

## The Altech Process to Produce High Purity Alumina from Kaolin Clay

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### Abstract



Altech Chemicals Limited has commercialized the production of 99.99% (4N) high purity alumina (HPA) from kaolin using the hydrochloric acid process. The Altech process involves the removal of oversize silica / quartz followed by the calcination of kaolin at around 700 °C to convert the crystal structure of the clay to a more reactive form (meta kaolin) for leaching. Hydrochloric acid (HCl) is used in the leaching process. The leach reaction is exothermic and the oxide components (except silica) are converted to soluble chlorides, producing a high concentration of aluminum chloride (AlCl<sub>3</sub>) in solution. The pregnant liquor solution (PLS), from leach residue filtration is directed to crystallization where aluminum chloride hexahydrate (AlCl<sub>3</sub>·6H<sub>2</sub>O or ACH) is crystallized out of solution. This is achieved by increasing the hydrochloric acid concentration of the liquor by bubbling in anhydrous HCl gas. ACH crystals are then centrifuged and washed from the solution. ACH is purified by two stages of the re-dissolution / crystallization process. The purified ACH crystals are heat treated in two stages via natural gas fired rotary kilns. The first stage involves heating the ACH to around 700 °C in order to decompose the ACH to alumina. The second stage involves heating to around 1280 °C to produce alpha alumina (α- Al<sub>2</sub>O<sub>3</sub>). Altech has developed the technology to produce HPA pellets for the sapphire industry as well as fine (< 1 micron) HPA powder for use in the lithium-ion battery industry. Production costs are anticipated to be considerably lower than established HPA producers - in the bottom quartile of the production cost curve.

**Keywords:** Non-bauxite ores, High Purity Alumina, Chloride hydrometallurgy.

### 1. Introduction

Altech Chemicals Limited, an Australian company is aiming to become one of the world's leading suppliers of 99.99% (4N) high purity alumina (HPA) through the construction and operation of a 4,500 tpa high purity alumina processing plant at Johor, Malaysia. Feedstock for the plant will be sourced from the Company's 100%-owned kaolin deposit at Meckering, Western Australia and shipped to Malaysia. Altech's production process will employ conventional "off-the-shelf" plant and equipment to extract HPA using a hydrochloric (HCl) acid-based process.

### 2. Uses of HPA

HPA is a critical ingredient required for the production of synthetic sapphire and is increasingly consumed in the manufacture of lithium-ion batteries. Synthetic sapphire is used in the manufacture of substrates for LED lights, semiconductor wafers for the electronics industry, and scratch-resistant sapphire glass used for wristwatch faces, optical windows and smartphone components. There is no substitute for HPA in the manufacture of synthetic sapphire. Lithium-ion battery manufactures require HPA as a coating for the plastic anode/cathode separator to reduce separator shrinkage and combustibility.

## 2.1. HPA Demand Growth Forecast

According to independent group CRU, the forecast for 4N+(99.99%) HPA, the market segment that Altech’s plant is designed to supply, is to grow at 30% per annum from 19,000 tonnes (2018) to 272,000 tonnes (2028), as illustrated in Figure 1 below. CRU estimated that HPA in powder form used in lithium ion battery separators will reach 187 kt by 2028. In addition, HPA as a pellet / bead form used in LEDs will reach 85 kt by 2028.

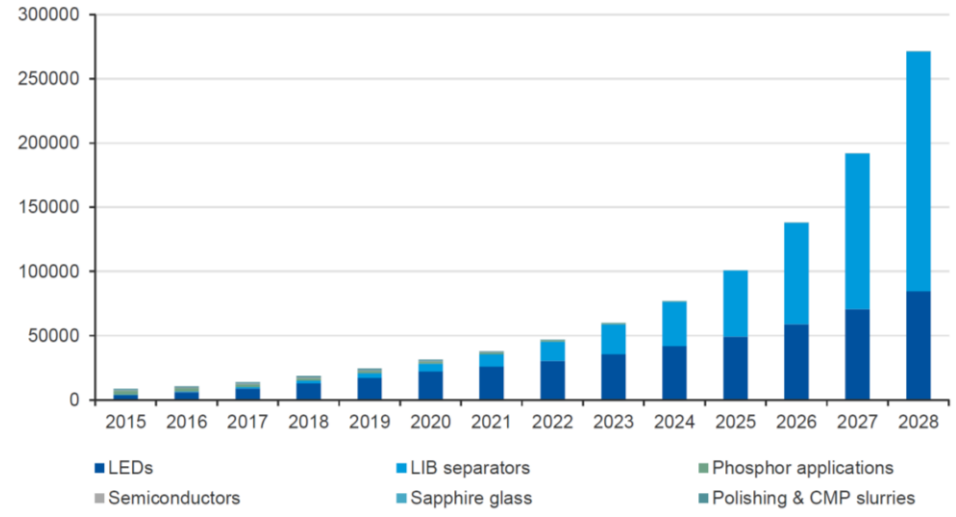


Figure 1. Total 4N+ HPA demand, 2015-2028.

Overlaying the demand profile, the report concluded an impending significant market deficit, where supply – no matter how optimistic – could not keep pace with the level of 4N+ HPA demand. The result of the analysis is an extremely large apparent 4N+ HPA short term deficit, peaking around 2021 at a deficit of around 20,000 tpa (blue bars in Figure 2). The long term supply deficit continues until 2028 and further peaks at a ~ 50,000 tpa deficit (green bars in Figure 2).

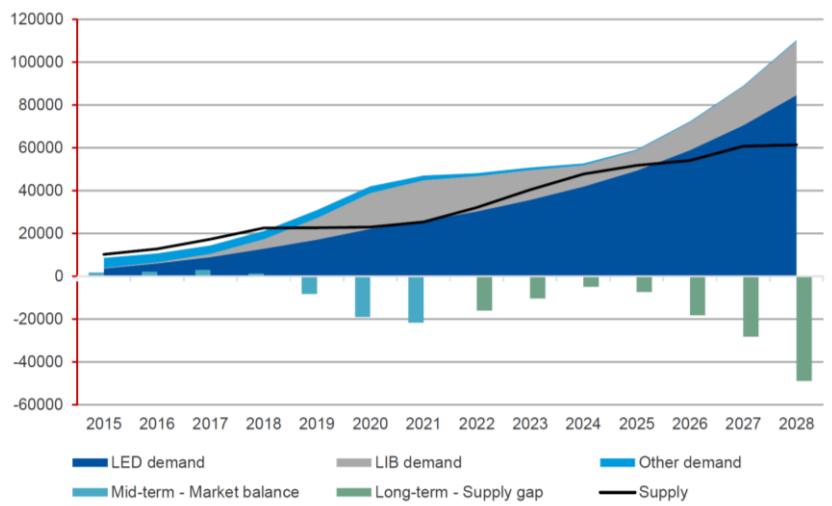


Figure 2. CRU base market balance and supply gap, 2015-2028.

The price of 4N HPA depending on quality and end applications ranges from US\$15 / kg to US\$56 / kg, but with some outlying prices significantly higher – albeit for lower volumes.