# The Borneo Alumina Indonesia Project's Success in Production

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**Abstract**

The Borneo Alumina Indonesia Project is owned by PT Borneo Alumina Indonesia (BAI), whose shareholders are Inalum and Antam. Located in Mempawah, West Kalimantan Province, Indonesia, it is constructed by China Aluminium International Co., Ltd. (CHALIECO), the EPC contractor. Its technical provider, Shenyang Aluminium Magnesium Design and Research Institute Co., Ltd. (SAMI), implemented basic & detailed design and was responsible for supplying some key equipment. This project is designed with an annual production capacity of 1 million metric tons of sandy alumina using West Kalimantan bauxite. The bauxite is transported by truck to the stockyard outside the alumina plant, and crushed, then is transported by belt into the stockyard of alumina plant, then wet processing. Low-temperature Bayer process is adopted: during which ball mills are used to grind bauxite, with a digestion temperature of 150 °C and a dissolution residence time of 45 minutes. Red mud thickening and washing area uses high-efficiency settlers with diameters of 20 meters, including thickeners and five washing stages, seven effect evaporation and two-stage precipitation process are applied. One calciner with a daily output of 3 000 tonnes of alumina is used for calcination; gas is supplied by the circulating fluidized bed coal gasification technology in the calcination. The thermal power plant uses circulating fluidized bed boilers, with the power generation system combining back pressure and condensation turbines. An isolated power grid technology is used for the first time. The project was successfully put into operation on 30 December 2024.

**Keywords:** Indonesia, Borneo, Alumina production, Greenfield project.

## 1. Introduction

The Borneo Alumina Indonesia Project lies south of the Duri River in Pontianak Count. Its construction site is in northern Mempawah, Pontianak County, West Kalimantan. SAMI's technologies are used in this project. There is Kijing port constructed by IPC (Indonesian Port Company), and the IPC Port is for the public, about 5 km to the west of the project site. Waterway transport via the IPC Port is basic for this project, which supplies fuel and raw materials that are required for production. Those will be delivered to the plant and products will be delivered to the port [1]. Bauxite is transported by truck from mine to refinery.

This project's work scope includes: BAI Alumina Plant, including Thermal Power Plant and Gas Station, transportation between Port and Plant; Red Mud Stockyard, the road from Stockyard to Plant, piping networks and associated facilities; Intake Water System.

The Borneo Alumina Project is the first Indonesian state-owned alumina refinery project , which has achieved efficiency, energy-saving, and environmentally friendly production goals through the use of multiple advanced technologies. The project has a designed production capacity of 1 Mt alumina/year, and its processes include grinding, digestion, red mud treatment, precipitation, calcination, etc., all of which are demonstrative in the alumina industry. In December 2024, the project was successfully put into operation, providing a technical example for the development of high bauxite resources in Southeast Asia. The first batch of 20 kt of alumina has been safely transported to the smelting plant of Inalum.


**Figure 1. Refinery and mine location.**

## 2. Bauxite Supply

The project uses the local bauxite from West Kalimantan, and the mine is 35 kilometres away from the alumina plant. The chemical content of the bauxite is shown in Table 1 which indicates the presence of gibbsite, kaolin, quartz, hematite, alumogeothite and others phases. As a result of combination of calculated and measured values from Figure 2, we have estimated the mineralogical composition of bauxite. The gibbsite is 55 % and the detailed mineralogical composition is shown in Table 2. the Bond Index of this bauxite is 12 kWh/t, and total available alumina at 150 ℃ (TAA) is 35.28 % as $Al_2O_3$.

**Table 1. The composition of bauxite.**

| Item | $Al_2O_3$ | $SiO_2$ | $Fe_2O_3$ | $TiO_2$ | $Na_2O$ | L.O.I |
|---|---|---|---|---|---|---|
| Content (%) | 40.34 | 19.02 | 16.1 | 0.73 | 0.17 | 22.48 |

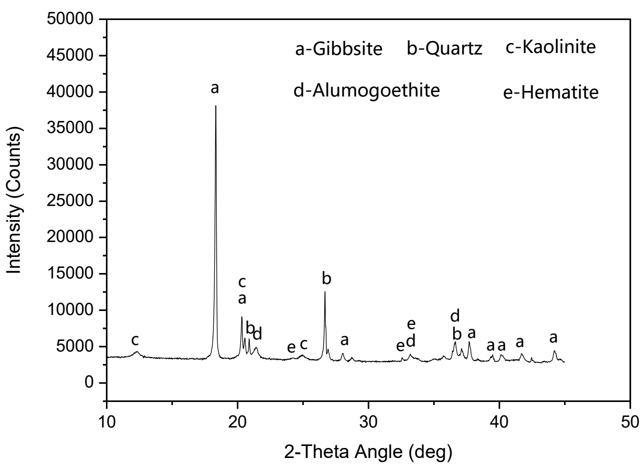


**Figure 2. XRD pattern of bauxite [2].**

**Table2. Mineralogical composition of bauxite.**

| Item | Value |
|---|---|
| Gibbsite (%) | 55.00 |
| Hematite (%) | 5.6 |
| Alumogeothite (%) | 13.5 |
| Kaolinite (%) | 6.87 |
| Anatase/Rutile (%) | 0.73 |
| Illite (%) | 1.27 |
| Quartz (%) | 15.24 |

