

# AP Technology™

## Anode technology Leading the way



*Sohar Aluminium,  
Oman (courtesy of  
Sohar Aluminium)*

At Rio Tinto Alcan, we know what it takes to produce high quality anodes: state of the art know-how, unmatched industrial experience, continuous R&D and our advanced AP Technology™ anode solutions. That's why we're the undisputed leader in designing, building and operating paste plants and anode baking furnaces worldwide.

Together these innovations provide you with the benefits of unrivalled performance, low investment costs, continuous process improvements, unprecedented reliability and simplified anode plant construction, commissioning and operation.

Anodes quality is crucial to the safe and optimal operation of any potline. Over the last 20 years, we've focused on developing processes and technologies to consistently deliver high anode quality. Innovations include the SCAP-Rhodax® and Bi-Eirich processes, a high density anode forming solution, advanced baking furnace technology and a brand-new firing system.



*Carbon plant, Mozal smelter, Mozambique (courtesy of BHP Billiton)*

### End-to-end services

Our flexible AP Technology™ anode solution ranges from complete anode plant or baking furnace construction to plant retrofits. Our services include:

- Pre-feasibility studies
- Transfer of anode technology expertise through licensing agreements
- Basic engineering of the paste plant, baking furnace and rodding shop including all handling systems
- Detailed engineering of the baking furnace refractory, insulation and concrete casing
- Supply of our advanced Tiger Firing System
- Training at our Institut Paul Héroult
- Technical support during construction, commissioning and operation
- Refractory supply quality control services
- Lab analysis of raw materials, baked anodes and specific construction materials

### Sohar Aluminium smelter showcasing our industry leading anode solution

- High productivity SCAP-Rhodax® process
- Capex efficient Bi-Eirich mixing line
- Lowest baking furnace capital expenditure due to nine pits per section
- Significantly reduced baking furnace energy consumption of 1.8 GJ/t
- New flue wall and head wall design ensuring refractory stability with heat expansion
- New fire process control methodology ensuring complete combustion of volatile matters

### Advanced anode baking, improved HSE standards performance

Our commitment to health, safety and environment (HSE) excellence is reflected in our anode process technologies. Our baking furnace firing solution incorporates

### Worldwide users of AP Technology™ anode solutions

	Production capacity (kt/year)	Complete anode plant	Baking furnace	Furnace retrofit
Alba 1	84			1996
Alba 2	84			2002
Alba 3	135	1992		
Alba 5	169	2005		
Almahdi	72		2008	
Alouette 1	125		1992	
Alouette 2	169		2004	
Alro	135			2004
Aluar 3	184		2007/2009	
Boyne	235		2012	
Dunkerque	125	1991		
Egyptalum	173	2000		
Guizhou	66		1997	
Hillside 1, 2	270	1995		
Hillside 3	70		2003	
Kurri Kurri	100		2004	
Lauralco	125		1991	
Maaden	480	2012/2013		
Mozal 1	135	2000		
Mozal 2	135	2003		
Nalco 2	105	2003		
Qatalum	340		2010	
Sebree 1	33			2009
Sebree 2	109			2011
Sohar	200	2008		
Tomago 1	135	1983		2008
Tomago 2	90	1995		
Tomago 3	83		2003	
Zalco D	82		2003	

a comprehensive safety system that complies with European standards and is readily adapted to other world standards. This system controls the combustion process and sub-systems, including the fuel and power supply, fume ring main, fume treatment centre and heating equipment. A thorough approach to risk analysis allowed us to develop specific equipment and software, a fume flow per fluewall line monitoring system, safety interlocks, automatic safety procedures and safety-certified hardware (SIL 2).

Our state of the art AP Technology™ anode package includes bake processes that minimise waste and reduce environmental impacts. Thorough combustion of fuel and volatiles in the fluewalls ensures low tar content in the fumes. Our worldwide expertise and sophisticated modelling tools yielded a furnace design that minimises energy consumption and lowers CO<sub>2</sub> emissions. A one-step dry fume treatment centre uses alumina to scrub the fumes without solid or liquid by-product rejection.

### Emission performance

Total particulates	< 5 mg/Nm <sup>3</sup>
Condensed tars	< 2 mg/Nm <sup>3</sup>
Gaseous fluorides	< 1 mg/Nm <sup>3</sup>
Specific flow rate	< 4,500 Nm <sup>3</sup> /t

### Green anode process

With many paste plants in operation and carbon research facilities on two continents, we're focused on developing and optimising green processes to address the challenges of amperage creep and declining raw material quality.

Our innovative approach and extensive experience in green anode processes ensure you benefit from the best basic engineering, specifications, flow sheet and technical assistance, to produce high density anodes.

