WHITE PAPER

GREEN CREDENTIALS OF ALTECH HIGH PURITY ALUMINA PROCESS

MARCH 2020

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EXECUTIVE SUMMARY

Altech's proposed high purity alumina (HPA) project, which will use a single-step hydrochloric acid leach process to produce HPA from kaolin (aluminous clay) feed-stock, will consume considerably less energy and emit less greenhouse gases, when compared to the current industry standard of HPA production.

Incumbent HPA producers use high grade aluminium metal as a feedstock; the aluminium metal is dissolved in alcohol, hydrolysed and calcined back to alumina (HPA). The process is known as the "alkoxide" process, and it is energy and emissions intensive. HPA produced via this method commences with the mining of bauxite ore, then ore refining, followed by smelting and finally alkoxide dissolution. Energy use and greenhouse gases emissions increase and accumulate with each step of the process so that by the time HPA is finally produced, net energy consumption (primarily electricity) and total greenhouse gasses emissions (primarily CO_2) are considerable (see figure 1).

Altech's HPA process does not use aluminium metal, rather it uses a benign aluminous clay feedstock (kaolin), and because it is a single step production method, energy consumption and greenhouse gasses emissions will be almost 50% less than those of incumbent HPA producers. For Altech's production method, it is estimated that there will be a 46% reduction of greenhouse gases per tonne of HPA and that the comparative carbon footprint will be 6.6 tonnes of CO_2 per tonne HPA, versus 12.3 tonne CO_2 per tonne of HPA for the alkoxide process. Altech's production method will also deliver an estimated 41% reduction of overall energy consumption per tonne of HPA (45 GJ per tonne of HPA compared to 77.4 GJ per tonne HPA).

A major consumer of HPA is the lithium-ion battery sector, where HPA is increasingly applied directly onto battery anodes and cathodes, and is already established as an important coating applied to polymer battery separator sheets to prevent shrinkage, reduce battery combustibility and improved battery safety and life. As lithium-ion batteries are the key source of energy storage to support the renewables energy sector, HPA's role in supporting the global transition to a lower carbon economy is a further enhancement to HPA's overall green credentials.

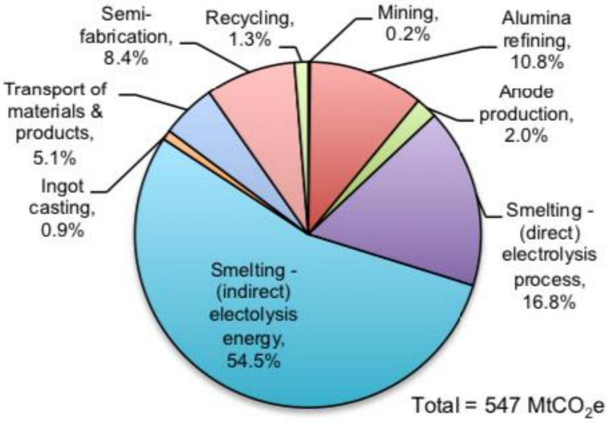

Figure 1: Aluminium Productions Global Green House Gases Emissions (2018) (by process)

In addition to the environmental advantages the Altech Kaolin to HPA process offers, the HPA plant in Johor, Malaysia has been designed with specific focus on minimising environmental impact. State of the art equipment and best available techniques (BATs) have been specified to minimise emissions to air and waste water, and an HCl recovery plant shall be constructed to recover and recycle the majority of one of the plants key reagents. The major solids by-products from the process are largely silica sand, and are intended to be reutilised by other industries rather than being stockpiled as is the case with red mud tailings. Energy efficiency of the plant has also been considered, with LED lighting and variable speed drives specified wherever possible, and high efficiency gas burners used on fuel burning equipment.

The green credentials of the Altech HPA process and plant lend itself to potential green investment, with a green bond framework now in place. The project will meet all local environmental regulations as well as internationally recognised standards including the Equator Principles and International Finance Corporation (IFC) Performance Standards for Environmental and Social Sustainability. The project environmental management system shall be developed in accordance with ISO14001.

Use of any green bond proceeds shall be limited to financing of the HPA plant, and shall be overseen by the Altech Chemicals CFO and Board of Directors. Environmental impact of the HPA plant shall also be monitored on an annual basis, with reporting of CO_2 emissions and energy consumption per tonne of HPA metrics included in a Green Investor Report. This data shall be reviewed and approved by an external auditor prior to management review and publication.

ALKOXIDE HPA PROCESS EXPLAINED

The dominant incumbent technology to produce high purity alumina (HPA) is the alkoxide process, which uses high grade aluminium metal as feedstock.

The manufacture of aluminium metal is an energy intense 3 step process:

- Bauxite mining
- Bauxite to smelter grade alumina (SGA) by Bayer Process
- SGA to aluminium metal by Hall-Heroult Process

Production commences with the mining of bauxite ore, a hydrated oxide of aluminium consisting of 30 to 56 percent alumina (Al_2O_3) and impurities such as iron, silicon, and titanium. The ore is refined into alumina via the Bayer process. The alumina is then shipped to a primary aluminium refinery for electrolytic reduction to aluminium (Hall-Heroult process); the refining and reducing processes are seldom accomplished at the same facility. Four (4) tons of bauxite is required to produce one (1) ton of aluminium metal —enough to make 60,000 soft drink cans.

Bauxite Mining

Scrapers and small excavators are used to remove overburden and expose the caprock, a solid concrete-like layer. Depending on the depth of the caprock, it can be broken by blasting, or simply removed with scrapers and excavators. The bauxite is then mined using excavators or loaders to load the bauxite onto haul trucks and transported to a crusher.

The crusher is used to break the ore down to a smaller size suitable as feedstock for alumina refineries. The relative geographic locations of the bauxite mines and the alumina refineries determines how the crushed ore is delivered to the refineries. Alumina refineries tend to be located close to cheap sources of electricity and at, or close to, a deep-water port. Crushed bauxite is transported from the mine to the refinery via either ocean going ships, railway, or in the rare instance where the refinery is close to the bauxite mine, conveyor belt and/or trucks.