## 3. Determination of Process Technical Parameters

### 3.1 Red Side

Advanced technologies are used in the red side. In the grinding process we adopt a closed-circuit grinding system comprising "ball mill + curved screen", and the fineness of the slurry is well controlled. Compared with the traditional cyclone classification, the power consumption of this system is reduced, and the wear-resistant design of the curved screen prolongs the life of the equipment.

A digestion temperature of 150 °C is determined based on the bauxite extraction shown as Figure 3. Slurry is preheated by tubular-heaters, the digestor residence time is determined to be 45–60 minutes. The extraction rate of $Al_2O_3$ in gibbsite is more than 97 %. The digestion A/C should be 0.72 with the safety margin from the break point at 150 °C, as shown in Figure 4.

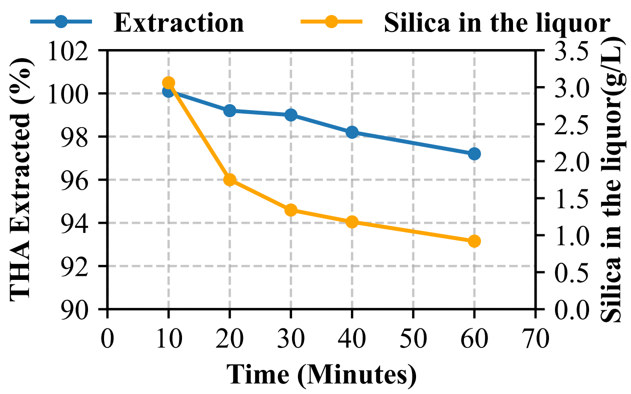


**Figure 3. Alumina extraction and silica in the liquor [2].**

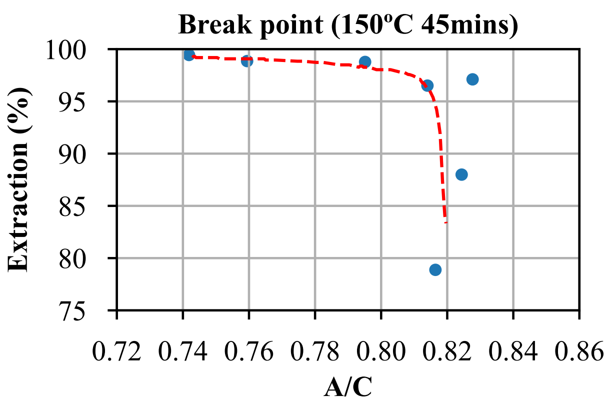

**Figure 4. Digestion breakpoint with BAI bauxite in synthetic liquor at 150 °C [3].**

Advanced deep cone settlers and washers with self-dilution in settlement and separation, 5 times counter current washing process with Outotec's technologies are used, increasing the feed dilution ratio by a circulating pump, with the washing efficiency improved, and red mud losses reduced. The filter press and dry stocking technology is applied for red mud, which can significantly reduce alkali consumption. Sand removal process is applied and is bypassed during trial production.

### 3.2 White Side

Advanced two-stage seed precipitation processes is applied with solid content of 150 g/L in the first stage, 650 g/L in the second stage, supplied with interstage inter-vertical cooler. Two-stage cyclones are applied for particle control, with a target fraction yield of more than 50 %.

Hydrate filtration applied pan filters with counter-current washing technologies; the washing water volume reaching 0.4 t/t dry $Al(OH)_3$ and the resulting moisture of the filter cake is 3–4%.

Disc filters are selected for fine and coarse seed filtration and vertical leaf filter are used for control filtration, ensuring that the solution's suspended matter content will be less than 15 mg/L.

Advanced product quality technologies are applied and they meet the international standards for sandy alumina.

### 3.3 Energy-saving and Innovation Technologies

The following SAMI's energy-saving and innovation technologies are used in this project.

