 70 ºC) and pH (9 y12); ii) the characterization of the hydroxymethylation by spectroscopic and volumetric analysis; iii) the development of a mathematical modeling of hydroxymetilation of sodium lgnosulfonate and the estimation of kinetic constants of reactions; iv) the synthesisof industrial traditional and modified PF resins by replacement of 10, 20 and 30%w/w of P, v) the production of laminates and their characterization including dynamic mechanical analysis used to compare conditions of curing and the determination of tensile modulus, bending strenght, biaxial flexural impact strenght and Mode- I Interlaminar Fracture Toughness in both processing directions to evaluate the mechanical performance.

In this work, the optimal conditions of hydroxymethylation were 50 ºC and pH<10. Simulated results from mathematical model were in accordance with experimental measurements.

All resins (traditional and modified) had similar properties. The best conditions of curing used to obtained laminates were 70 kg/cm2 and 150ºC. The higher content of lignins in the PF resins decreased the crosslinking of laminates obtained.

Finally, modified laminates exhibited mechanical properties comparable with those of traditional laminates, indicating a negligible depreciation of them.

Industrial tests were carried out at Centro S.A, San Francisco, Córdoba.