### SCAP-Rhodax®: a revolutionary process

Developed in conjunction with Solios Carbone at our Aluminium Dunkerque plant in France, this high productivity paste plant process results in an anode with improved density and high resistance to thermal shock cracking. At the Alba and Sohar Aluminium smelters, licensees use our proven SCAP-Rhodax® process to:

- Produce an aggregate with a naturally high grain-to-sand (G/S) ratio after the fines fraction addition
- Lower investment and maintenance costs due to the need for two fractions as opposed to four or more on conventional preparation lines

### The Bi-Eirich mixing line

The use of two Eirich continuous mixers provides an alternative to conventional mixing processes, reducing investment and maintenance costs while producing anodes with similar characteristics. We've gained strong industrial experience with this process at the Alucam (15 t/h) and Sohar Aluminium (30 t/h) smelters. At our Alma smelter, the use of a high throughput Eirich mixer enables paste line capacities ranging from 30 t/h to 70 t/h.

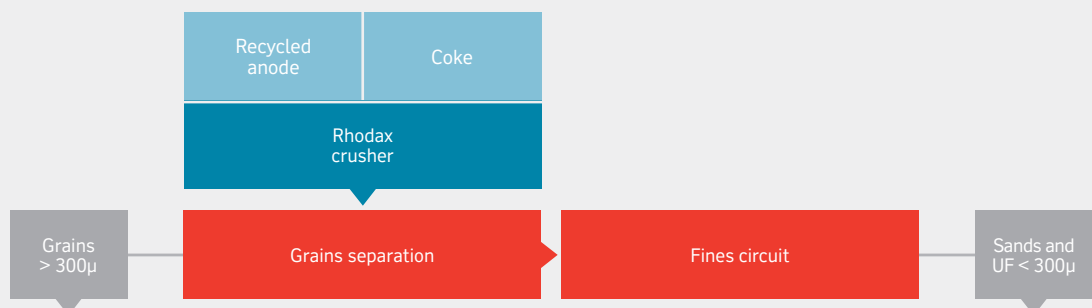
### High densification vibrating compactors with counter pressure and vacuum

Our industrial experience at the Alma, Aluchemie, Boyne and Saint-Jean-de-Maurienne facilities enables us to help optimise vibrating compactors to produce high density anodes. These compactors increase anode density by two to four points with the absence of cracking (baked apparent density above 1.60 with typical coke quality).

Sohar Aluminium,  
baking furnace  
(courtesy of Sohar  
Aluminium)



### SCAP-Rhodax® an incredibly simple and efficient process



## Baking process ABF design

We constantly strive to lower investment and operating costs by providing:

- High anode production capacity up to 85 kt/year/fire and low refractory mass
- 3D modelling to optimise fluewall design for flow and temperature homogeneity, pressure drop and refractory deformation with heat expansion
- New fluewall concepts

AP Technology™ advanced anode technology and know-how produce tangible results including:

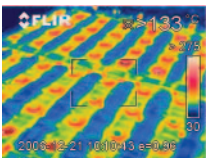
- Low energy consumption

Fuel (oil/gas)	1.8-2.4 GJ/t
Packing coke	5-10 kg/t

- Homogenous level of baking

Typical Lc average	30-33 Å
Standard deviation	1 Å

- Average internal fluewall life currently over 150 baking cycles (about seven to eight years) assuming efficient anode butt cleaning in the rodding shop



Furnace thermal profile

Furnace retrofit capabilities include anode size increases, concrete casing (tub) modification and conversion of closed furnace to open furnace design.

New fluewalls are prefabricated outside the furnace which facilitates fluewall replacement and avoids slowing down furnace production during maintenance.

Our state of the art anode solution is part of our AP Technology™ offer, the industry's most comprehensive smelter technology and services package.

## Tiger Firing System

Our new AP Technology™ firing system is the result of the extensive experience gained from having numerous baking furnaces in operation and of recent developments in carbon research facilities.

In addition to detailed design engineering of the baking furnace brickwork, the Tiger firing control system maximises furnace productivity, lowers fuel consumption and tar emissions, and enables uniform temperature distribution. Key innovations are:

- Global and integrated safety functions including safety-certified equipment and integrated safety management
- Robust design based on operation and maintenance experience
- Automatic control of draft, heating and blowing with operator friendly equipment
- Total flexibility for fire configuration and fluewall line fume monitoring without software reprogramming
- Continuous monitoring of combustion including use of combustion analyser
- New fire process control methodology recently implemented in several AP Technology™ baking furnaces

## Rodding shop and anode handling facilities

Modelling and simulation optimise the rodding shop design (configuration, conveyor lengths, machine numbers and trolleys) and anode handling equipment (furnace tending assemblies, auxiliary cranes and conveyor layouts from the furnace to the storage area). For an existing operation, this resulting analysis allows you to improve the rodding shop performance by reducing cycle time and enhancing reliability.

## Technical assistance

Dedicated and experienced technical support is provided during anode plant start-up and operation.

- Green process optimisation leading to increased anode density and improved thermal shock resistance with high G/S ratio
- Baking process optimisation resulting in decreased gas consumption and tar emissions, and increased baking homogeneity and fluewall life
- Control of carbon dust problems including raw material specifications and baking process optimisation
- Raw material and anode manufacturing process optimisation supported by our R&D programme

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