

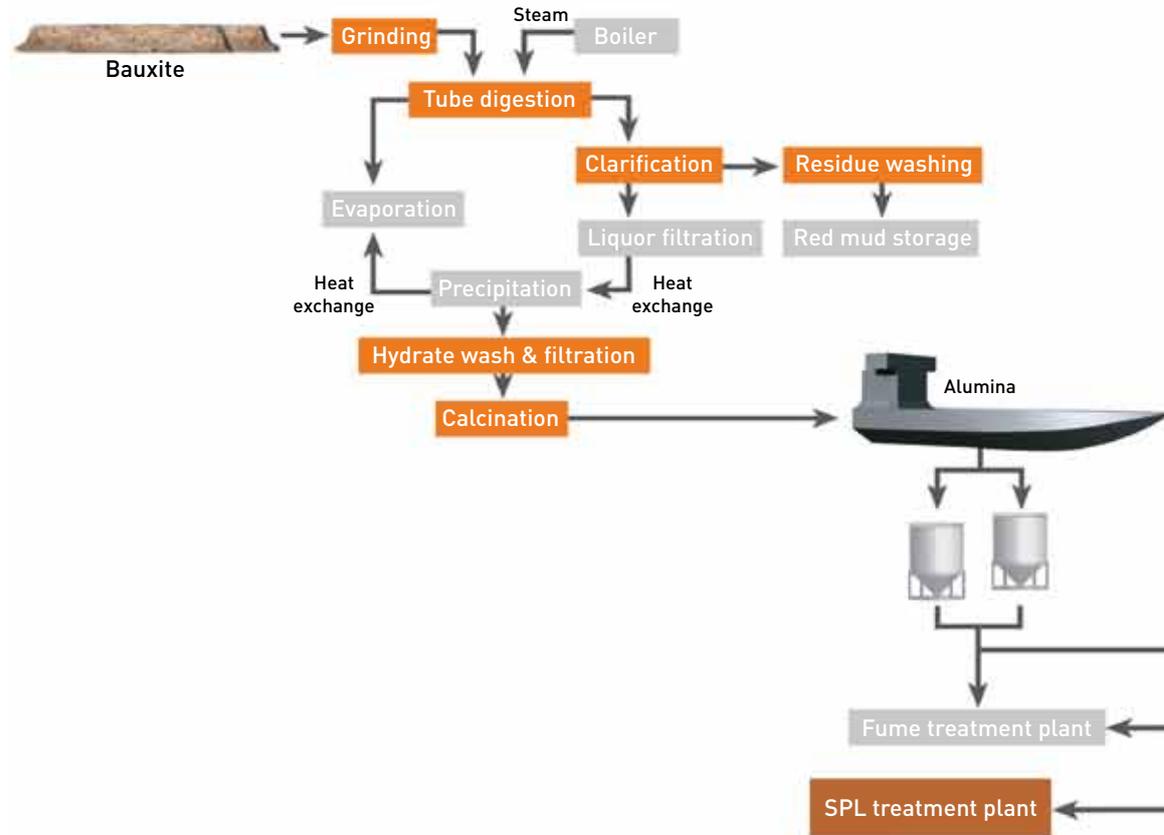


Alumina and aluminium technologies

Outotec's aluminium expertise is a powerful combination of innovative proven technologies. Cooperation and having a team approach enable us to provide you with the best possible service and vast expertise in alumina refining, paste plant and rodding shop as well as casthouse machinery – tailored to meet your specific needs.

