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PHYSICO-CHEMICAL CHARACTERIZATION OF THREE MAJOR TECHNICAL LIGNIN RESIDUES FROM SOUTH AFRICAN BIOREFINERIES FOR THEIR POTENTIAL VALORIZATION

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Lignin, the second most abundant natural polymer on Earth (following cellulose), has emerged as a potential alternative material to petroleum-based chemicals and renewable resources for the production of various aromatics, biofuels and bio-based material. Thus, it is becoming increasingly important to understand the compositional and structural properties of lignin to provide key features and insights for its valorization. In this study, the physico-chemical characterization of three types of industrial (technical) lignins, namely kraft lignin, soda lignin and lignosulfonates was performed. Natural lignin sample purchased from Sigma-Aldrich was used for reference. Characterization has been conducted using gel permeation chromatography (GPC), X-Ray Fluorescence (XRF) spectrometry, Fourier transform infrared spectroscopy (FT-IR), 13C-1H correlation two-dimensional (2D) heteronuclear single-quantum coherence (HSQC) nuclear magnetic resonance (NMR), and thermogravimetric analysis-thermal desorption-gas chromatography–mass spectroscopy (TGA-TD-GC–MS). The results showed that the pre-treatment severity of the cooking process considerably influenced the lignin composition and structural properties. Notably, the variability in physico-chemical properties of technical lignins often lead to different behaviors or reactivities in bioconversion processes such as enzymatic treatment. Thus, the measured physico-chemical properties in this study assisted in proposing potential valorization strategies in the context of biorefinery, focusing mainly on their depolymerization and their subsequent upgrading into value-added chemicals and fuels.

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