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GERMAN RESEARCH CONFIRMS 4N HPA CRITICAL FOR LITHIUM-ION BATTERY SAFETY & PERFORMANCE

Highlights

- Test work shows sodium contamination from low grade alumina and boehmite in lithium-ion battery applications
- Up to 80-fold increase of sodium levels
- Minimum sodium leaching for 4N alumina (99.99%)
- Serious battery safety risks, performance and durability problems
- Minimum quality industry standards for alumina coated separators called for

Altech Chemicals Limited (Altech/the Company) (ASX: ATC) (FRA: A3Y) is pleased to provide the results from high purity alumina (HPA) research activities recently completed by the internationally renowned Fraunhofer-Gesellschaft research organisation (refer ASX Announcement 25 March 2020).

The Fraunhofer Institute for Ceramic Technologies and Systems (IKTS) of Dresden, Germany specialises in lithium-ion battery research. The Altech commissioned test work focussed on assessing how readily impurities (predominantly sodium) leach from lower quality alumina (sub-4N) and boehmite into battery electrolyte solution, a cause of lithium-ion battery thermal runaway, inefficiency and life cycle reduction.

As the lithium-ion battery industry rapidly expands in response to increased demand for electric vehicle (EV) and portable electronic device batteries, some in the industry have turned to cheaper low-grade alumina and boehmite as a coating material for battery separators. This substitution is away from high quality 4N alumina (99.99%) as a standard separator sheet coating. Results from the Fraunhofer test work point to a previously unrecognised contamination risk and heightened safety hazard – sodium leaching – from lower grade alumina or boehmite.

A lithium-ion battery stores then releases power by lithium ions moving between the battery cathode and anode, representing the charge and visa-versa discharge cycles. Separating the cathode and anode within the battery is a thin polymer sheet through which lithium ions pass via a liquid electrolyte – a separator sheet (see Figure 1). The composition of these polymer separator sheets has evolved over time in parallel with increases in battery energy density and faster charging / discharging requirements. Now separator sheets are mostly coated with thin layers of alumina powder to maintain separator integrity under the ever-increasing operating temperatures of modern high-energy lithium-ion batteries (see Figure 2).

Figure 1. Cross section of lithium-ion battery

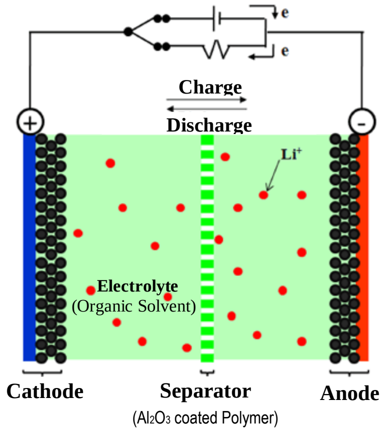
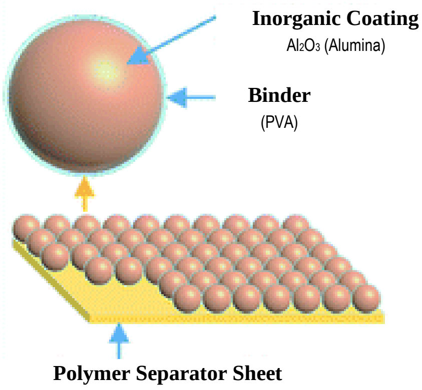


Figure 2. Schematic of alumina (Al_2O_3) coated polymer separator



The Fraunhofer test work exposed various commercial grade alumina / boehmite powders known to have been adopted for battery separator coatings, to lithium battery electrolyte solution under controlled battery type conditions. What was observed was severe sodium leaching and contamination of the organic electrolyte solution from the lower grade alumina and boehmite powders. The IKTS reported that the sodium content in the electrolyte rose from an initially acceptable 0.5 ppm, up to potentially catastrophic level of 40 ppm (an 80-fold increase) for the test using low quality 3N alumina (99.9%). Similar leaching and electrolyte contamination were observed for the boehmite test (99.7% purity), where the sodium level in the electrolyte jumped 20-fold. For the 4N alumina (99.99%), almost zero leaching of sodium was observed.

Figure 3 illustrates the discolouration of the organic electrolyte solution that resulted from the leaching of contaminates in the Fraunhofer test work.

Figure 3. Electrolyte samples showing discolouration – Left to Right, 4N Alumina (99.99%), 3N Alumina (99.9%), Boehmite (99.7%)

The presence of high levels of sodium in the extremely sensitive lithium-ion battery electrolyte solution presents potentially serious battery safety risks, adverse battery performance issues and battery durability problems. Sodium contamination is to be avoided at all costs anywhere within a lithium-ion battery. Sodium can dramatically reduce battery discharge capacity and adversely impede the movement of lithium ions within the battery. When there is too much sodium present in the battery's organic electrolyte solution, the movement of lithium ions is hindered and the battery discharge capacity is rapidly reduced. Overall, sodium has a negative impact on battery performance and safety. Sodium presence in battery electrolyte promotes dendrite growth and lithium plating on the anode, which are catalysts for battery failure.

Dendrite growth within the battery cell is a significant safety concern. Dendrites are microscopic metals that are as thin as hair and as sharp as needles. Dendrites grow from the anode during overcharging and fast charging ("supercharging") of a lithium-ion battery. If unchecked the dendrites will in all likelihood eventually pierce the separator and cause a thermal runaway leading to battery fire or even explosion.

It would appear that the lithium-ion battery industry currently incorrectly assumes that the sodium impurities contained within lower grade alumina and boehmite are “crystal bound”, and simply do not leach out of the alumina – this new test work proves this assumption to be incorrect!

Altech managing director, Iggy Tan said that *“the ramifications from these research findings for the portion of the lithium-ion battery industry that is transitioning – or is contemplating transitioning – to cheaper alumina substitutes for separator coatings, are set to be profound.*

It is hard to comprehend why lithium-ion battery manufacturers would transition to a lower quality alumina – when this material is introducing sodium into the battery electrolyte and as a result jeopardising battery safety and performance. The extra cost of a high purity alumina coating versus the lower grade material is minimal, likely less than US$ 1 per kWh battery capacity or US$ 100 for a typical EV. A small cost impact on the end product to ensure the highest level of battery safety and quality.

It is potentially catastrophic that many in the industry appear to be attempting to move to lower quality material as a battery separator coating. A minimum quality standard for all alumina used as coating material on battery separator sheets should be adopted by industry” he concluded.

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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 (Al_2O_3) 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, semiconductor 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%.

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.

In July 2019 Altech 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.