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Increasing precipitation rate from sodium aluminate solution by adding active seed and ammonia

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Abstract: Remarkably increasing precipitation rate of sodium aluminate solution was studied by adding active seed and ammonia. The fine active gibbsite seed with irregular edge, large specific area and high oil adsorption capacity was prepared by sodium bicarbonate solution and sodium aluminate. The seeded precipitation rate reached up to 65% by adding less than 20g·L^{-1} active seeds into the sodium aluminate solution. Moreover, 75% precipitation rate was obtained due to the coupling contribution from the active seed and ammonia. Ammonia added in the initial precipitation stage improved precipitation rate, whereas minimal change in precipitation rate occurred by adding ammonia in latter period of precipitation. High precipitation rate also led to precipitation of fine gibbsite. In addition, increasing ammonia amount benefitted the formation of $Al(OH)_4^-$ and slightly reduced the amount of $Al_2O(OH)_6^{2-}$. Electrical conductivity in solution was decreased by adding ammonia. This is quite probably attributed to the increase in ionic pairs of $Na^+Al(OH)_4^-$ and subsequently precipitation of gibbsite from $Al(OH)_4^-$.

Keywords: active seed, ammonia, sodium aluminate solution, precipitation rate, ionic pair

1. Introduction

Low precipitation rate (45%-52%), numerous seeds (200g·L^{-1}-700g·L^{-1}) and long precipitation time (35h-50h) significantly decrease precipitation efficiency in the Bayer process. Breakthrough in increasing precipitation rate has been expected in alumina production in the latest decades. Various methods to enhance precipitation rate have been developed and can be classified into the following four categories. (1) Adding considerable additives. Nearly 100% precipitation rate was achieved by adding considerable sodium bicarbonate solution into the sodium aluminate solution for reacting OH^- with HCO_3^- (Li et al.,2009; Li et al.,2011). Remarkable increase in precipitation rate has been also reported by reducing concentration of caustic soda (expressed as Na_2O) via the

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