



Altech Chemicals
Limited

ASX ANNOUNCEMENT AND MEDIA RELEASE

26 November 2019

HIGH PURITY ALUMINA USE IN SEMI-CONDUCTOR APPLICATIONS

Highlights

- HPA adopted as a filler in epoxy molding compounds for semi-conductors
- HPA as a filler improves semi-conductor heat dissipation
- Market size 700 – 900 tonnes per annum
- HPA price of ~US\$100/kg
- Altech to develop a HPA product specification for the EMC market

Altech Chemicals Limited (Altech/the Company) (ASX: ATC) (FRA: A3Y) is pleased to provide information regarding the use of high purity alumina (HPA) in the manufacture of epoxy moulding compounds (EMC's) that are used in the semi-conductor industry to improve heat dissipation. Altech recently commenced an investigation of the EMC for semi-conductor market for the purpose of targeting some of its future HPA product into this market segment.

Introduction of alumina into EMC's used in semi-conductors

Typically industrial-strength epoxy compounds are used for the package assembly of semi-conductors, as the epoxy compounds provide the required physical protection, mechanical strength, as well as a number of desired performance properties – primarily in relation to heat and moisture, both of which can destroy a semi-conductor, warp an electronic device (that the semi-conductor is used in), or even cause a device to catch fire.

Electronic devices continue to become more compact – Moore's Law – the exponential growth in the number of transistors that can be packed into a single semi-conductor. However, thermal or heat dissipation is a real problem as semi-conductors continue to reduce in size and contain more transistors. It is suggested that heat could represent the ultimate barrier to the ever smaller and more powerful semi-conductors that end-users have become accustomed to.

The epoxy resins that have traditionally been used for semi-conductor package assembly are reaching their limits in terms of effective heat dissipation. However, adding thermally conductive materials into the resins has been demonstrated to improve heat dissipation and thereby improve the protection of semi-conductors against heat related failure. The thermally conductive fillers that are being used include HPA, crystalline silica, and magnesium oxide. HPA however is a preferred filler, due to its heat conductivity (7 times higher than silica) and a much lower thermal expansion coefficient (50% lower).

Figure 1 below illustrates a typical semi-conductor chip encased in an epoxy resin compound with HPA used as a thermal filler. The heat produced from a semi-conductor chip and the die pad more efficiently dissipates via the alumina rich epoxy resin and lowers thermal stress related problems for the semi-conductor and the assembly package (integrated circuit board).

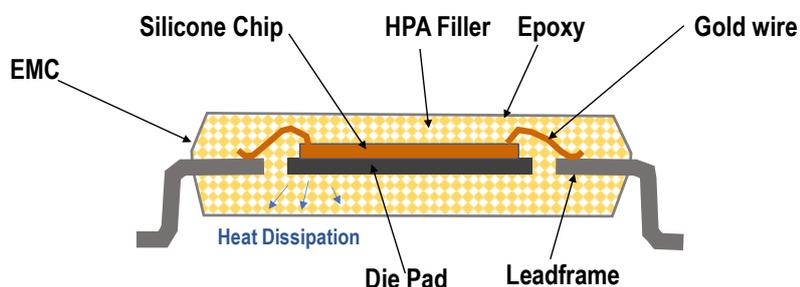


Figure 1: Schematic diagram of a SOP (Small Outline Package)

Figure 2 below is a scanning electron microscope (SEM) image of HPA used as a filler material in an epoxy resin moulding compound. The image demonstrates the efficiency of the conductive filler within the epoxy resin package.

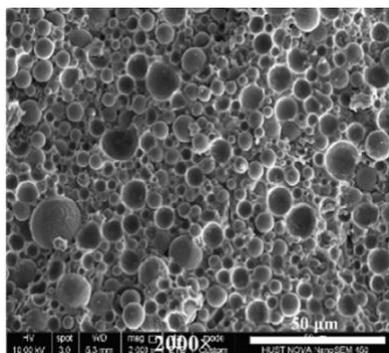


Figure 2 SEM Image of Alumina Filled EMC (50% v/v)

The purity of the material selected as the conductive filler in an epoxy resin for use in the semi-conductor industry is extremely important, consequently there are very stringent (and low) limits on the impurities permitted in the chosen filler. Of the impurities, sodium is probably the most detrimental element. Radioactive material is another detrimental impurity, as gamma rays from an impurity such as thorium increases the likelihood of semi-conductor and/or CPU malfunction. Thorium is present in bauxite, the traditional feedstock used for the production of aluminium. A small amount of thorium residue will remain in any HPA produced via the conventional bauxite – alumina – aluminium production process (Bayer process). Thorium is not present in HPA that is produced from Altech's kaolin HCL processing route.