- Unloading trolley is applied for stacking bauxite in bauxite stockyard.
- Gravity curved screen is applied for grading, gravity process achieve energy saving process.
- Digestion flash exhaust steam was used for preheating and pre-desilication heating, flash steam is used in multi-levels for achieving energy saving.
- Little diameter deep cone settlers and washers with self-dilution are used, good settlement effect with less land occupation is achieved.
- HID, leaf filtration, fine seed filtration, hydrate filtration and hydrate cyclone are located in one building, allowing to achieve energy saving and less buffer tank volumes.
- Coarse seed disc filters are located on the tops of precipitation tanks to discharge seed directly, and power consumption is reduced to 15 kWh/t alumina because of gravity process.
- Energy-saving stirring paddles are applied in stirring tanks and stirring power consumption is reduced by 30%.
- Seven-effect falling films are used for evaporation, the unit steam consumption is reduced to 0.2 t/t water evaporated.
- A large gas suspension calciner is applied for hydrate calcination, with a capacity of 3 kt/d, and its heat consumption less than 2.95GJ /t $Al_2O_3$ (low calorific value).

### 3.4 Safety and Advanced Control

An advanced control technology has been adopted, with three main control rooms located in the alumina area, the thermal power plant and the coal gas area. The adopted technical solutions provided for high overall operation rate of the refinery as through the application of large-scale system guarantee schemes, and coordinated protection of isolated networks, the operation rate of the refinery is ensured to be above 95 %.

## 4. Key operational Control and Advanced Product Indicators

Trial production is ongoing from 30 December 2024, the temporary alternative Tayan bauxite was used because the bauxite transportation road was not achievable, Typical alumina content of Tayan bauxite is 45−63 %. The key operation and production index is as below Tables 3−6 [4].

**Table 3. The key control indicators**

| Item | Index in July 2025 |
|---|---|
| Digestion A/C | 0.687 |
| Green Liquor A/C | 0.668 |
| $Na_2Ok$ Concentrations of the green liquor (g/L) | 146.03 |
| $Na_2Ok$ Concentrations of the spent liquor (g/L) | 168.44 |
| $Na_2Ok$ Concentrations of the evaporated spent liquor (g/L) | 202.71 |

**Table 4. The Red mud composition**

| Red mud | Index in July 2025 |
|---|---|
| $Al_2O_3$ (%) | 19.57 |
| $Fe_2O_3$ (%) | 31.52 |
| $SiO_2$ (%) | 26.78 |
| $TiO_2$ (%) | 1.91 |
| CaO (%) | 2.66 |
| MgO (%) | 0.05 |
| $Na_2O$ (%) | 5.41 |
| Alkali content (w $Na_2O$ in liquor/w red mud, %) | 0.32 |

**Table 5. The key operational indicators**

| Item | Index in July 2025 |
|---|---|
| Chemical extraction of alumina from the bauxite (%) | 88.29 |
| Productivity of the green liquor (kg$Al_2O_3$/$m^3$) | 89.2 |

The product quality meets the high standards of international metallurgical grade alumina. The product quality parameters are shown in Table 6.

**Table 6. Product quality parameters**

| Item | Index in July 2025 |
|---|---|
| $Al_2O_3$ (%) | 98.8 |
| Impurity | |
| $SiO_2$ (%) | 0.013 |
| $Fe_2O_3$ (%) | 0.02 |
| L.O.I (%) | 0.96 |
| Physical properties | |
| Specific surface area ($m^2$/g) | 69 |
| Particle size(＜45 μm) (%) | 15 |
| Angle of repose (°) | 31 |

The changing of bauxite and coal from Contract was a big challenge for the ramping up of BAI project, as some updated process works had to be done in order to adapt to new raw materials. Unskilled operators is another challenge because of unskilled operation and lack of knowledge about alumina production. The operational indicators will be better controlled with the skilled operation and alumina production learning in the future.

The big impact for processing is high quartz of Tayan bauxite; firstly it caused jam at grinding, secondly sediments at the bottom of pre-desilication tanks were increasing. Solution measure:1) pipe configuration was adjusted for preventing blockage, 2) stirring blades length was increased and compressed air is added to assist solid passing through pre-desilication tank. The impact of high quartz bauxite was overcome through above methods.

## 5. Conclusion and Prospect

The Borneo Alumina Indonesia Project is the first alumina refinery of Indonesian government allowing 850 employment opportunities to be created for Indonesia. This project allowed to establish local aluminium industry production chain: it has successfully linked the bauxite production of Antam to the aluminium smelter of Inalum.

The Borneo alumina project in Indonesia has successfully solved the processing problem of high silica bauxite through the control of process parameters and the optimization of equipment selection. The operation of this project provides important technical references for the development of alumina industry in Southeast Asia.

## 6. References

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