Outotec

Proven technologies for the aluminium industry



Experience in aluminium processing and production

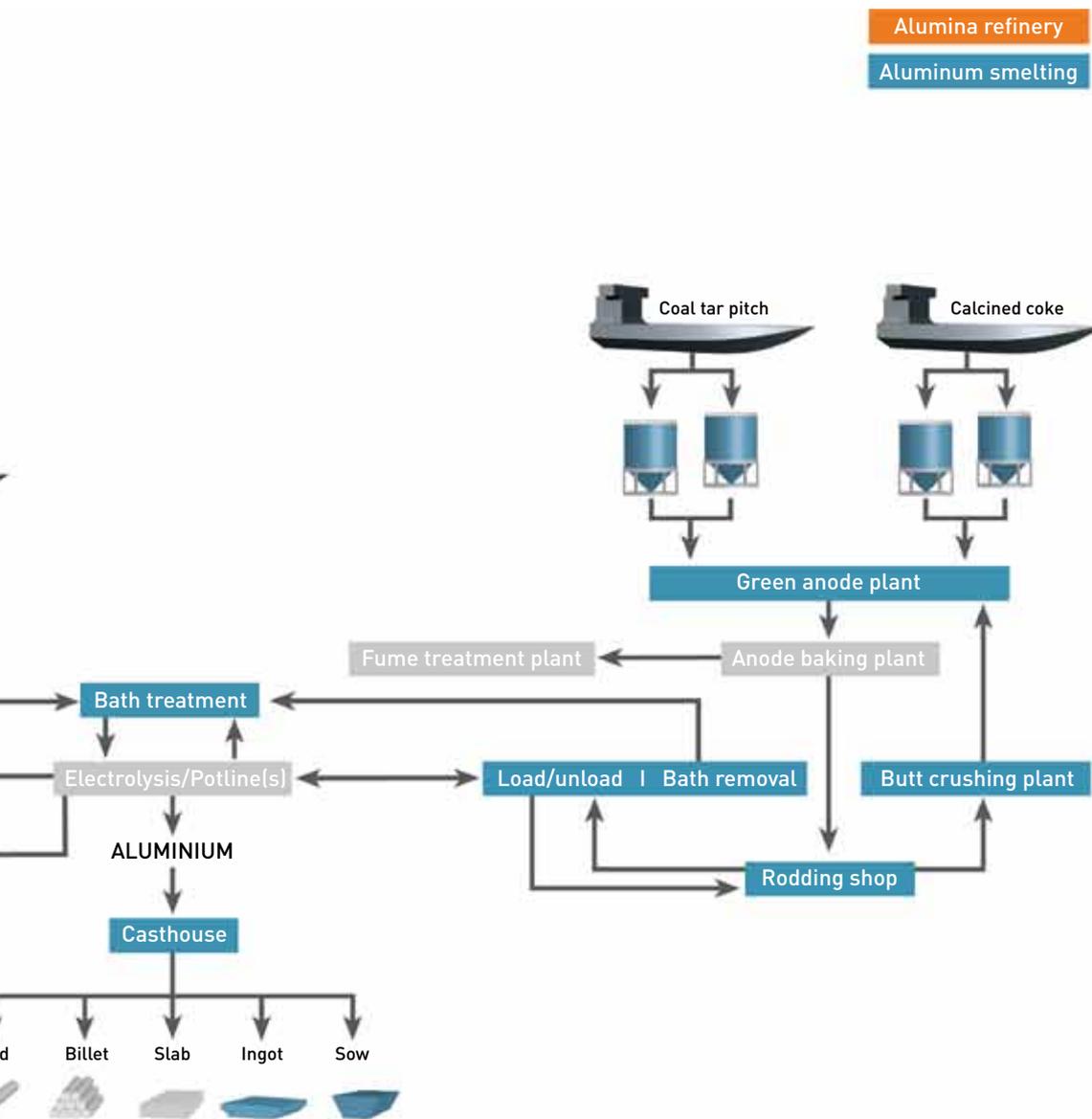
A global leader in the development of minerals processing and metallurgical technologies, Outotec has a distinguished history of achievement going back more than a hundred years. Outotec has a long tradition of developing metallurgical processes, which are environmentally sustainable. The company's aluminium expertise is based on former Lurgi Metallurgie, KHD and AISCO technologies, now united under the common Outotec brand.

In the global aluminium industry, Outotec provides total business solutions for processing and production of alumina and aluminium. Outotec offers you proven expertise in alumina refining, paste plant, rodshop, and casthouse machinery. Today, Outotec's circulating fluidized bed (CFB) technology for the calcination of alumina is the industry standard.

One partner for the plant's life cycle

Early choice of a single technology partner, who can manage production processes and design throughout the entire operation, saves time and money. Without bottlenecks, plant operation is smooth, and profits accrue quickly. Outotec is committed to continuously developing processes and equipment for customers' production plants. Outotec helps you enhance your production process – and will take care of the whole delivery.

As your partner, Outotec offers comprehensive engineering and project implementation services as well as customer support through its worldwide network of service centers. Outotec's qualified and experienced field personnel ensures trouble-free commissioning. Every plant is unique and therefore processes modified to meet specific requirements.



Outotec's long-term commitment and extended customer service minimize operating risks throughout the life cycle of the plant. Cooperation can begin with a feasibility study leading to a lump-sum turnkey plant delivery and, ultimately, to a long-term partnership.

Comprehensive aluminium technologies

Outotec's solutions for the aluminium industry cover proven technologies. Furthermore, we offer professional engineering and project management services based on extensive R&D resources as well as comprehensive technological and business knowledge of metals production. Our global sales and after-sales network is always close at hand when expertise is needed.