Bauxite Refining (the Bayer process)

The Bayer process is the principal way for producing alumina by refining Bauxite. The process was invented by Austrian chemist, Carl Josef Bayer in 1887, and started gaining importance after the invention of Hall-Heroult aluminium process (see below). Till today the process is unchanged and is used to produce nearly all the world’s alumina supply.

In the Bayer process, crude bauxite ore is dried, ground in ball mills, and mixed with a preheated spent leaching solution of sodium hydroxide ($NaOH$). Lime (CaO) is added to control phosphorus content and to improve the solubility of alumina. The resulting slurry is combined with sodium hydroxide and pumped into a pressurized digester operated at 105 to 290 °C. After approximately 5 hours, the slurry of sodium aluminate ($NaAl_2OH$) solution and insoluble content in the bauxite, known as ‘red mud’, is cooled to 100°C and sent through either a gravity separator or a wet cyclone to remove coarse sand particles. A flocculent, such as starch, is added to increase the settling rate of the red mud. The overflow from the settling tank contains the alumina in solution, which is further clarified by filtration and then cooled. As the solution cools, it becomes supersaturated with sodium aluminate. Fine crystals of alumina trihydrate (Al_2O_3 •

$3H_2O$) are seeded into the solution, causing the alumina to precipitate out as alumina trihydrate. After being washed and filtered, the alumina trihydrate is calcined to produce a crystalline form of alumina, which is advantageous for electrolysis. The alumina product is usually in the form of 'smelter grade alumina' (SGA) with a purity in the order of 99.5%.

Red Mud

Large amount of residue, 'red mud', is produced from the Bayer process. The mud is a mixture of compounds originally present in the parent mineral, bauxite, and of compounds formed or introduced during the Bayer refining process. The disposal (storage) of red mud is a real problem for the alumina refining industry and the environmental issues associated with this problem are now gaining more prominence.

Conventional red-mud disposal methods have revolved around the construction of clay-lined dams or dykes, into which the red mud slurry is simply pumped and allowed to dry naturally. Red mud contains toxic heavy metals and its high alkalinity makes it extremely corrosive and damaging to soil and life forms, presenting a massive environmental problem. The construction and operation of these conventional disposal areas was simple and inexpensive, however the potential impact on the surrounding groundwater and environment, and difficulties associated with surface rehabilitation is significant, a toxic legacy of bauxite refining.

Figure 2: Red mud being pumped into a storage pond

Figure 3: Typical red mud storage ponds

Bauxite Smelting (Hall-Heroult process)

The Hall-Héroult process was invented in Europe and America, it was discovered simultaneously and independently by 23 year old scientists Martin Hall and Paul Héroult, who each patented the invention in 1886. The invention was based on the fused-salt electrolysis of alumina dissolved in a molten Cryolite bath, the process is still used today with some large improvements.

Crystalline alumina (Al_2O_3) is used to produce aluminium metal. Electrolytic reduction of alumina occurs in shallow rectangular cells, or "pots", which are steel shells lined with carbon. Carbon electrodes extending into the pot serve as the anodes, and the carbon lining serves as the cathode. Molten cryolite (Na_3AlF_6) functions as both the electrolyte and the solvent for the alumina. The electrolytic reduction of Al_2O_3 by the carbon from the electrode occurs as follows:

$$2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2 \qquad (1)$$

Aluminium is deposited at the cathode, where it remains as molten metal below the surface of the cryolite bath. The carbon anodes are continuously depleted by the reaction. The aluminium product is tapped every 24 to 48 hours beneath the cryolite cover, using a vacuum siphon. The aluminium is then transferred to a reverberatory holding furnace where it is alloyed, fluxed, and degassed to remove trace impurities. From the holding furnace, the aluminium is cast or transported to fabricating plants.

The smelting of aluminium is a very energy intensive process – and over 80 per cent of smelting greenhouse gas emissions are indirect (electricity-related) emissions, with aluminium smelters consuming around 4% of global electricity output[1].

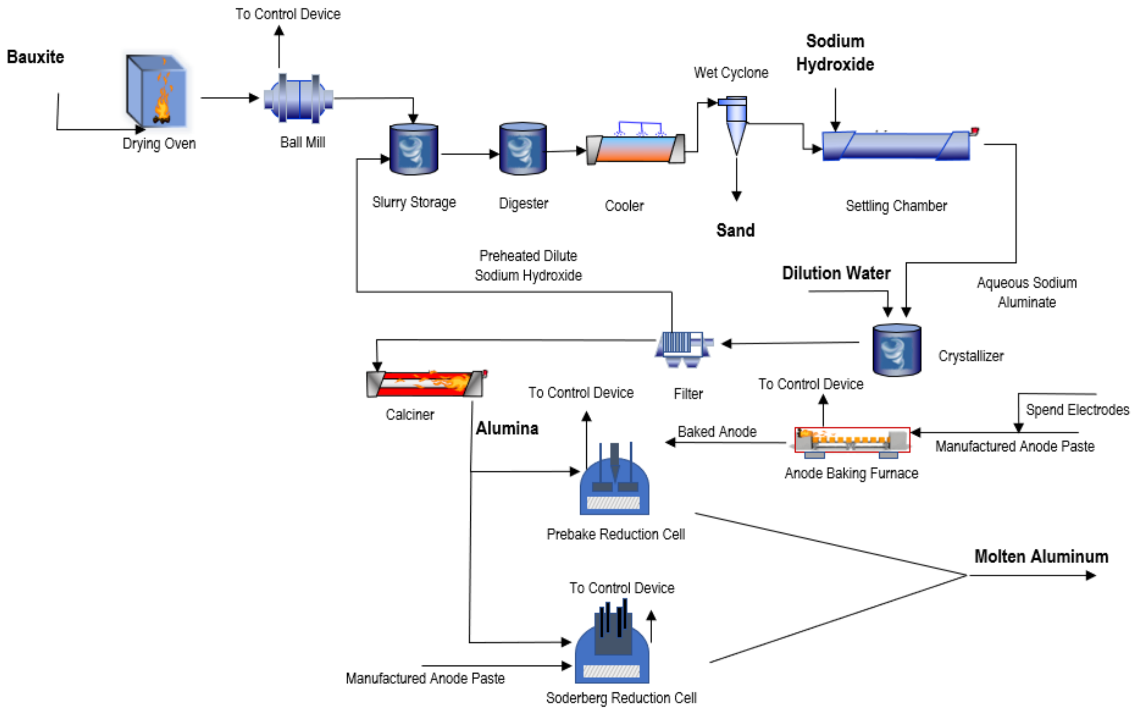

Figure 4: Schematic diagram of primary aluminium metal production

Alkoxide Process

The alkoxide process is used to produce HPA from aluminium metal feedstock. High purity aluminium alkoxide is synthesized from aluminium metal and alcohol; hydrated alumina is then produced by hydrolysis of alkoxide; and finally high purity alumina is obtained by calcination of the hydrated alumina.

