INVESTIGATION OF MELTS CONTAINING Na₂CO₃, Na₂SO₃, Na₂S/Na₂Sₓ, and Na₂O/Na₂O₂ FOR THE ELECTROLYTIC RECYCLE OF PULPING CHEMICALS

Ryan Wartena
Jack Winnick
School of Chemical Engineering
Georgia Institute of Technology
Atlanta, GA
Peter Pfrohnm
Institute of Paper Science and Technology
Atlanta, GA

The purpose of this work is to verify the electrochemical reactions that could occur in a molten kraft melt. This will aid in developing an alternative process to the traditional equilibrium-limited wet chemical method [1] for recovery of pulping chemicals. This work is an extension to include sodium sulfides and oxides into the mix with sodium carbonate and sulfate (2).

Cyclic voltammetry (CV) and electrolysis conditions have been applied to molten salt mixtures between the initial and anticipated final compositions for electrolytic recycling of pulping chemicals. Thermodynamic potentials have been fitted to the cyclic voltammograms. Gas detection and post-electrolysis chemical analysis support the conclusions drawn from the CVs.

A mixture composed to simulate the initial conditions (sodium carbonate, sodium sulfide/polysulfide and sodium sulfate) exhibited carbonate ion oxidation and sulfate ion reduction at the limits of the potential window by CV. Gas analysis during electrolysis confirms the carbonate ion oxidation (Figure 2). At potentials inside the positive limit, oxidation of sulfate to sulfur occurs with subsequent chemical reaction to polysulfide. Mixtures with added sodium oxide and peroxide, prepared to simulate a near-final composition, had similar spans of the potential window and had an additional oxidation peak attributed to oxide and peroxide oxidation (Figure 1). All major peaks were found to be scan-rate dependent except for one attributed to an intermediate of sulfate reduction, presumably chemically reacting with another species in the melt.

We conclude the electrolytic recycle process is feasible since carbonate oxidation cleans the melt of carbon and sulfate reduction produces the desired sulfide and oxide ions. This investigation also demonstrates that separation is necessary between the anolyte and the catholyte so the reduction products are not consumed by oxidation (Figure 3).

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REFERENCES