

Anode slotting 'predicts' improved efficiency

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Two slots being cut simultaneously

T.T. Tomorrow Technology headquartered in Due Carrare in the north-east region of Italy, is driven by innovation in both the main operating sectors, namely:

- casthouse furnace tending equipment and material handling vehicles
- anode handling, slotting, cleaning, cutting and tending lines.

In the last ten years the company has become a qualified and competent development partner for customers about to undertake major investments and aiming to optimise production processes and machinery. TT equipment is well known for its high automation level, and its enhanced flexibility and reliability. Together with the protection of operators and workplace as well as the environment are core goals of the company, recognised by satisfied customers worldwide.

The trend towards energy saving and to efficient materials recovery is well known at Tomorrow Technology: anode slotting technology allows smelters to achieve increased current efficiency thanks to improved pot stability and reduced cell voltage drop, and it is one of the most rapidly developing fields of activity of the Italian company.

Gas bubbles generated during aluminium electrolysis form an insulating film on the anodes. A first dramatic consequence is decreased current efficiency in the cells. Slots represent an easy way to evacuate the gas, which otherwise remains trapped under the

anode. Up to date slot cutting technology can also control the gas exit direction. Gas flow and direction can be optimised by the design of slot shape and inclination. Experience with slotted anodes has proved a further operational advantage: the lower instability level of the metal pad reduces thermal stress and shock in the anode blocks, thus reducing the risks of cracks in the anodes.

"Prediction is very difficult, especially about the future," Niels Bohr, Nobel Prize 1922, said; but the short-term-return through using slotted anodes in aluminium production cells is an easy and powerful prediction.



Anode with deep slots after cut

After having been awarded contracts by two major smelters to study the way to produce, handle and clean (after the baking furnace) the anodes whose slots were formed in the vibrocompactor, Tomorrow Technology knows the problems intimately. Forming slots in the press causes quality loss and many scrapped anodes, so it did not make commercial sense. Despite the apparently low investment cost, the overall costs were higher, since poor performance in the potrooms was compromising the smelters' target of increasing current efficiency.

Anode slot cutting was an early achievement of TT when in 2001 the first anode cutting machine was delivered to Nag Hamadi at the Aluminium Company of Egypt; the first machine operated a wet cut (this was allowed since anodes were cut before the backing furnace) but the interest to develop tools and machines to cut carbon blocks was never neglected by the management of the Italian company. Solid R&D as well as industrial care have been the driving force to develop effective and efficient projects resulting in the automatic slots cutting lines today manufactured by Tomorrow Technology.

TT supplies equipment to handle the baked anodes (usually received at the exit of the cooling tunnel) and to cut the bottom slots in automatic mode. This meets the realisation criteria and the hourly capacity required by the customers, thus resulting in simple, reliable and easy-to-operate equipment (of course, now

speaking of absolutely dry cuts).

The latest model of the TT Automatic Slots Cutting Machine cuts one or two longitudinal slots into the bottom surface of the baked anodes, and has been designed straight or with (variable) slope, and can also interrupt the cut before the end of the anode. Anodes with different dimensions are slotted automatically, even if fed in random order. No particular change or manual adjustments to the machine setting are now required to slot the anodes of different sizes. The machine checks the different anodes entering the slotting device,

