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MWP – Young Researcher Abstract 2025

Project title: Non-Isocyanate Polyurethane Wood Adhesives: Eco-friendly Strategies for Sustainable Construction	
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Abstract (approx. 200 words): Despite the crucial role of adhesives in wood construction, conventional formaldehyde-based binders compromise environmental safety and are increasingly subject to government regulations. A competitive alternative, isocyanate-based polyurethane, is recognized for its excellent bonding performance; however, the toxicity of isocyanates during production and curing raises serious concerns regarding scalability. The current project, therefore, focuses on developing eco-friendly and innovative strategies that mimic the chemistry of isocyanate polyurethanes while enabling greater adoption of sustainable materials in the wood panel industry. Specifically, ongoing research investigates the synthesis of non-isocyanate polyurethane (NIPU) adhesives through two complementary approaches. In these strategies, tannin and lignin serve as the polymer backbones for NIPU formation. Hexamethylenediamine and dimethyl carbonate are incorporated to carbonate and aminate the primary molecular chain, thereby introducing urethane linkages through amide formation. Microfibrillated cellulose subsequently integrated as a reinforcing agent to enhance structural properties. The resulting NIPU adhesives are comprehensively characterized using advanced analytical techniques to evaluate their chemical structure and performance. The designed NIPU formulae have been employed to fabricate eco-friendly plywood and particleboard. Finally, the attributes of the engineered wood products are holistically assessed to establish their performance, providing insights into their potential as scalable, sustainable alternatives to formaldehyde and isocyanate-based adhesives.	
Key words: Biobased adhesives; Sustainable materials; Non-isocyanate polyurethane; Wood composites	