FLEXIBLE DEBURRING GRINDING SOLUTIONS
FOR SLABS, BLOOMS, BILLETS AND INGOTS FOR
CONTINUOUS PRODUCTION

by

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Synopsis:

At the end of the continuous casting process, the cast products, such as e. g. slabs, need to be cut to shorter lengths which is mostly done by torches. Torch cutting, however, leaves slag deposits, known as burr or beard, on the edges of the cut product ends. Removal of such burr is essential to avoid defects of the rolled product and damages to the rolls.

Conventional deburring methods, e. g. by means of rotating hammers or shear knives, do not reliably remove the burr from the head and tail ends of the torch-cut product. BRAUN Maschinenfabrik has therefore developed a highly flexible deburring grinding solution (patent pending). Based on BRAUN’s well-proven HP (high-pressure/high-performance) grinding technology, the newly designed deburring grinding machines are able to rapidly, reliably and economically remove burr from both the upper and lower edges at the ends of the cut products. If necessary, the cut surfaces and also the end zones of the top and bottom surfaces of the cut product can be ground as well.

Moreover, BRAUN’s novel-type deburring grinding machines also allows deburring grinding of the longitudinal slab edges (required after traverse grinding of the rolling surfaces of the slab by certain types of slab grinding machines) or deburring grinding of the edges at the ends of round ingots.

The machines can be retrofitted to existing production lines and operate in- or off-line.

Topics: deburring grinding, continuous casting, slabs, blooms, billets, ingots, reliable burr removal, product quality improvement, production process improvement

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1. BASIC PRINCIPLES OF DEBURRING BY MEANS OF GRINDING

Depending on the actual steel grade, more or less heavy, strong-adhering burr at the head and the tail ends of the product has to be removed reliably in order to achieve fault-free surfaces. BRAUN’s HP (high-pressure/high-performance) grinding technology has already proven its worth as the most reliable and most effective, thereby also highly flexible and environmentally friendly way to achieve fault-free product surfaces.

Hot-pressed grinding wheels (see Fig. 1) are the tools, used with high contact pressure and high drive power for the deburring grinding process. In order to meet the requirements of the deburring application with regards to highest removal rates, fully automatic control to reduce labour costs, high reliability and optimum safety, etc., the selection of the proper grinding wheel specification is as important as the utilization of a superior grinding machine.

The abrasive layer of the resin-bond grinding wheel, compressed under high temperature and high pressure, consists of grain and binder. Both components have to be adjusted in the right proportion to each other. The binder, based on phenolic resins, ensures the greatest distances between grains and thus the lowest grain surface density, which contribute to the formation of very large chips compared to the grinding wheel size.

Hot-pressed grinding wheels operate at working speeds of 80 m/s and are thus exposed to high centrifugal forces. Safe machine and process design and compliance with safety regulations are important.

![Fig. 1: Basic structure of a hot-pressed grinding wheel](image)

2. REQUIREMENTS FOR THE DEBURRING PROCESS

The torch cutting process carried out during and after continuous casting results in firing slag deposits on the upper and especially the lower cut face edges, and on the cross-sectional surface of the cast product.

In addition to burner settings, burr and beards formation are strongly dependent on the steel alloy and are particularly noticeable in the case of stainless steel alloys, since steel powder is added during the torch cutting process to reduce material losses. Steel powder residues adhere to the slab surface after torch cutting.
The following characteristics of burrs and beards have been noticed in practice by different customers (see Fig. 2):

- Moderately adhering burrs on the top and bottom of the slab with a slurry of approximately 25 to 50 mm and a length up to the respective slab width.
- Strongly adhering metal powder incenses at the slab top side over the entire slab width
- Strongly adhering slag reflow at the slab top and bottom over the entire slab width
- Strongly adherent local slag baths, usually occurring at the entry and exit points of the cutting burners, at the slab top and bottom

The methods used so far for deburring slabs, billets, and ingots, are either the shearing-off of the burr by means of a shear knife or the removal of the burr by a deburring machine with rotating hammers. Deburring shears machines only remove the bottom side burr, leaving the top side burr to be manually removed. The disadvantages of rotating hammers deburring machines are especially evident for stainless steel alloys, where strongly adherent burrs are not removed and are instead deeply fused into the slab substrate.

Fig. 2: Beard and Burr Formation on Slabs
3. FUNDAMENTALS AND KEY DESIGN FEATURES OF BRAUN’S DEBURRING GRINDING MACHINE

BRAUN’s main goal was the development of a deburring grinding solution to rapidly and reliably remove burrs from the front and the rear ends of the slabs at both the lower and upper edges, or, if necessary, to grind the cut end surfaces. Furthermore, customers also expressed the desire to grind up to about 70 mm in length direction of the slab on the upper and lower rolling surfaces (see Fig. 3).