The aluminium metal, typically in the form of pellets or needle, is cleaned and degreased before feeding into an alkoxide synthesis reactor. Alcohol, ROH, is also fed into the reactor as a digestion agent. The digest reaction occurs at elevated temperature:

$$Al + 3ROH \rightarrow Al\,(OR)_3 + 3/2H_2 \qquad (2)$$

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[1] IEA (2010), p. 194. Electricity consumption figure is for 2007

The aluminium alkoxide produced from the digestion is purified by distillation to remove any impurities from the digested liquor. Depending on the impurity content in the aluminium metal, a certain amount of aluminium is contained in the liquor bleed with impurities during the purification process.

Purified aluminium alkoxide liquor is then fed to a hydrolysis tank to react with pure water according to the following reaction:

$$2Al\,(OR)_3 + 4H_2O \longrightarrow Al_2O_3 \cdot H_2O + 6ROH \qquad (3)$$

The above hydrolysis reaction for aluminium alkoxide is extremely fast. It is important to control the conditions during hydrolysis and to avoid producing rigid agglomerates during drying.

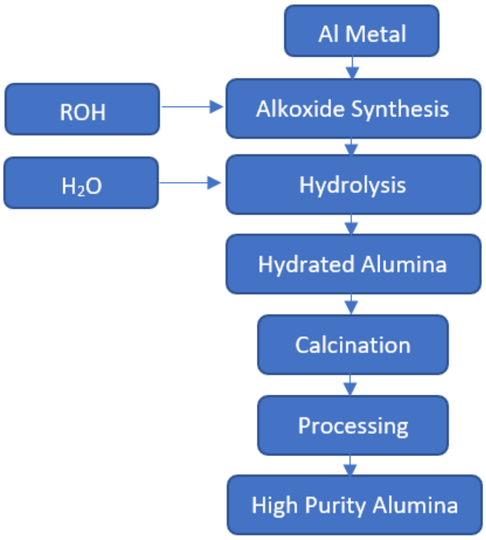


Figure 5: Alkoxide Process of High Purity Alumina Production

The hydrated alumina is separated from the liquor by filtration or dried directly using a spray dryer. The dried hydrated alumina is calcined in a kiln to produce the final high purity alumina product:

$$Al_2O_3 \cdot H_2O \longrightarrow Al_2O_3 + H_2O \qquad (4)$$

The calcination temperature is above 1200 °C in order to produce α-alumina product, which is a stable phase used by the industry.

The alumina products from the calciner is in a form of agglomerates. Deagglomeration is required to obtain a narrow particle size distribution. A ball mill, vibration mill, jet mill, media agitating mill or other types of fine grinding mill can be used for the deagglomeration process.

The high purity alumina powder is bagged and ready for delivery to the customer.

ALTECH KAOLIN TO ALUMINA PROCESS

Instead of using high energy consumption and high CO_2 footprint aluminium metal as feed stock, the Altech process uses kaolin to directly produce high purity alumina (HPA). The Altech process include the following steps as shown in Figure 6.

- Kaolin Mining in Meckering, Western Australia
- Kaolin to Alumina Conversion Plant in Johor, Malaysia
    - Kaolin beneficiation
    - Kaolin Calcination
    - Kaolin HCl Acid Leaching
    - Aluminium Chloride Hexahydrate (ACH) Crystallisation and Purification
    - ACH and Alumina Calcination
    - HPA Product Finishing

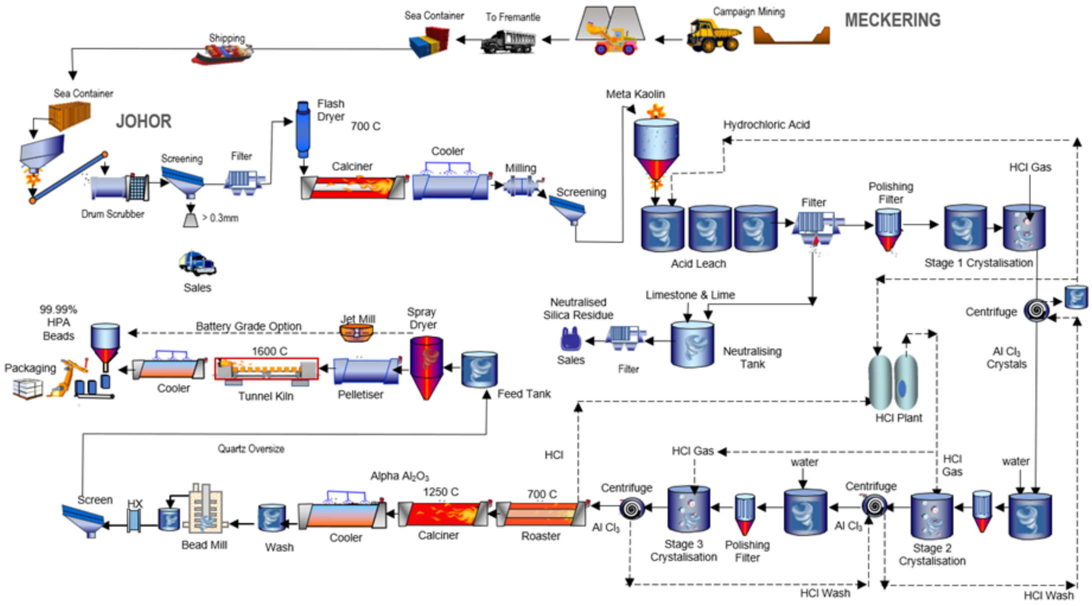


Figure 6: Altech HPA Process

Kaolin Mining and Transportation

The mining of kaolin ore will be on a campaign basis, approximately two months every three years. Kaolin ore will be hauled from the pit to the ROM and stacked to a maximum height of 4m above the ROM floor; this will ensure sufficient space for ore stockpiling. The first three years of feedstock will be mined in one campaign lasting around two months and deposited on the run of mine (ROM) pad. From then on all mining activities will cease until the next campaign.

