Variability in Black Liquor Composition

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The composition of black liquor has inherent variability, whether it is changes in the wood (species, age, region harvested), fluctuations in the white liquor (reduction efficiency and caustizing efficiency) or changes in pulping (grade, white liquor dosage, H-factor). These fluctuations in composition affect the heating value, viscosity and boiling point rise of the black liquor to the recovery boiler. This presentation looks at the ability of modeling tools (dynamic mass balances, classic time series models, and state-of-the-art time series neural networks) to provide predictive information for black liquor composition and properties and it provides examples of all three, drawing mostly from work done at the University of Toronto.

Dynamic mass balances are the easiest to understand and can provide useful information about lag in the system, such as the transition from one wood species to another, Figure 1. Heating value is calculable from black liquor composition, but empirical models for both viscosity and boiling point rise would need to be developed to relate black liquor composition to these properties. Additionally, despite the potential of dynamic modeling, significant work is still needed for implementation and verification at a mill to realize the potential. Alternatively, classic time series models, and state-of-the-art time series neural networks can be used to forecast changes in black liquor properties. Interestingly, the classic time series models slightly out-perform the neural networks in data analysis. What is less clear is how far out would this information need to be forecast and what degree of accuracy would be required for this to be a useful input to recovery boiler control.

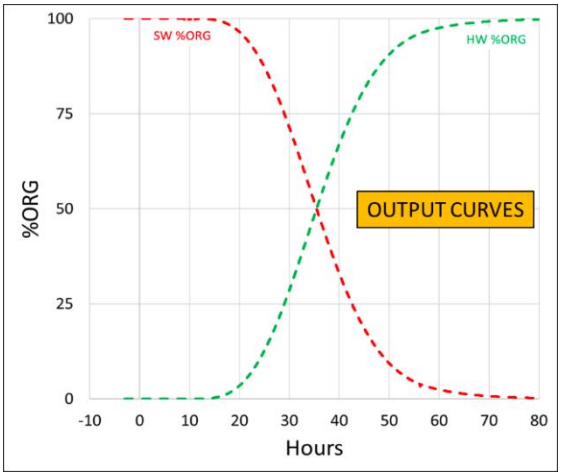

Figure 1. As-fired %Org during SW →HW grade transition [1]

Reference

1. Rogerson, A.M. Dynamic modelling of process chemistry in kraft pulp mills. MASc Thesis, University of Toronto, Toronto, ON, Canada, 2022.