

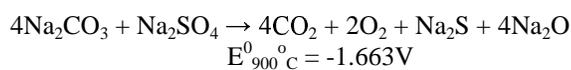
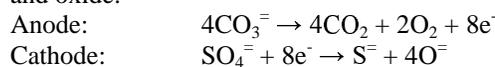
**Recycling Paper Pulping Chemicals with Molten Salt  
Electrolysis: Cyclic Voltammetric Investigation of  
Reactant Mixtures Containing Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub> and  
Na<sub>2</sub>S**

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This work initiates a systematic investigation of a new electrochemical pathway for efficient recausticization of paper pulping chemicals. Molten alkali salts of carbonate, sulfate and sulfide are produced in the recovery boiler at temperatures depending, upon composition, ranging from 750-900°C. The traditional recycle process requires quenching the salts by dissolving in water and performing a chemical equilibrium-limited ion transfer with calcium hydroxide (calcium oxide). In an attempt to alleviate this bottleneck of the pulping mill, we have developed an energy-efficient process thru the salient advantages of molten salt electrochemistry which eliminates the addition of inorganic chemicals to the process loop. We shall discuss the information obtained and theory deduced for the electrochemical reductions and oxidations in synthetic Kraft melts as it pertains to the environmental goal of closed-loop pulping, process simplification and energy-efficiency.

An electrolytic recycle process for paper pulping chemicals requires their decarbonization and production of sodium oxide as a precursor to sodium hydroxide while maintaining a balance of sulfur in the melt. Cyclic voltammetry has been used to investigate the electrochemical reactions occurring in single, binary and ternary reactant Kraft melts on different electrode materials. Voltammograms of sodium carbonate in an argon atmosphere have been performed for the full electrochemical window at 860°C on gold and nickel electrodes. A melt of sodium carbonate and sodium sulfate at 840°C was scanned on gold electrodes where the anode followed carbonate discharge while the cathode reaction is proposed to follow sulfate reduction to sulfide and oxide.



In mixtures containing sodium carbonate and sodium sulfide a dual oxidation is proposed of sulfide oxidizing to sulfate while carbonate discharges to carbon dioxide and oxygen. Voltammograms of the ternary system of sodium carbonate, sulfide and sulfate will also be discussed and related to the feasibility of recausticizing real Kraft melts with molten salt electrolysis on commercially viable electrode materials.