Raw kaolin will be reclaimed from the ROM stockpile by means of a front-end loader and transferred to a trommel screen to reject material over 12mm trommel. Undersize material will be conveyed by the same mobile unit to the loading shed to an extendible conveyor unit that extends the full 20-ft length of a shipping container and retracts during loading to ensure even distribution of kaolin over the length of the container.

Run of mine (ROM) kaolin ore will be loaded into standard sea containers and trucked from the Meckering site in Western Australia (WA) to Fremantle Port, WA, before being shipped to Tanjung Pelepas port, Johor Bahru, Malaysia. The containers unloaded from the port of Tanjung Pelepas are either stored at the port or directly trucked to Altech's HPA plant in the Tanjung Langsat Industrial Complex, Johor, Malaysia.

Kaolin to Alumina Conversion Plant in Johor, Malaysia

The kaolin is unloaded and fed into the wet screening circuit consisting of a drum scrubber, a filter and various screens. This operation ensures kaolin particle size is reduced to <300µm and the majority of oversize silica/quartz is removed.

Beneficiated kaolin will be calcined at a temperature less than 700°C in an indirect rotary kiln to convert the crystal structure of the clay to a more reactive form (meta kaolin) for leaching. The kiln will be indirectly fired by natural gas with associated cyclone and bag-house to collect off-gas fines. The calcine will be cooled, screened and any oversized material crushed to a particle size of <300µm.

Leaching follows, during which the calcine will be mixed with recycled wash liquor containing hydrochloric acid (HCl) at ~30% w/w. The leach reaction is exothermic and the oxide components (except silica) are converted to soluble chlorides, producing a high concentration of aluminium chloride ($AlCl_3$) in solution. The leached slurry is then pumped to leach residue filtration. The silica residue slurry is filtered and the silica residue neutralised before being provided to local vendors, such as brick works or cement plants.

The pregnant liquor solution (PLS), from leach residue filtration is directed to crystallisation where aluminium chloride hexahydrate ($AlCl_3 .6H_2O$ or ACH) is crystallised out of solution. This is achieved by increasing the hydrochloric acid concentration of the liquor (ACH is insoluble in concentrated HCl) by bubbling in anhydrous HCl gas. ACH crystals are then centrifuged and washed from the solution.

The resultant ACH solids will be transferred to a re-dissolution tank where the ACH crystals will be dissolved in demineralised water and then fed to the second crystallisation circuit. This dissolution process makes it possible to release residual impurities, which may have become trapped in the crystals during the first crystallisation. Like the first stage crystallisation, the ACH acid concentration in the liquor is increased by bubbling in HCl gas, and crystallised ACH is centrifuged and finally washed to remove any residual acid and/or impurities. A third stage of crystallisation is identical to the second, however the centrifuge has no washing stage and the ACH crystals are not redissolved.

The purified ACH crystals are then 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, with trace amounts of basic aluminium chlorides (oxychlorides). Almost all of the chloride is liberated as HCl gas, which is recovered and reused in the process. The solids from the roaster fall directly into the second rotary kiln that then heats the solids further (to 1200°C) to remove the remainder of the HCl and water (H_2O) and produce HPA: highly pure alpha alumina (α- Al_2O_3). The HPA will discharge to a cooler and is then fed directly to a final wash stage to remove surface trace impurities.

The HPA is milled in a bead mill to produce a slurry with fine alumina particles of D50=0.5 microns. The milled HPA slurry is then spray dried to produce HPA powder.

From here, two products are produced.

1) Spray dried HPA is deagglomerated by a jet mill to produce fine powder (for Li-ion Battery Application)
2) Spray dried HPA is pelletised and densified in a tunnel kiln operating at a temperature of 1650 °C, then cooled to produce densified HPA beads (for sapphire application such as LED substrate).

The final products are bagged and stored separately for delivery to customers.

ENERGY CONSUMPTION

The high-level estimated energy consumption for the Alkoxide and Altech Processes are 77.4 and 45.1 GJ/t HPA respectively. The breakdown at each process is shown in Figure 4. The energy consumption from bauxite to aluminium metal process consumes 50.5 GJ/t HPA (Excludes metal to HPA), which is greater than that consumed by the Altech's Kaolin to HPA process: 45.1 GJ/t HPA. The overall energy consumption by Altech process is 58.3% of that by alkoxide process.

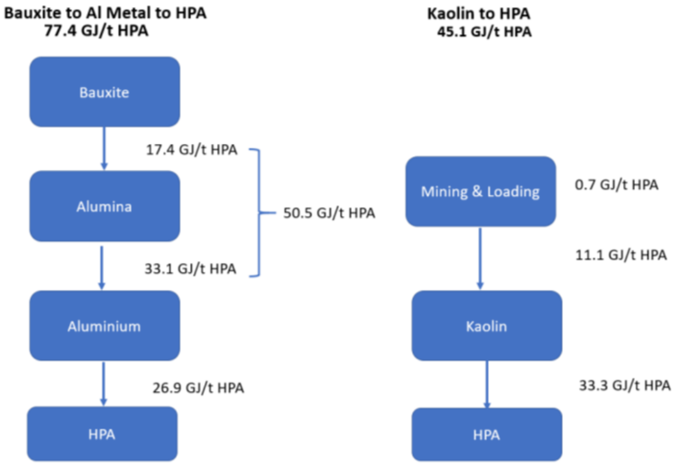


Figure 7: Comparison of Energy Consumptions for Alkoxide and Altech Processes

CO_2 FOOTPRINT

As a comparison, the cradle to production plant exit gate CO_2 footprints for both processes are estimated (high level). The CO_2 footprints from gate to grave are the same by assuming there is no differences in product applications.

