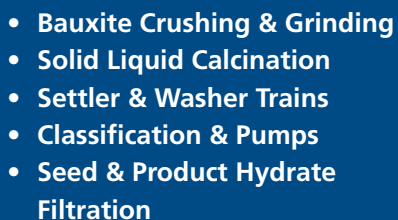


Typical BAYER-Process Flowsheet



Bauxite Crushing & Grinding

Bauxite

Bauxite ore is the major mineral source for extraction of alumina and subsequently aluminium, the most abundant element found in the earth's crust. The name bauxite originates from France where it was discovered. There are three (3) main structural types of bauxite:

- Gibbsite – $\text{Al}(\text{OH})_3$
- Boehmite – $\text{AlO}(\text{OH})$
- Diaspore – $\text{AlO}(\text{OH})$

Each of these three types of bauxite has different chemical and physical properties that make them more or less difficult to mine and subsequently use for economically refine to alumina.

Of the bauxites currently being mined, the dominant form is gibbsite, followed by a mixture of gibbsite and boehmitic. The main impurities are compounds of iron, silicon and titanium.

A large quantity of the world's bauxite is mined from large blanket type deposits with an overburden from 0 to 70 m of rock and/or clay, which may require blasting before loaded by front end loader or shovel and transported by truck, rail or conveyor to the refinery.



4400 t/h Primary ABON Sizer, crushing bauxite



World's largest Rod Mills on Bauxite at Gove , Australia

Processing

At the refinery, the bauxite is stored in a stockpile by a stacker for later reclaiming and processing into alumina. Roller screening of the bauxite to remove coarse waste material may be the first unit operation before the bauxite is crushed in one or more stages to a particle size of about 50 - 75 mm, before being mixed with a hot caustic soda solution in the grinding mills.

Since most bauxite mines are located in the tropics with its rainy season, bauxite processing equipment must, as a rule of thumb, be able to handle wet and sticky

bauxite as well as dry and dusty bauxite, which makes the ABON Mineral Sizer the preferred type of crusher selected for both primary, secondary and tertiary crushing of the bauxite in many cases.

After crushing, wet grinding of bauxite is accomplished in either open or closed-loop milling circuits using various types of grinding mill designs, tailor made to the bauxite:

Ball or Rod Mills, Rod-Ball Mill or SAG Mill

FLSmidth Minerals has operating experience with all the above equipment and cover the complete equipment flow sheet from Run-of-Mine bauxite up to and including the de-silication tank reactor prior to digestion.



2500 t/h Secondary ABON Sizer, crushing bauxite

Solid Liquid Calcination (SLC)

The SLC Process converts spent plant liquor and Sodium Oxalate to Sodium Aluminate and recovers the Caustic from Sodium Carbonate using Bauxite and/or Alumina Dust as solid feedstock.

Liquor Productivity is increased by decreasing content of organic agents and Sodium Carbonate in the liquor, allowing an increase in caustic concentration.

Quality of Hydrate and Alumina is improved by reduction of Sodium in Alumina and production of a coarser Hydrate.

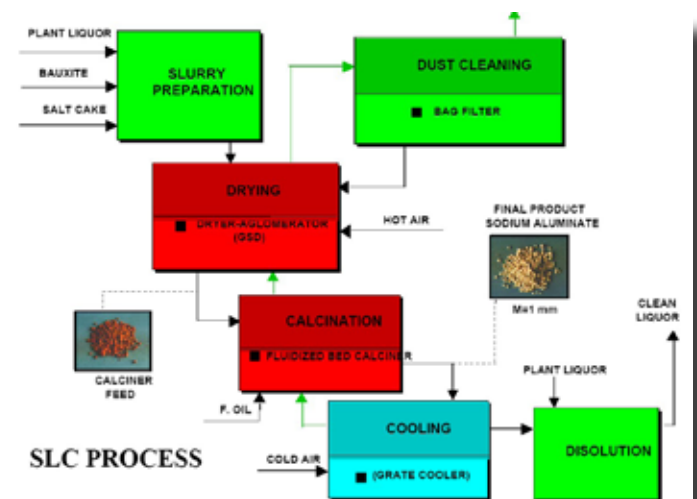
Improved Plant Efficiency is achieved by:

- Recovery of dissolved Caustic and Alumina
- Lower viscosity of plant liquor and pumping power
- Increased settling rates and less foaming
- Utilization of High Organic Bauxite deposits without decreasing Plant Efficiency
- Environmentally Sound processing of Salt cake to sodium aluminate without additional residue generation



2 x 300 SLC Units arrives (as PAM) to the Gove Refinery in Australia

Liquor Purification with the Solids Liquid Calcination Process (SLC)



R&D Timeline of SLC Process

1st Generation 120 TPD Solid Liquid Calciner with Alcan and Alumina Espanola.