Proven technologies for the aluminium industry

- Alumina refinery
- Aluminium smelter green anode plant
- Aluminium smelter rodding shop
- Casthouse
- Services and after sales

Alumina calcination

Calcination is the final stage of the Bayer process, in which bauxite is digested with caustic soda to first extract and then precipitate a pure aluminium hydroxide (hydrate). The hydrate from the Bayer process is then calcined to alumina in a CFB. This step was earlier carried out in rotary kilns, but today all new capacity is installed as fluidized bed calciners.

Due to the homogeneous temperature in the CFB reactor, product qualities regarding specific surface area, loss on ignition and alpha content in the alumina can fulfill the demands of today's aluminium smelters. We have installed more than fifty CFB calciner units worldwide. This represents approximately one third of the world's production of smelter grade alumina.

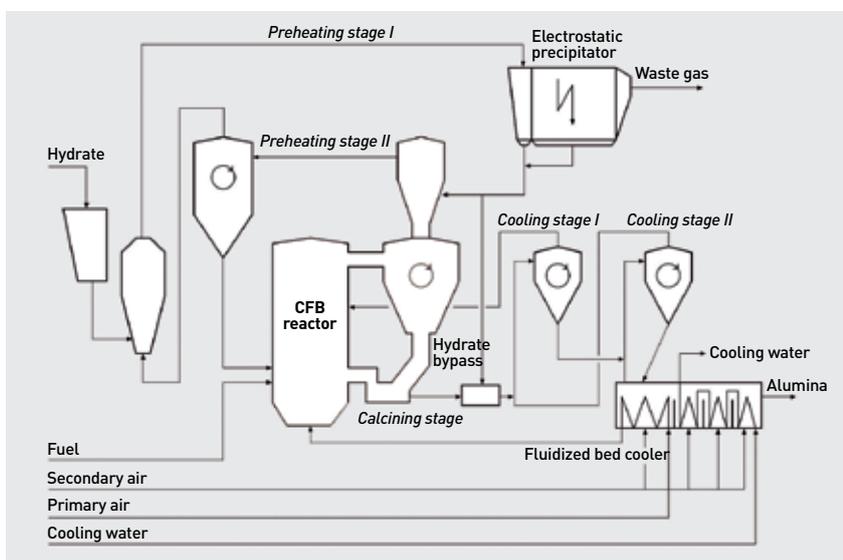
CFB calcination process

The circulating fluidized bed calciners use a multi-stage venturi preheating system to recover the waste gas heat by preheating and de-watering the hydrate. Final calcination to alumina (Al_2O_3) is accomplished in the CFB reactor in which the energy is provided by direct combustion of fuel (oil or gas). The energy of the hot alumina is recovered to the incoming air in a multistage cooling system including cyclones and a fluidized bed alumina cooler.

Some energy of the hot alumina is also used for direct calcination of incoming hydrate in a so-called "hydrate by-pass". This efficient heat recovery system leads to an overall fuel energy consumption of less than 3 GJ/t of alumina for the calcination process. CFB calciners operate in a range from 900 to 1,000°C depending on product quality demands.

Advantages of CFB plants

- Low specific energy consumption – low temperature profile
- Low maintenance cost
- High availability
- Wide range of part load operation
- Uniform product quality – no off-specification product
- Easy and reproducible change of product quality
- Extremely stable and easy operation of the plant without need of sophisticated control equipment
- Low NOx emission



Alumina calcination in the CFB.



"Our goal is to produce the highest quality alumina in the world. In order to reach that we needed two things: the best available technology and the most qualified professionals. Outotec provided us with both. Their technology is reliable and easy to work with. The same is true of their people." Victor César Ribeiro da Cruz, Alunorte, Brazil.

Solutions tailored to your needs

Prior to the application of fluidized bed technology, alumina was traditionally calcined in a rotary kiln. While this equipment has the major disadvantage of high energy consumption, it has one advantage: it is very gentle on the product and thus minimizes fines generation.

You, our customer, want the advantage of low energy consumption that is brought by fluidized bed technology. We also recognise that you want low fines in product.

Outotec set itself the challenge to achieve both of these targets in a single plant. By combining the inherent advantages of CFB technology with knowledge gained from our extensive R&D in the field of solids fluidization and heat transfer, Outotec has, in its latest design, achieved a new benchmark in product quality, allowing you to operate your refinery more flexibly and more efficiently.



PAM deliveries – design and construction of largest possible modules off-site

Outotec's preassembled module (PAM) technology reduces capital cost. PAM enables plant construction even in remote areas with undeveloped infrastructure or lack of skilled workforce. Opting for PAM minimizes on-site construction (structural, mechanical, piping, refractory lining, instrumentation, electrical) and ensures continuation of production at site with minimized interruption during the installation process.