The cradle to gate CO_2 footprints for both processes are:

- Altech Process: 6.6 t CO_2 /t HPA
- Others: 12.3 t CO_2 /t HPA, double that of the Altech process

Similar to that of the energy consumptions, the major difference in CO_2 production between the processes is in the production of the feedstock to the HPA plant. The kaolin from cradle (mine) to HPA plant gate is 0.8 tCO_2/t HPA, much lower than that of aluminium metal to HPA plant gate: 7.5 t CO_2/t HPA

CO_2 REDUCTION IN LED APPLICATION

As an application example, the CO_2 reduction is estimated by considering the energy savings associated with replacement of incandescent lights by LEDs, based on the following assumption:

- Assume LED market increases from 1 to 4 b units by year 2025
- Assume, on average, 6w LED replace 50w incandescent
- Assume the light operates 4 hours per day

CO_2 reduction due to the electricity saving alone is 52,800 ton CO_2 reduction per hour, equivalent to 77.1 million ton CO_2 reduction per annum (4 hours per day). This calculation does not include the CO_2 generation from manufacturing and disposal.

LED lights have longer service lives and hence less replacement, less CO_2 on a per annum basis.

HPA PLANT ENVIRONMENTAL DESIGN

The Altech HPA plant, to be built and operated in Johor, Malaysia has been designed with sustainability and potential impact to the environment in mind. State of the art process equipment, and best available techniques (BATs) for emissions management have been included in the design in order for the plant to meet and exceed both the local environmental regulations and IFC Environmental Guidelines.

Energy efficiency has also been considered. LED lighting will be utilised wherever possible, variable speed drives (VSD) are installed for control of the majority of process equipment, and high efficiency natural gas burners are used in fuel burning equipment.

All process gas emissions are first treated by either baghouse or wet scrubber units (or both) prior to discharge to meet emissions regulations for particulate matter and HCl content. Processes in which HCl fumes are present or generated are vented to a plant wet scrubbing system for treatment. The plant includes an Acid Recovery circuit which is intended to recover HCl gas and acid from the roasting and leaching stages respectively. This circuit minimises both the amount of raw HCl acid reagent which enters the process and the amount of losses which require neutralisation and treatment.

All fuel burning process equipment (kilns and boiler) use natural gas as the primary fuel source, and are designed with modern high efficiency burners in order to minimize the NOx and SOx content in the flue gases, along with overall minimisation of gas emissions.

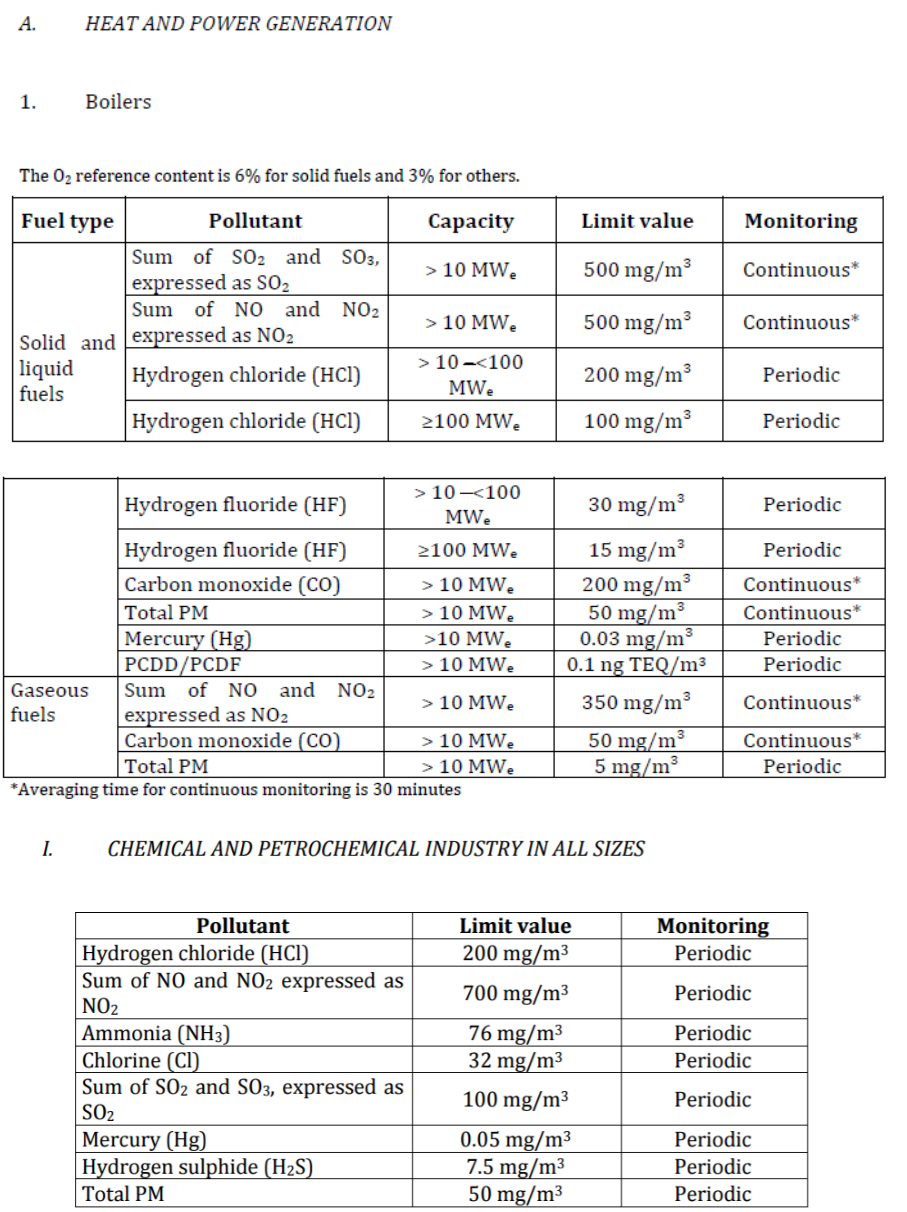
All process water is neutralised and filtered prior to discharge to the site drain. Storm water is collected in dedicated onsite detention tanks (OSD) and monitored prior to discharge. Water is diverted to the water treatment circuit if necessary prior to discharge. Sampling and online monitoring of the waste water and storm water composition prior to discharge is completed to ensure effluent limits are met.

