

ABSTRACT

**The Effects of Bayer Liquor Impurities on the
Precipitation of Alumina Trihydrate****Deidre Murien Tucker**

$\text{Na}_2\text{C}_2\text{O}_4$, Na_2CO_3 , Na_2SO_4 , NaCl and CaO together account for approximately 60% of the impurity constituent of the average steady state industrial Bayer Liquor. This study established qualitatively and quantitatively the effects these impurities have on gibbsite productivity, particle size distribution and crystallization processes.

The effect of Na_2CO_3 was found to be the most dominant. At steady state concentration levels precipitation efficiency was reduced by approximately 7.0%. This means that for the average Bayer process operation, productivity losses are in excess of 25,000 metric tons of gibbsite per annum. An equally significant reduction occurs in the quantity of fine gibbsite particles (seed) produced.

Fundamental to the effects on productivity and granulometry are the structural changes which take place in carbonated sodium aluminate solutions. Carbonate increases the level of disorder in these systems. This was attributed to the possible break down of existing aluminate polymers.

Under Bayer process conditions carbonate chemisorbs as well as physisorbs onto gibbsite surfaces. A reduction in the number of active sites available is therefore indicated. The impurity shows chemisorption preferences for the 001 crystal faces.

Kinetic Studies show that carbonate impacts on the mechanisms associated with growth and nucleation. A productivity model was developed which is applicable to a range of temperatures (supersaturation) and carbonate concentrations.

As a single impurity CaO reduces productivity by approximately 5.0% at the steady state level, and the effect increases with increasing concentration. There is an accompanying reduction in the quantity of fines produced. These effects however, are significantly curtailed in the presence of $\text{C}_2\text{O}_4^{2-}$, CO_3^{2-} , Cl^- and SO_4^{2-} ions.

Operations can tolerate levels of Na_2SO_4 and NaCl as high as 30 grams per dm^3 and 20 grams per dm^3 respectively. The impact on productivity and granulometry at the higher concentration levels are related to changes in the structure of the sodium aluminate solution and surface adsorption by gibbsite.

Sodium oxalate showed no effect on those aspects of Bayer process precipitation that were investigated.