The first PAM delivery of two large calciners took place in 2006 to the Northern Territory in Australia. The calcining units were preassembled in South East Asia and transported by ship to Rio Tinto Alcan Gove.





Green anode plant

Outotec offers the full scope of technologies and processes for green anode manufacturing, for building new plants or upgrading existing plants.



The services cover

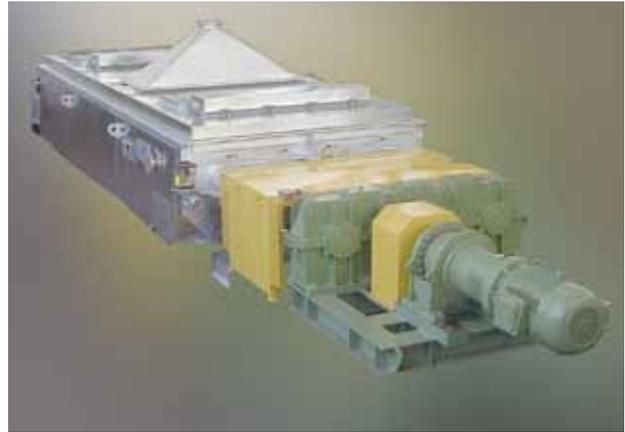
- Basic and detail engineering for complete plant
- Proprietary and key equipment supply
- Site supervision, commissioning and start-up services
- Turnkey plant deliveries, and
- Plant retrofits and machine upgrades

With many years of experience, Outotec is flexible to design green anode plants to the customer's flow sheet or recommend its own process technology. In any case most up-to-date HES standards will be applied.



Liquid pitch facility for bulk storage of liquid pitch

- Special articulated ship unloading arms
- Liquid pitch storage tanks
- Special road tanker loading facilities with fume return line
- Totally sealed pitch pumps
- Nitrogen blanketing system for storage tanks
- Dedicated HTM-systems



Preheating screw used for continuous heating of coarse or fine-grained anode dry aggregate

- Intermeshing of helical flights of hollow screws
- Adjustable speed of screws by frequency converter
- Gentle product conveyance at low speed, with negligible wear on screws



The vibrocompactor meets the growing demand for green anode quality for modern aluminium smelters

- Sliding table and turntable type
- Combination of two or more sliding table vibrating compactors
- Vacuum technology
- Inflatable rubber bellows for vibrating table support and prestressing of cover weight
- Online density control system Densitrol® for consistent anode quality



Hydraulic anode crusher and butt crushing plants to break any size of green or baked reject anode blocks or carbon butts

- Capacity approximately 80-100 butts/h
- Capability to crush full size anodes up to 1700x1200x650 mm
- Pressure type crushing avoids huge amount of fine particles
- Low head room
- Heavy duty design, easy to operate and maintain



Total rodding shop solutions

As your partner we offer

- Basic and detail engineering for complete plant
- Proprietary and key equipment supply
- Site supervision, commissioning and start-up services
- Turnkey plant deliveries
- Plant retrofits and machine upgrades



Load/unload system for multiple rod styles

- Fully automatic – no operator required
- Used with pallet transporter or trailers
- Centering devices for aligning with P&F bells
- Use with bath conveyor in pit or completely above floor level
- 95° pallet dump completely cleans pallet directly into bath conveyor



Primary bath cleaning for both in-line and spider configurations

- Suitable for hot or cold bath
- Hydraulic prebreak station
- Secondary cleaning with hydraulic pushers or flail cleaning
- Final air blow-off
- Fallen carbon conveyor



Butt shotblast machine designed specifically for the aluminium industry taking into account the unique challenge of cleaning bath residue from carbon butts

- 360° rotation during cleaning cycle
- Blow off ensures no carry out of shot
- Steel cabinet with rubber sound insulation and manganese wear lining
- Use of multiple chambers for up to 90 butts/hr



Butt stripping press for the removal of spent carbon.