Solids by-products from the process are collected, and are intended to be sold as filler material to concrete or brick making facilities. All other routine solid waste streams from the plant operation from maintenance, administration and cleaning activities will be removed from the site by approved waste contractors. The environmental waste management plan implemented on site shall incorporate the 3-Rs approach: Reduce, Reuse, Recycle.

Emissions to Air

The emissions standards followed in the plant and equipment design are as follows:

a) Gas Stack Emission Standards from Environmental Quality (Clean Air) Regulations 2014
b) Recommended Malaysian Air Quality Guidelines (Ambient Standards)



A. HEAT AND POWER GENERATION

1. Boilers

The O_2 reference content is 6% for solid fuels and 3% for others.

Fuel type	Pollutant	Capacity	Limit value	Monitoring
Solid and liquid fuels	Sum of SO_2 and SO_3, expressed as SO_2	> 10 MW_e	500 mg/m^3	Continuous*
	Sum of NO and NO_2 expressed as NO_2	> 10 MW_e	500 mg/m^3	Continuous*
	Hydrogen chloride (HCl)	> 10 –<100 MW_e	200 mg/m^3	Periodic
	Hydrogen chloride (HCl)	≥100 MW_e	100 mg/m^3	Periodic
	Hydrogen fluoride (HF)	> 10 –<100 MW_e	30 mg/m^3	Periodic
	Hydrogen fluoride (HF)	≥100 MW_e	15 mg/m^3	Periodic
	Carbon monoxide (CO)	> 10 MW_e	200 mg/m^3	Continuous*
	Total PM	> 10 MW_e	50 mg/m^3	Continuous*
	Mercury (Hg)	>10 MW_e	0.03 mg/m^3	Periodic
	PCDD/PCDF	> 10 MW_e	0.1 ng TEQ/m^3	Periodic
Gaseous fuels	Sum of NO and NO_2 expressed as NO_2	> 10 MW_e	350 mg/m^3	Continuous*
	Carbon monoxide (CO)	> 10 MW_e	50 mg/m^3	Continuous*
	Total PM	> 10 MW_e	5 mg/m^3	Periodic

*Averaging time for continuous monitoring is 30 minutes

I. CHEMICAL AND PETROCHEMICAL INDUSTRY IN ALL SIZES

Pollutant	Limit value	Monitoring
Hydrogen chloride (HCl)	200 mg/m^3	Periodic
Sum of NO and NO_2 expressed as NO_2	700 mg/m^3	Periodic
Ammonia (NH_3)	76 mg/m^3	Periodic
Chlorine (Cl)	32 mg/m^3	Periodic
Sum of SO_2 and SO_3, expressed as SO_2	100 mg/m^3	Periodic
Mercury (Hg)	0.05 mg/m^3	Periodic
Hydrogen sulphide (H_2S)	7.5 mg/m^3	Periodic
Total PM	50 mg/m^3	Periodic

Figure 8: Clean Air Regulations – Third Schedule Extract

The vendors selected for supply of the rotary kilns and steam boiler have stated no issues with achieving the required NOx and SOx combustion limits defined in the regulations.

Any gas streams containing dust from the process are first treated by reverse pulse baghouse equipment designed to maintain PM levels below the requirement of 50mg/m^3.

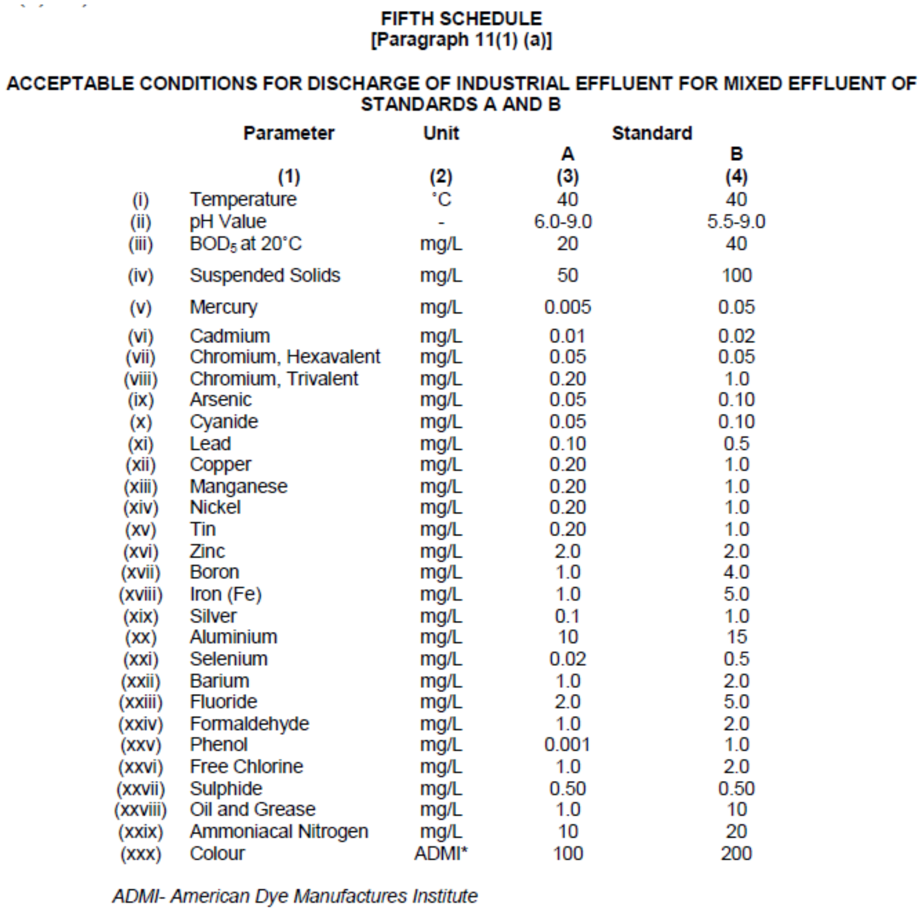
The production process involves generation of HCL gas during the roasting and calcination of aluminium chlorohexahydrate. The majority of this HCL gas is captured during the roasting stage and recovered by an Acid Recovery package (Area 600) and returned to the process. Residual HCL gas is produced during the calcination stage, and this vent gas is treated by a high temperature baghouse, and then to the plant scrubber for secondary treatment before discharge.

