

MWP – Young Researcher Abstract 2025

Project title: Lignin's Function in Building Insulation: Addressing EU Regulatory and Environmental Challenges	
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Abstract (approx. 200 words): Recent advancements in sustainable building practices have drawn significant attention to bio-based thermal insulation materials as a viable alternative to conventional insulation foams, particularly in light of new EU regulations. The use of polyurethane foam panels as thermal insulation poses significant environmental concerns due to their harmful emissions. These environmental impacts have driven our research toward more sustainable material derived from forest products: cellulose and lignin. Scientists attempting to replace polyurethane foam with cellulose-based alternatives face practical challenges. While cellulose foams offer promising sustainability advantages, current production methods typically require energy-intensive freeze-drying processes, constraint the scalability. In this study, we have developed a novel foam preparation platform at room temperature utilizing water-dispersible lignin nanoparticles (LNPs) and cellulose through the Pickering approach. The innovative aspect of our research focuses on using volatile solvent as both the dispersed phase and the blowing agent in Pickering emulsions stabilized by LNPs, while cellulose role in strengthening the foam's structure. This unique interfacial engineering enables the formation of low thermal conductivity, lightweight, and high porosity of dry foam at room temperature without shrinking and additional energy input. In addition, this porous material has potential as sound sound-absorbing material. This cost-effective method offers potential for scaling up the production of versatile eco-friendly lignocellulosic foams.	
Key words: Cellulose, Lignin nanoparticle, Scalable thermal insulation foam	