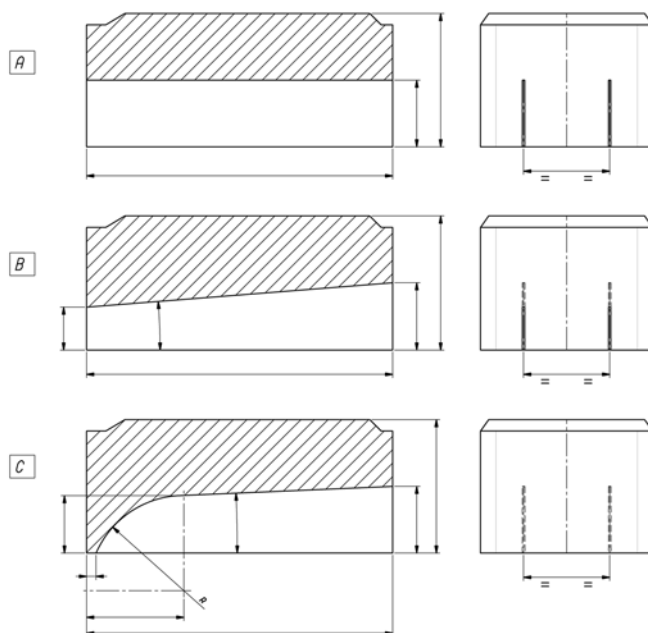
which is automatically adjusted to fit the size of the incoming anodes. TT Automatic Slots Cutting Lines are furthermore specifically designed to minimise operator exposure to any potential hazards, during both operation and maintenance, as well as to preserve good environment and working conditions.

The latest models have been designed to perform three families of slot profiles (as shown in the diagram):

- straight slots (passing through the anode at constant depth): the value of the constant slots depth is adjustable or pre-selectable from the operator panel
- inclined slots: starting from a pre-selectable slot depth, and ending to a smaller depth via a constant slope; the value of the inclination angle is anyway adjustable from the operator panel;
- interrupted slot: while slots are being cut, the blades are quickly removed, so ending the slots; the position where the blades are removed from the slot is selectable from operator panel.

The machine also allows the operator to let the anodes pass the cutting section without being slotted (by-pass mode).

The automatic slot cutting machine manu-



TT Slot Cutting Lines have been designed to perform three different kinds of slot profiles: straight slots, inclined slots and interrupted slots

factured by Tomorrow Technology thus gives maximum flexibility in the selection of the geometrical parameters of the slots. At the same time, smoothness of the machine movements ensures accurate and uniform cutting of the slots, as well as long life of the machine, low wear of tools and reduced maintenance requirements.

As mentioned, the proprietary design of the anodes trolley allows it to work with anodes of different sizes even if fed in random sequence. The set-up of the machine components automatically detects the dimensions of the incoming anodes, and selects the appropriate working parameters. This releases the operators from manual adjustment required to fit batches of different anodes sizes and gives absolute flexibility to cut (even different) slots in anodes with different dimensions.

A special carbon collecting hopper under the blades receives the carbon dust produced by cutting. The hopper also has aspiration ducts to reduce or eliminate such dust entering the cabin. Recovered carbon is transported to storage silos and then delivered to the raw material storage, where it is recycled without any loss.

The duration of maintenance operations as well as time to change the blades are reduced

to a minimum thanks to the proprietary design of the connection of the blades to the shaft. Handling of the blades is helped by the service winch mounted on the arm designed to lift the blades and move them outside the cabin. Life of blades is satisfactorily long, having reached up to 80,000 cuts, thanks to the control program of the PLC developed by TT to optimise the cutting parameters, such as forwarding speed, blade rotation and cutting force.

The operator panel (HMI) is designed to manage operation of the machine and slots geometry as well as to monitor and record all operation parameters and fault alarms. The operator panel also allows control of each movement in manual mode during maintenance.

The TT Automatic Slot Cutting Machines are always enclosed in soundproof and dust-proof cabins, complete with access doors with glass windows, and with anode feeding and discharging openings. Critical sections of the machines may be hydraulically lifted and removed during maintenance operation, thus ensuring the operators' easy and safe access to the various components of the machine.

Design and production of machines to cut slots in baked anodes is a consolidated activity of Tomorrow Technology. The strong demand to enhance efficiency in aluminium electrolysis cells drives a well proven answer in anodes slotting technology. These slots allow better release of the gas produced in the electrolytic cells, lowering ohmic voltage drop between the anode and the cathode and increasing pot stability. The TT management is convinced that this technology will find an increasing number of applications already in the near future. It is easy to implement and gives short-term return on investment thanks to the saving in energy costs and the increase of productivity/cell amperage.

Author

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