The limited space conditions in the outlet area of a continuous casting plant, the requirement for easy retrofitting of the system between two consecutive outlet table rolls, and the requirement for a 360 ° rotatable grinding head (see Fig. 4) were the reasons for a gantry-type design of the deburring grinding machine.

Slab surface temperatures up to 900 °C in the deburring area necessitate heat shielding (F) for the gantry frame (A) above the roller table (see Fig. 5). The vertical slide (C), into which the grinding spindle motor is integrated and the horizontal slide (B) move on a linear guide system. At the lower end of the vertical slide, the swivel-mounted grinding head (E) is positioned on a swivel drive (D), which allows the required continuous and endless rotation.
The slab positioning and recognition system (H) locates and positions the slab on the roller table. The chip discharge (G) below the slab ensures a reliable discharge of the abraded material.

4. PROCESS DESCRIPTION AND TECHNICAL DATA OF DEBURRING GRINDING MACHINE

Deburring grinding of the slabs after the continuous casting can take place either inline or offline.

When the slab is entering the area of the deburring machine, the slab head face is recognized by a laser measuring system. Next, the slab is slowed down and positioned via the roller table control. After the slab has been stopped, the position of the slab on the roller table, its thickness and width, as well as its lateral position are automatically determined before the deburring cycle starts.

The following grinding cycles are possible with the deburring grinding machine (see Fig. 7):

- Two grinding passes on the slab bottom side, adjacent to the cut face
- One chamfering pass at the lower cut face edge, across the entire width
- Two grinding passes on the slab top side, adjacent to the cut face
- One chamfering pass at the upper cut face edge, across the entire width

Fig. 7: Possible grinding positions

<table>
<thead>
<tr>
<th>Deburring process:</th>
<th>dry, hot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor power:</td>
<td>60 HP, 1500 to 3000 rpm</td>
</tr>
<tr>
<td>Wheel position:</td>
<td>90° to grinding direction</td>
</tr>
<tr>
<td>Wheel diameter:</td>
<td>1.6 inch</td>
</tr>
<tr>
<td>Grinding pressure:</td>
<td>up to 900 lbs</td>
</tr>
<tr>
<td>Infeed speed:</td>
<td>3 in/s</td>
</tr>
<tr>
<td>Grinding depth:</td>
<td>0.3/64 in</td>
</tr>
<tr>
<td>Total cycle time:</td>
<td>4 min for lower and upper edge</td>
</tr>
</tbody>
</table>

Fig. 8: Technical data of deburring grinding machine
5. SOLUTION FOR LONGITUDINAL DEBURRING GRINDING OF SLABS

Torch cutting is not the only source for burrs on continuously cast products. Traverse grinding of slab rolling surfaces by certain types of slab grinding machines can cause burrs at the longitudinal slab edge. These strongly adhering burrs can be particularly difficult to remove. For their reliable removal from the longitudinal slab corners, BRAUN has developed a different deburring grinding unit comprising two grinding robots (Fig. 9) situated at the slab surface grinding machine exit.

As soon as the head end of the slab is detected by a roller table light barrier, two robots equipped with grinding wheels (one robot located on each side of the roller table) automatically grind the upper and lower longitudinal edges of the slab alternately while the slab continuously moves forward on the roller table (see Fig. 10). Preset grinding pressure is automatically maintained throughout the process. The abraded burr (swarf) removed from the longitudinal edges (corners) of the slab is collected in a moveable spark box. The slab transport speed is supervised by a laser measurement system, which provides the information required for control of the robots. When the tail end of the slab passes the light barrier, the two grinding robots are automatically retracted.

The required grinding wheels for the two robots are stored in a vertical chain conveyor-type tool magazine with an automatic tool changing device. This ensures that all four longitudinal edges (corners) of the slab can be ground with interruptions for tool changes. The unloading of the worn grinding disc and loading of the new grinding disc will be safely done by an operator in a separate loading area without disrupting the deburring process.
6. CONCLUSION

The deburring solutions as described for cast or surface-ground slabs, blooms and billets are feasible and adaptable to specific products requirements. Based on flexible design concepts, deburring grinders can be retrofitted on existing continuous casting lines or condition-grinding plants with relatively low investment costs.

Building on the company’s specific know-how and experience in grinding, and coupled with intensive R&D focussed on flexible, integrated solutions for deburring of cast and semi-finished products, even of round electrodes and ingots, BRAUN has developed robust new abrasive deburring and chamfering solutions for the steel and special metals industry.

References:

