



Effects of Methanol and H₂O₂ Addition on Lignin Depolymerization at Varying Temperature and pH



Interdisciplinary
Renewable &
Environmental
Chemistry REU

A. LaVallie, M.S., I. Brzonova, M.S., Y. Ji, Ph.D
University of North Dakota

Objective: Subject Kraft lignin to varying combinations of temperature, pH, H₂O₂ and methanol to determine optimal breakdown conditions by monitoring:

- Specific breakdown products by GC-MS, LC
- Total carbon signatures by TCA (total carbon analyzer) with comparison to actual products
- Lignin solubility/degradation extent by determining mass of solids left after addition of H₂O₂/MeOH and heating to 120° C.

Research Project: Kraft lignin was exposed to combinations of temperature, pH, H₂O₂ and methanol in order to find optimal conditions for lignin depolymerization into the liquid fraction. Samples and their replicates (18 total) for each pH level (2, 7 and 11) were varied in terms of MeOH (0, 10 or 25%) and H₂O₂ (0, 3 or 10%). Analysis will include:

1. Mass loss (to liquid fraction) to determine depolymerization extent of each set of conditions.
2. Total carbon analysis (TCA to determine the particulate sizes and percentages extant in the liquid and solid fractions. High monomeric percentages (low temperature fraction) are preferred; this indicates greater breakdown.
3. Determination of type and extent of breakdown products via GC-MS and HPLC. Aware of products already present in Kraft lignin, further products of breakdown will be noted and quantified as part of the assessment of optimal treatments for lignin breakdown.



Audrey LaVallie,
visiting TMCC
faculty



Figure (right): Relative mass volatilized at various temperatures during TCA analysis of liquid fraction of pH 7 samples. Note increased small-molecular fraction and concomitant reduction of char level with increased H₂O₂.