1992 - 1993:	Equipment Selection
1993 - 1996:	24 tpd Pilot Testing
1997 - 1999:	Construction of 120 tpd Unit
1999 - 2000:	Commissioning, Demonstration, Consolidation and Optimization;

2nd Generation SLC Process developed with Alcan for Liquor Purification at Gove, Northern Territory

2002:	Pilot Testing - Gas Suspension
2003:	Pilot Testing - Environmental
2004:	Basic Engineering
2004:	Environmental impact study
2005:	Detailed Engineering
2005-2006:	PAM Construction

Settler & Washer Trains



Deep Cone® Paste Thickeners

- Maximum underflow slurry solids and minimum thickener footprint
- Produce uniform, non-segregating paste consistency underflow slurry
- State of the art approach for dry stacking of red mud
- Torque capacities available to 13,500,000 Nm
- 138 Deep Cone Paste Thickeners sold to over 45 operating sites

Main Features

- E-Duc® autodilution and flocculation feed systems (for washers)
- Mud bed in compression
- Rakes with pickets for increase of solids concentration
- High torque drives
- Steep floor slope
- Mud discharge cone with centre scraper
- Designs without bottom bearing available

Hi-Rate Thickeners

- Technology for high specific capacity at reduced footprint
- In combination with red mud drum filters for mud disposal at highest solids concentration and minimum soda losses
- Advanced mud level and thickener control systems available

New Generation of drive heads — A-Type

- State-of-the art design for bridge type thickeners
- Multiple efficiency planetary gears replacing traditional worm gear arrangements
- Heavy duty, high precision 4-point contact ball bearing designed to handle tilting forces
- Reverse rotation feature
- Permanent torque measurement by load cell(s)
- High safety span between design torque, 100% - alarm and cut-off at 180% resulting in extended reaction time for corrections

Red Mud Filter



Advantages

- 22 mm high flow filter cells for highest hydraulic and pneumatic capacities
- Air sweeping device at both ends of the drum cell to assure quick filtrate and cake discharge
- Large diameter (1000 mm dia.) vacuum valve and wear plate with large sealing area for long resistance to wear
- Dedicated discharge roller drive system – allowing for optimising ration of drum vs. discharge roller speed
- Agitator drive is designed for easy maintenance access to the drive, the bearings and the excenters; especially the agitator shaft is divided in such a way, that also inside eccentric-bearings can be dismantled and replaced without disassembling the eccentric and the outside bearing
- Agitator drive is supported on the filter vat (not on the foundation) for best fit of components in the workshop and after site erection
- Robust cake discharge comb in special red mud design
- Agitator pivot bearings can be replaced from the outside without disassembling the drum. They are provided with lubrication points to assure to the bearings a long life
- Mud pockets with sluicing pipes and drainage nozzles to temporarily drain out the settled sand

Hydrate Classification & Slurry Pumping

Hydrocyclones

Hydrocyclones are used in many alumina refineries to enhance classification efficiency. A partial list of applications includes

- Bauxite grinding
- Bauxite refinement
- Sands separations from red muds
- Sand washing,
- Hydrate classification
- Product size control
- Seed size control
- Hydrate thickening
- Deliquoring
- Agglomeration
- Preferential separation/reduction of oxalates,
- Spent liquor solids recovery
- Cooling tower water clean-up
- Lime slurry degritting

The most common applications are sands separation from red muds and the various duties in the hydrate classification and debottlenecking area.

The versatility of hydrocyclones suggests they may be suitable problem solvers in many applications and this must be determined by a step-by-step evaluation. Solutions are tailored to meet the individual plant and operating conditions with hydrocyclones which are a low cost investment item. High efficiencies and outstanding flexibility are combined with simple operation and maintenance without any special space or installation requirements.

FLSmidth Krebs is an innovative hydrocyclone supplier offering experience and value in proving benefits, thorough testing, optimum equipment design, suitable controls, maintenance friendly, and an appreciation of the limits of performance.



