

Optimal commissioning of a 3-roll Reducing & Sizing Block

von Moos have installed a Kocks Reducing & Sizing Block (RSB) in conjunction with an optical profile meter in response to market requirements for tighter tolerances and flexible delivery of small batch sizes. The profile meter enabled the RSB to be commissioned extremely rapidly and significant improvements in reduced changeover and run-in times, and improved throughput, yield and quality have been achieved.

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Key issues for rod and bar rolling in response to a demanding market that requires ever shorter lead times, smaller batch sizes and higher grade qualities are the ability to:

- Allow a targeted combination of mechanical and thermal processes during hot forming
- Enable sustained rolling of very tight tolerances with high yield and efficiency
- Provide the highest flexibility of rolling schedules and size sequence, for example, rolling of related dimensions and free-size rolling

To address these issues, von Moos Stahl AG, upgraded its 20-year-old single-strand wire rod and bar mill at its plant in Emmenbrücke, Switzerland in 2002 with a 3-roll KOCKS RSB and replaced the existing 4 axis optical profile meter with a 6 axis device.

Plant and products

The von Moos product range comprises structural steels, quenching steels, case-hardening steels, easy-machining steels, steels with enhanced cold forming capabilities, and micro-alloyed steels. Annual capacity in 3-shift operation with 16 shifts per week is 400,000t. The billets are provided from the plant's



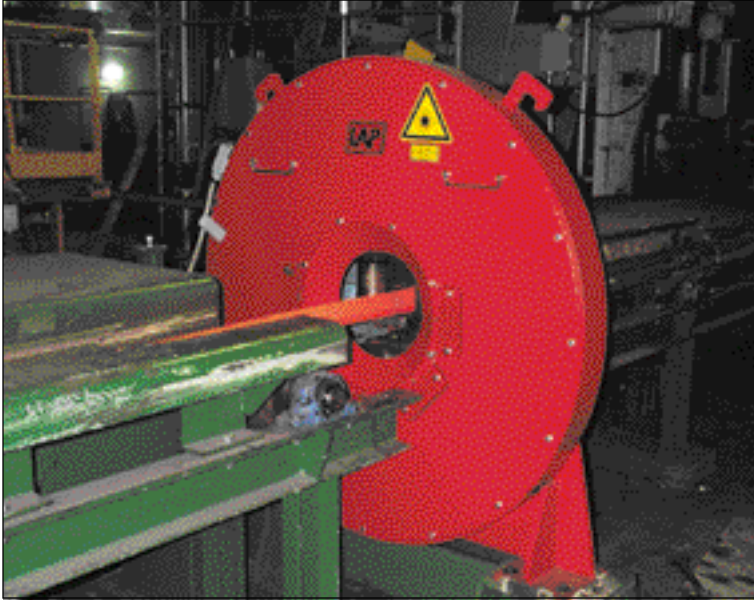
● Figure 1 Kocks RSB at von Moos

own continuous casters. As, typically, only small batches are rolled, size changes are frequent so this requires regular measurement of profile and diameters along the entire rolled stock to quickly achieve the required tolerances and quality standards, especially after product or size changes.

The 5-stand 370mm RSB is integrated into the existing bar mill as a finishing block to produce straight bars from 15.7 to 52.0mm diameter, coils from 16.5 to 38.0mm, and coiled hexagons from 17 to 30mm, and also to supply all the feeder sizes for the wire rod block. By allowing quick changeover between production lines, plant utilisation is considerably increased.

Product dimension measurement

The Global Measurement Group – LAP Laser GmbH, Lüneburg, Germany has been producing laser gauges for profile measurement for steel mills since 1984. Using modern laser technology and powerful Digital Signal Processor (DSP) microprocessors, these gauges measure position, distance, width, length, diameter and flatness of flat and long products. More than 100 gauging systems are in use in the steel industry worldwide. Depending on the task and rolling technology, measurement can range from assessment of only the key dimensions of height and



● Figure 2 RDMS gauge for profile measurement

width, to complete profile measurement. Systems are then appropriately equipped with 2, 3, 4 or 6 axes. Due to the static arrangement every read-out provides an accurate cross-section without the need to wait for completion of a rotation or oscillation cycle, and it was the first system developed to measure the cross-section of long products gap-free from head to tail with static sensors. The collected data reveals all relevant influences in the rolling train, like cross rolls, eccentricity, roll break, push/pull conditions and asymmetric fill.