- Up to 425 mt force for removing up to full size double anodes
- Bottom up or push down styles available
- Bottom up press will break carbon into several smaller pieces
- Production up to 80 rods per hour

Single combination press to strip both carbon and thimbles at same time



Thimble stripping press designed to break the thimbles away from the stubs

- Strip one thimble at a time or up to four at once
- Ideal for both in-line and spider rod configuration



Rod reconditioning after removal of bath, carbon and thimbles

- Rod brushing for removal of marks, chalk lines and scratches
- Graphite coating and stub drying
- Stub straightening
- Rod straightening
- Stub cut off and welding



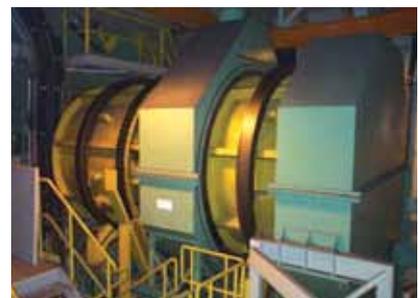
Mating station for aligning rods and carbon anodes

- clamps and guides ensure perpendicularity
- Rod remains attached to P&F carrier
- High productivity
- Simple walking beam or pusher design depending on production rates



Semi-automatic pouring system customized to meet existing furnace and rodshop layout and productivity requirements

- Various ladle configurations
- Can be refilled with ladle in casting car or removed
- Operator control room to oversee complete pouring system
- Single or double casting car system for redundancy



Thimble cleaning drum for cleaning of cast iron

- Manual and fully automated system
- Capacity from 100 kg to 7,000 kg/hour
- Built in dust take off points
- Storage silos, hoppers and feeders also available



Casthouse technologies

Jumbo sow caster with capacity up to 35 tph

- Water or air primary cooling
- Fully automated, single operator
- Pouring from single or dual crucibles
- Robotic skimming, vacuum demoulding
- Weighing, marking and stacking



Rolling slab and T-bar sawline designed to meet your specific needs

- Fully automatic material handling
- Variable cut length
- Weighing, marking and stacking
- Choice of saw types and brands
- Chip collection and briquetting



Foundry ingot casting systems

- Complete supply from furnace tap hole to final strapped bundle
- Automatic pouring to 95% bundle weight accuracy
- Weighing, marking and bundle strapping
- Building and loading of superstacks available

R&D and after sales services

With a growing list of worldwide references, Outotec is continuing its dominance in the supply of technology and solutions of the aluminium industry.

Outotec's extended customer service operates through a global network of service centers that offers not only assistance to the customer's needs but also commitment to provide advanced customer support whenever needed.

With offices on every continent, Outotec has an unparalleled line-up of professionals who are highly experienced and understand exactly what it takes to optimize customers' plants and processes. They have developed, constructed, commissioned and serviced many of Outotec's technologies around the globe. Core experience is, therefore, built on leading-edge technologies, is "hands-on" and focused on ensuring a customer's plant is optimized.

Outotec's extensive after sales services cover

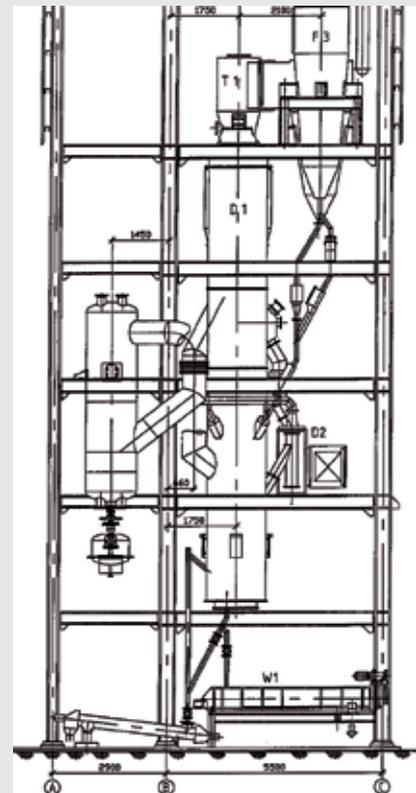
- Site services
- Equipment and plant diagnostic and audits
- Process optimization
- Upgrades and modernizations
- Spare parts
- Training and users' meetings

Innovation through research

To maintain its position at the forefront of innovation, Outotec has two in-house research centers, in Finland and in Germany, with a broad range of laboratories, bench-scale and pilot plants.

These R&D centers are engaged in development of existing and new technologies, process research and measurement and analyses services. CFB test facilities are available at the R&D center in Frankfurt, Germany, for technology development and for testing of customer's aluminium hydrate.

Outotec's largest CFB based test facility is the Circofer® demonstration plant at the R&D Center in Frankfurt. This plant is equipped with a 700 mm diameter CFB, recycle cyclone, integrated heat generator, char separator, magnetic separator, gas cleaning system, and all necessary ancillary equipment.



700 mm Circofer® demonstration plant, R&D Center, Germany.

Outotec develops and provides technology solutions for the sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, Outotec has developed over decades several breakthrough technologies. The company also offers innovative solutions for the chemical industry, industrial water treatment and the utilization of alternative energy sources. Outotec shares are listed on the NASDAQ OMX Helsinki.

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