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Innovations in Australia's aluminium industry

Although the Australian aluminium industry has been operating in Australia since 1955 and now includes bauxite mining, alumina refining, aluminium smelting and downstream processing industries, it continues to innovate to meet the needs of consumers today and into the future.

Australia is leading global research in innovative alumina refining technologies

With a global focus on net zero by 2050, there is a lot of attention on decarbonising the aluminium smelting sector. Still, here in Australia, the emissions associated with bauxite mining and alumina refining are not being forgotten. Alcoa, Rio Tinto and South32's Worsley

Alumina operations have their global research headquarters in Australia, innovating to develop new alumina refinery technologies for the world.

Australia's alumina refineries are working collaboratively with the Australian Renewable Energy Agency (ARENA) on innovative processes that could enable refineries that currently use fossil fuels to use renewable electricity or hydrogen instead. For example, Alcoa is currently trialling a new way of generating steam required to refine bauxite (aluminium ore) into alumina. Known as Mechanical Vapour Recompression (MVR), this process uses renewable energy to recycle waste steam that would otherwise be exhausted into the atmosphere. If the feasibility studies are successful, Alcoa plans to install a three-megawatt MVR module with renewable energy at its Wagerup refinery in Western Australia to test the technology at scale. The MVR technology powered by renewable energy could reduce an alumina refinery's carbon footprint by 70 per cent and can significantly reduce water use in the refining process by capturing water vapour that would otherwise be lost to the atmosphere.

Alcoa is also undertaking a project in conjunction with ARENA and the West Australian Government to test electric pressure calcination. This process can produce pure, uncontaminated steam exhaust, which can be captured and reused, reducing demand for steam from natural gas boilers - potentially reducing Australian alumina refining emissions by 40% when powered by 100% renewable electricity. The project also aims to improve understanding of load flexibility and the provision of essential systems services to the electricity grid.

Rio Tinto, in partnership with ARENA, is conducting a feasibility study to investigate the technical implications of displacing natural gas with renewable hydrogen in the calcination process at its Yarwun refinery. If successful, the technical and commercial lessons from the hydrogen calcination technology could lead to its more comprehensive implementation in Australia and globally. The findings of these studies have potential innovative applications in other high-temperature manufacturing processes.

Existing industry is an enabling pathway for new economy industries

While alumina has been produced in Australia for more than fifty years and is largely supplied to the global aluminium smelting industry as metallurgical grade alumina, usually at purities of more than 99 per cent, there has been an emergence in demand for very high purity alumina (HPA). This trend is driven by increased global demand for a new world of technologies which need higher quality, purity and versatility.

HPA's properties, such as high brightness, corrosion resistance, good thermal conductivity, high melting point, chemical stability and high mechanical strength, make it suitable for manufacturing various electronic and vehicle components. It creates safer, more efficient and longer-lasting lithium-ion batteries, synthetic sapphire for LED lighting and high-technology optics.

There is a range of new Australian HPA projects in the pipeline. For example, Alpha HPA is constructing what will potentially be the world's largest HPA plant in Gladstone, with targeted production of 10,000 tonnes per annum. The Alpha HPA process will use a precursor from nearby alumina refineries in its ground-breaking "Smart SX" (solvent extraction) low emissions refining technology. Alpha HPA also collaborates with other neighbouring manufacturers so that by-products from its extraction process can be recycled, making the project an almost zero discharge facility. The solvent extraction technology, combined with renewable energy, aims to generate a range of HPA products with a carbon footprint up to 70% lower than traditional production methods.

Another key trend is circular economy and recycling. While there is a focus on recycling aluminium itself, Australian companies are pioneering new technologies to transform aluminium smelter bath into aluminium fluoride. ALCORE Limited proposes building a \$16.4M aluminium smelter bath recycling plant in Bell Bay, Tasmania. The plant is proposed to transform 1,600 tonnes of bath per year into

aluminium fluoride, an essential chemical for aluminium smelting, for which Australia currently imports 100% of its requirements. The potential to establish domestic aluminium fluoride production will help increase Australia's manufacturing resilience and capability and be an excellent illustration of the circular economy.