KREBS® millMAX™ for the Alumina Industry

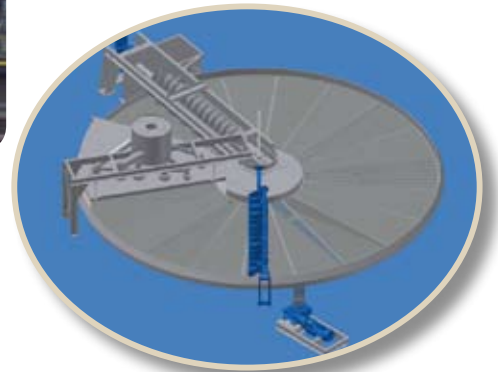
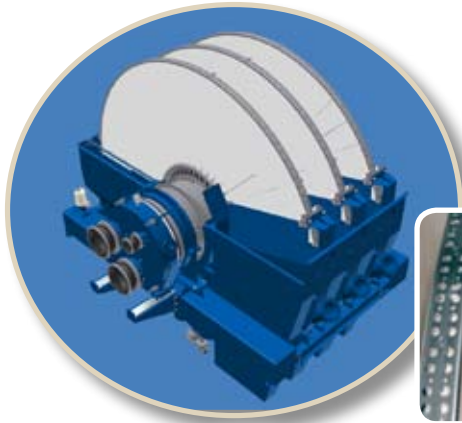
KREBS® millMAX™ Pumps treat the cause of pump wear and loss of efficiency. In most established millMAX™ installations, wear life of parts has been even and in the majority, overall wear life has generally improved by 100%. The increase in wear life is achieved together with a reduction in power consumption typical in the 10-20% or lower range.

The reduction in power consumption can be as a cost saving, or additional pumping capacity with the same installed motor.

- Patented design feature to reduce degradation of solids
- High Chrome Iron Construction
- Reduced energy consumption for same flow/head
- Longer, more uniform wear life
- Optional driMAX™ slurry mechanical seal
- High temperature elastomer seals
- Stainless steel fasteners



Seed & Product Hydrate Filtration



Seed Hydrate Filtration

High Capacity, Large Diameter Disc Filters

The Large Diameter, High Capacity Disc Filter is the state-of-the-art filter for filtration of Seed and Product Hydrate in the precipitation circuit.

- HiFlow hydraulic design for highest filtration capacity and lowest cake moisture
- Reliable cake discharge by advanced blow back design
- Large diameter discs with 5.5 or 6.0 m diameter
- High speed filter with up to 6.0 rpm disc speed
- Multiple discs with up to 6 discs per filter
- Multi-channel design providing 40 channels for 40 sectors per disc
- Optimum slurry agitation by discs running in multiple low volume troughs
- Special design for quick and simple disc replacement
- Improved sector and rim fixing system resulting in proven long-term mechanical and operating reliability
- Extended cloth life time due to modern sector design and improved cloth cleaning features.



Product Hydrate Filtration

High Capacity Horizontal Pan Filters

The High Capacity Horizontal Pan Filter is a highly reliable filter specially designed for the actual needs in the Alumina industry.

- The filter design envelopes a modern synthesis of latest process achievements with reliable and rugged equipment design for highest customer satisfaction
- Advanced filtration rates are combined with most efficient counter current washing technology
- Enhanced product hydrate characteristics achieved through heel cake filtration
- Large diameter pan filters with up to 10 m diameter in successful conventional (71m²) operation
- Advanced self-control features
- Lowest cake moisture through using vacuum steam drying technology
- Special uniform slurry distribution device resulting in even cake build-up
- Reliable cake discharge by wear-resistant discharge scroll
- Highest filter productivity due to extended operation cycles
- Preventative maintenance friendly design

Your Alumina & Bauxite Contacts

FLSmidth in brief

FLSmidth heads an international group of companies supplying the most complete line of equipment for the global bauxite, alumina and aluminium industry. Our brand names include ABON, DORR-OLIVER, EIMCO, KREBS, KOCH, MVT, RAHCO, FULLER-TRAYLOR and MÖLLER getting together under the FLSmidth umbrella.

FLSmidth & Co. A/S is a global organisation based in Copenhagen, Denmark employing about 9,000 people worldwide. It provides the global cement and mineral industries with plants, machinery, services, and know-how.

Ever since its creation more than 125 years ago, FLSmidth has been characterised by innovative thinking and a desire to find the best possible technological solutions for its customer base. Today, more than 650 people of the company's workforce are directly involved in developing the technology of the future.



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