Lignin-based green wet-additives as PFAS replacements in amphiphobic paper and molded fiber products

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Abstract

Novel bio-based sustainable alternatives to per- and polyfluoroalkyl substances (PFAS) are urgently needed due to the harmful effects of fluorinated "forever chemicals" on water reservoirs and human health. Lignin, the second most abundant aromatic biopolymer, offers a promising alternative to synthetic water and oil repellents such as PFAS. The natural hydrophobic function of lignin can be harnessed to create eco-friendly and sustainable products, and offering a viable solution to replace harmful synthetic chemicals. For this purpose, we investigated lignin as a wet-additive by mixing with pulp fiber followed by the preparation of hand sheets. Furthermore, the same procedure was repeated using methyltrimethoxysilane (MTMS) modified lignin as a wet-additive to investigate the effect of substituted silane-agent instead of hydroxyl groups on the oleophobic properties of prepared hand sheets. Attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR), confirmed the presence of the lignin. Water and oil contact angle analyses were performed to evaluate the hydrophobic and oleophobic properties for designing amphiphobic paper and molded fiber products. The results showed that the prepared samples exhibited water resistance compared to the control samples. This indicates the potential application of the formulation in food packaging, proving its effectiveness as a sustainable alternative. Overall, lignin, a low-value, under-utilized byproduct of the paper industry, represents a missed opportunity for cost savings and sustainable innovations. Utilizing lignin as a wet-additive in food packaging products and sustainable alternative to polyfluoroalkyl additives, could significantly decrease environmental concerns associated with traditional packaging materials, leading to a more sustainable and eco-friendly industry.