All process vents which may contain HCL fumes are ducted to a plant scrubbing package (Area 620). The scrubber is designed to reduce HCl content to <50ppm before the vent gas is discharged to stack 620-SKA-001.

Emissions to Water

The regulations governing industrial effluent and sewage discharge below have been used in the design and specification of HPA plant equipment;

a) Environmental Quality (Industrial Effluents) Regulations 2009 (Standard A)
b) Environmental Quality (Sewage) Regulations 2009 (Standard A)



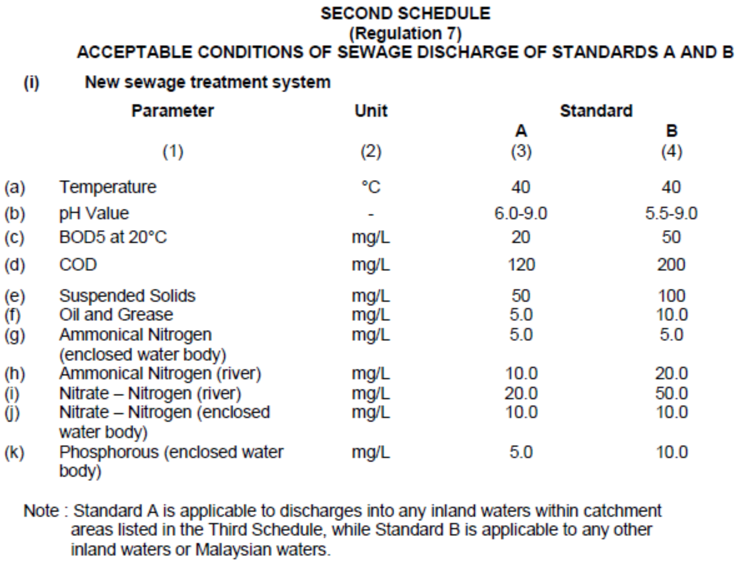
FIFTH SCHEDULE
[Paragraph 11(1) (a)]

ACCEPTABLE CONDITIONS FOR DISCHARGE OF INDUSTRIAL EFFLUENT FOR MIXED EFFLUENT OF STANDARDS A AND B

	Parameter (1)	**Unit (2)**	**Standard A (3)**	**Standard B (4)**
(i)	Temperature	°C	40	40
(ii)	pH Value	-	6.0-9.0	5.5-9.0
(iii)	BOD_5 at 20°C	mg/L	20	40
(iv)	Suspended Solids	mg/L	50	100
(v)	Mercury	mg/L	0.005	0.05
(vi)	Cadmium	mg/L	0.01	0.02
(vii)	Chromium, Hexavalent	mg/L	0.05	0.05
(viii)	Chromium, Trivalent	mg/L	0.20	1.0
(ix)	Arsenic	mg/L	0.05	0.10
(x)	Cyanide	mg/L	0.05	0.10
(xi)	Lead	mg/L	0.10	0.5
(xii)	Copper	mg/L	0.20	1.0
(xiii)	Manganese	mg/L	0.20	1.0
(xiv)	Nickel	mg/L	0.20	1.0
(xv)	Tin	mg/L	0.20	1.0
(xvi)	Zinc	mg/L	2.0	2.0
(xvii)	Boron	mg/L	1.0	4.0
(xviii)	Iron (Fe)	mg/L	1.0	5.0
(xix)	Silver	mg/L	0.1	1.0
(xx)	Aluminium	mg/L	10	15
(xxi)	Selenium	mg/L	0.02	0.5
(xxii)	Barium	mg/L	1.0	2.0
(xxiii)	Fluoride	mg/L	2.0	5.0
(xxiv)	Formaldehyde	mg/L	1.0	2.0
(xxv)	Phenol	mg/L	0.001	1.0
(xxvi)	Free Chlorine	mg/L	1.0	2.0
(xxvii)	Sulphide	mg/L	0.50	0.50
(xxviii)	Oil and Grease	mg/L	1.0	10
(xxix)	Ammoniacal Nitrogen	mg/L	10	20
(xxx)	Colour	ADMI*	100	200

ADMI- American Dye Manufactures Institute

Figure 9: Industrial Effluents Regulations 2009



SECOND SCHEDULE
(Regulation 7)
ACCEPTABLE CONDITIONS OF SEWAGE DISCHARGE OF STANDARDS A AND B

(i) New sewage treatment system

	Parameter (1)	Unit (2)	Standard A (3)	Standard B (4)
(a)	Temperature	°C	40	40
(b)	pH Value	-	6.0-9.0	5.5-9.0
(c)	BOD5 at 20°C	mg/L	20	50
(d)	COD	mg/L	120	200
(e)	Suspended Solids	mg/L	50	100
(f)	Oil and Grease	mg/L	5.0	10.0
(g)	Ammonical Nitrogen (enclosed water body)	mg/L	5.0	5.0
(h)	Ammonical Nitrogen (river)	mg/L	10.0	20.0
(i)	Nitrate – Nitrogen (river)	mg/L	20.0	50.0
(j)	Nitrate – Nitrogen (enclosed water body)	mg/L	10.0	10.0
(k)	Phosphorous (enclosed water body)	mg/L	5.0	10.0

Note : Standard A is applicable to discharges into any inland waters within catchment areas listed in the Third Schedule, while Standard B is applicable to any other inland waters or Malaysian waters.