Special morphologies (crystal form, shape and structure) are also demanded of the EMC filler, in the case of HPA the industry requires a morphology that is conducive to low viscosity, an attribute that is favourable in the epoxy resin packaging process.

Altech's preliminary investigation into the demand for high quality HPA from the EMC semi-conductor market indicates a global market size in the range of 700 – 900tpa, with a price of US\$100/kg being commanded by product that meets required specifications. Year-on-year growth in the market is typically in line with growth experienced in the semi-conductor business. Altech believes that its low sodium HPA, and the morphology of its HPA, may be ideal for the EMC semi-conductor application, and the Company intends to commence the development of a product specification that may suit this market sector's requirements.

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About Altech Chemicals (ASX:ATC) (FRA:A3Y)

Altech Chemicals Limited (Altech/the Company) is aiming to become one of the world's leading suppliers of 99.99% (4N) high purity alumina (Al₂O₃) through the construction and operation of a 4,500tpa high purity alumina (HPA) 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.

HPA is a high-value, high margin and highly demanded product as it is the critical ingredient required for the production of synthetic sapphire. Synthetic sapphire is used in the manufacture of substrates for LED lights, semi-conductor wafers used in the electronics industry, and scratch-resistant sapphire glass used for wristwatch faces, optical windows and smartphone components. Increasingly HPA is used by lithium-ion battery manufacturers as the coating on the battery's separator, which improves performance, longevity and safety of the battery. With global HPA demand approximately 19,000t (2018), it is estimated that this demand will grow at a compound annual growth rate (CAGR) of 30% (2018-2028); by 2028 HPA market demand is forecast to be approximately 272,000t, driven by the increasing adoption of LEDs worldwide as well as the demand for HPA by lithium-ion battery manufacturers to serve the surging electric vehicle market.



German engineering firm SMS group GmbH (SMS) is the appointed EPC contractor for construction of Altech's Malaysian HPA plant. SMS has provided a USD280 million fixed price turnkey contract and has proposed clear and concise guarantees to Altech for plant throughput and completion. Altech has executed an off-take sales arrangement with Mitsubishi Corporation's Australian subsidiary, Mitsubishi Australia Ltd (Mitsubishi) covering the first 10-years of HPA production from the plant.

Conservative (bank case) cash flow modelling of the project shows a pre-tax net present value of USD505.6million at a discount rate of 7.5%. The Project generates annual average net free cash of ~USD76million at full production (allowing for sustaining capital and before debt servicing and tax), with an attractive margin on HPA sales of ~63%. (Refer to ASX Announcement "Positive Final Investment Decision Study for 4,500TPA HPA project" dated 23 October 2017 for complete details. The Company confirms that as at the date of this announcement there are no material changes to the key assumptions adopted in the study).

The Company has been successful in securing senior project debt finance of USD190 million from German government owned KfW IPEX-Bank as senior lender. Altech has also mandated Macquarie Bank (Macquarie) as the preferred mezzanine lender for the project. The indicative and non-binding mezzanine debt term sheet (progressing through due diligence) is for a facility amount of up to USD90 million. To maintain project momentum during the period leading up to financial close, Altech has raised ~A\$39 million in the last 24 months to fund the commencement of Stage 1 and 2 of the plant's construction; Stage 1 construction commenced in February 2019 with Stage 2 now underway.

Altech recently announced the sale of an option to Frankfurt stock exchange listed Youbisheng Green Paper AG (since renamed Altech Advanced Materials AG (AAM)), whereby AAM can acquire up to a 49% interest in Altech's HPA project for USD100 million. AAM has commenced the process of securing the funds to enable it to exercise its option, which once complete is anticipated would be a catalyst for project financial close.

Forward-looking Statements

This announcement contains forward-looking statements which are identified by words such as 'anticipates', 'forecasts', 'may', 'will', 'could', 'believes', 'estimates', 'targets', 'expects', 'plan' or 'intends' and other similar words that involve risks and uncertainties. Indications of, and guidelines or outlook on, future earnings, distributions or financial position or performance and targets, estimates and assumptions in respect of production, prices, operating costs, results, capital expenditures, reserves and resources are also forward-looking statements. These statements are based on an assessment of present economic and operating conditions, and on a number of assumptions and estimates regarding future events and actions that, while considered reasonable as at the date of this announcement and are expected to take place, are inherently subject to significant technical, business, economic, competitive, political and social uncertainties and contingencies. Such forward-looking statements are not guarantees of future performance and involve known and unknown risks, uncertainties, assumptions and other important factors, many of which are beyond the control of the Company, the directors and management. We cannot and do not give any assurance that the results, performance or achievements expressed or implied by the forward-looking statements contained in this announcement will actually occur and readers are cautioned not to place undue reliance on these forward-looking statements. These forward-looking statements are subject to various risk factors that could cause actual events or results to differ materially from the events or results estimated, expressed or anticipated in these statements.