

## EXPERIMENTAL DE\* BLEACHING STUDIES

**D<sub>0</sub> Stage Reactions:** The brownstock pulp was delignified in a D<sub>0</sub> stage using a 0.20 k.f. (2.3 wt%) of ClO<sub>2</sub>. The procedure started by measuring the solids content of the brownstock pulp and using this information to weigh out 200 g of oven-dry (o.d.) pulp. Next, the ClO<sub>2</sub> solution was titrated to determine the volume needed to apply a 2.3% charge. Water was then added to the pulp while mixing it in a Hobart mixer to achieve a final consistency of 10% after addition of the ClO<sub>2</sub> solution. The pulp in the mixer was acidified with 4N H<sub>2</sub>SO<sub>4</sub> (approximately 2 mL) to around a pH of 2.7. The pulp was transferred to the Quantum mixer and slurry was preheated to 45°C. The ClO<sub>2</sub> was then added and the slurry was immediately stirred for 15 to 20 s. The pulp was reacted for 45 min at 45°C with adequate mixing (5 s every 2 min). After the reaction, the pulp was removed from the reactor and filtered to approximately 25% solids. The effluent collected was used to measure the terminal pH (target of 2.0) and a portion of it was saved for testing. Lastly, the pulp was washed with water.



Quantum Mixer

**E<sub>1</sub>\* Stage Reactions:** The washed D<sub>0</sub> pulps were treated immediately with an alkaline extraction stage in a continuously stirred pressure reactor (the peg-mixer). The peg-mixer reactor is a stainless steel vessel able to operate at pressures up to 90 psig with an optimum capacity of 2 – 4 L of pulp slurry. Volumes outside the optimal range results in poor mixing. Various oxidative conditions were used for the alkaline extraction stage (shown in Table 1). For convenience, the alkaline extraction stages described in Table 1 will be referred to collectively as E<sub>1</sub>\*.

The alkaline extraction stage procedure started by measuring the washed D<sub>0</sub> pulp solids content and wet weight, to determine its o.d. weight (Normally, within 5 g of the original 200 g). When hydrogen peroxide was applied, the approximately 30% H<sub>2</sub>O<sub>2</sub> solution was titrated to determine the volume needed to apply a 0.5% charge. The water needed to achieve a final consistency of 10% after addition of the NaOH solution was measured and added except for ~ 100 mL. Next, the pulp was preheated in the sealed reactor to 75°C, while the reactor was mixing. The NaOH and H<sub>2</sub>O<sub>2</sub> (if applied) were measured and placed in the remaining dilution water. The water was added through a port in the top of the reactor using a hose and funnel. Sodium hydroxide was applied at 2.0% for the E stage and at 2.5% for the (EO), (EP), and (EPO) stages. Oxygen pressure was immediately applied in the extraction stages that required it. During the initial application of the oxygen pressure, the reactor was vented to allow air to be evacuated. After venting for 10 s, the oxygen was applied at a pressure of 60 psig. This pressure was decreased approximately 12 psig every 5 min until it reached 0 psig. All E<sub>1</sub>\* stages were

reacted for 75 min at 70°C with continuous mixing. After the reaction, the pulp was removed from the reactor and filtered to approximately 25% solids. The effluent collected was used to measure the terminal pH (target of >10.5) and a portion of it was saved for testing. The final step was to wash the pulp with water.

**Table 1. Alkaline Extraction Conditions**

Bleaching Stage	Bleaching Conditions Employed <sup>a</sup>
E	2.0% NaOH, performed under atmospheric pressure.
EO	2.5% NaOH, 60 psig initially, decreasing 12 psig/5 minutes, final 50 minutes were performed at atmospheric pressure.
EP	2.5% NaOH and 0.5% hydrogen peroxide.
EPO	2.5% NaOH, 0.5% hydrogen peroxide, 60 psig initially, decreasing 12 psig/5 minutes, final 50 minutes were performed at atmospheric pressure.

<sup>a</sup>The charge of NaOH employed was selected so as to ensure that the terminal pH was > 10.5. The charge was based on the o.d. weight of the D<sub>0</sub> pulp.