Figure 10: Sewage Regulations 2009

All process water is neutralised and filtered prior to discharge to the site drain. Storm water is collected in dedicated onsite detention tanks (OSD) and monitored prior to discharge. Water is diverted to the water treatment circuit if necessary prior to discharge. Sampling and online monitoring of the waste water and storm water composition prior to discharge is completed to ensure effluent limits are met.

Solid Waste Management

Sale, disposal or removal of solid waste from the plant site will be required to meet the following regulation:

a) Environmental Quality (Scheduled Wastes) Regulations 2005

The solids products produced by the Kaolin to HPA process are essentially the silica component of the kaolin clay feedstock material to the plant, which is either screened as oversize, or is the unreacted component in the leach process which is then neutralised with lime. Due to the nature and composition of these solids, it is envisaged that the material will be sold to a concrete or brickworks as filler material or reused for other sand applications. Disposal of waste oils, lubricants etc shall be by a specialist waste contractor.

As the majority of the solid waste products produced by the HPA process are intended to be reutilised, the company has already minimised the impact of plant waste on local area landfill and waste disposal facilities. In comparison, the US EPA has estimated that a typical bauxite refining operation produces 2-2.5 tonnes of solids residue for every tonne of alumina produced.

Noise Levels

Local area requirements are for total plant noise levels to be maintained at 70dB(A) during day and 60dB(A) during night hours, measured at the border of the property. All equipment duty specifications include these criteria. Individual equipment noise levels shall not exceed 85dB(A) at 1m, otherwise noise enclosures or control measures are to be provided by the equipment vendors. The majority of process equipment is to be installed within cladded process buildings, which will assist in overall noise management, and mitigate potential impact to neighbouring communities and businesses.

Radioactive Components

Kaolin feedstock to the Altech HPA process has relatively low levels of Naturally Occurring Radioactive Materials (NORM), which undergo only minor concentration through HPA processing. This means that no additional controls of waste streams are required, and the silica sand residues can be re-utilised by other industries. Analysis of Meckering ROM material reported 84ppm of Thorium and 3.8ppm of Uranium. We have calculated these to equate to 0.33 Bq/g and 0.06 Bq/g, which are well below the imposed limits of control for naturally occurring radionuclides of 10 and 1 Bq/g respectively.

In comparison, processing of bauxite for the production of aluminium results in significant quantities of ‘red mud’ residue which pose an environmental risk. Processing of bauxite via the Bayer process results in concentration of NORM in the residue, meaning it is often stored rather than re-utilised. The US EPA estimates that only between 2-3% of all bauxite residues are reused in a productive way.

GREEN BOND FRAMEWORK

As a result of the potential energy savings and reduction in CO_2 emissions that the Altech HPA project offers over traditional processing methods, as well as the company’s general commitment to a sustainable and environmentally friendly operation, a green bond framework has been developed to promote the project to potential green and ethical investors.

ENVIRONMENTAL STRATEGY AND POLICIES

Altech is committed to conducting activities in an environmentally responsible manner. From a starting point of compliance with all applicable regulations, Altech will apply an environmental management system that will ensure the application of the highest practicable environmental standards to our products, services and processes.

Altech aims to comply with all Malaysian environmental regulations as required by law, as well as internationally recognised standards such as the Equator Principles and International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability. The environmental management system shall be developed in accordance with ISO14001.

As part of the Altech management team’s commitment to environmental policy and management, bi-annual management reviews shall be undertaken to ensure environmental audits have been completed and actions addresses, any environmental incidents have been reported and investigated, and all monitoring and statutory reporting obligations have been completed. The management review team shall consist of the Managing Director, Operations Manager, Health & Safety Manager and Human Resources Manager.

PROJECT FUNDING AND MANAGEMENT OF PROCEEDS

Altech has been investigating the use of kaolin in HPA production since 2010 as an alternative to traditional methods using aluminium. A bankable feasibility study (BFS) into the HPA project was completed in 2015, and Final Investment Decision Study (FIDS) released in 2018 signifying the commencement of final stages of financing for the project. Both the BFS and FIDS were completed and issued with the full support of the Altech Chemicals Board of Directors.

Any proceeds from green bonds shall be used exclusively to finance the construction of the Altech HPA plant in Johor, Malaysia. This includes purchase of process equipment, construction of process and ancillary buildings, and engineering and management of the project. The HPA plant shall be defined as the Eligible Green Asset.

Proceeds from green bonds shall be managed by Altech Chemical's Chief Financial Officer (CFO) during the course of the HPA plant construction and commissioning.

IMPACT MONITORING AND REPORTING

Altech shall monitor consumption of the following plant inputs with its Plant Control System (PCS) and Plant Database;

- Natural gas consumption (GJ)
- Diesel consumption (L)
- Electricity demand (MWh)
- Lime consumption (t)
- Kaolin imports data (t)

These inputs shall be used to calculate the HPA Plant's green footprint with the following metrics

- Annual Energy Consumption Reduced or Avoided (GJ/t HPA)
- Annual CO_2 Emissions Reduced or Avoided (t CO2/t HPA)

Annual metrics of the HPA plant shall be measured against the benchmarks set for the traditional bauxite/alkoxide processing route detailed above.

Annual reporting of the HPA plant green footprint once operational shall be reviewed and approved by the Altech Management team and an external auditor prior to circulation to investors.

CONCLUSION

Altech's kaolin to HPA process to be employed at the HPA project in Johor offers significant environmental advantages, with considerably lower greenhouse gas emissions and energy consumption per tonne of HPA produced when compared with current industry standard. It has been estimated that CO_2 production will be 46% lower per tonne of HPA produced, and energy consumption 41% lower than the HPA production from bauxite using the alkoxide method.

The HPA plant has been designed in accordance with both local and internationally recognised environmental standards, and engineering specifications have been made with environmental impact in mind.

A green bond framework has been developed to promote the HPA project to potential green investors, with a clear focus on the green credentials of Altech’s kaolin process, and the proposed HPA plant. Proceeds from green bond investments shall be used for the construction of the companies HPA plant in Johor, Malaysia.