The true ovality is measured as a deviation between the smallest and largest size in the same cross-section, not as a difference of subsequent readings along a bar, as is the case with oscillating or rotating systems. All results are displayed on the monitor in real time. The following selectable graphics are available: cross-sectional display, line chart of diameters along the bars, numerical display and statistics.

Profile measuring systems (RDMS) installations at von Moos

Prior to RDMS installation of the original 4-axis RDMS gauge in 1997 an oscillating gauge was used but was unsuitable due to high maintenance costs and inaccurate results, causing the operators to mistrust the system. The RDMS gauge was installed in-line behind the finishing stand of the bar mill where a challenge was the space restriction around the RSB, necessitating installation of the gauge 10m behind it. Such a distance means that the bar may have twisted, however, the gauge still needs to measure reliably. RDMS proved successful under these circumstances.

Experience with the LAP RDMS was very positive, providing representative cross-sections up to 400 times per second using laser micrometers which precisely scanned the measured object with laser beams. Even at the highest rolling speeds and in the presence of water and scale, the shape of the object is fully assessed and provided results that were totally dependable and traceable to the product properties. The rapid return on investment guaranteed by LAP was obtained after only 20 months. Only a short training period was required due to its simple operation and comprehensive data presentation, and the rolling mill operators accepted the system very quickly. Maintenance effort was low.

Based on this good experience with this first system von Moos decided in 2002 to install a 6-axis RDMS and relocate the existing 4-axes system to the Stelmor line. 3-roll technology has much higher demands on the 6-axis gauge than the 2-high mill had on the 4-axis gauge because the special characteristics of the RSB can frequently produce asymmetry, which, in extreme cases, result in a three-lobed shape that yields identical diameters under all angles when measured by a vernier caliper or a micrometer, even if it is completely out-of-round. Such bars can be despatched as good products when measured by conventional gauges. LAP has developed a unique patented measurement algorithm for the RDMS that precisely measures the ovality even in cases of three-lobed shapes.

The decision to install a 6-axis RDMS along with the RSB proved very useful during the RSB commissioning phase. The system provided results that corresponded well with readings of manual 3-point micrometers. The new gauge checks all bars from head to tail for compliance with the diameter and roundness specifications. The rolling stand adjustments along the entire rolling train are monitored continuously, allowing the operating personnel to quickly detect deviations and perform corrections. Due to the immediate display of the measured results after the bars enter the gauge, a glance at the monitor provides the operators with precise results.

Furthermore, results of necessary corrections of the mill stand settings are displayed simultaneously on the screen. This was an essential precondition for successful commissioning, and at the same time, the confidence of the operators in the new gauge was reinforced. The finishing roller could experience the relationship between corrections of the roll gap settings, speeds, push- or pull conditions or changes of the leading pass section, and their result on the product and good process knowledge was achieved very quickly.

Costs are lower because mill down time for adjustments is reduced, and incorrect adjustments

and their subsequent correction are avoided. The goal of getting on size during or shortly after the first billet of a new batch is achieved quickly, so producing less faulty material to sort out and recycle. The amount of dimension-related customer rejects at von Moos had been very low before the RSB installation, allowing only small improvements, but attainment of good product is now easier.

There is no longer any need to wait for sample results, which previously took up to 8 minutes, depending on the cooling method. The on-line results allow for immediate intervention in the rolling process and to adjust the stands between billets. Normally, corrections begin during the run time of the first billet. This avoids sorting out startup billets due to tolerance violations and the need for expensive manual re-inspection with downgrading or even scrapping of the entire billet. With up to five size changes per day and the wide variety of steel grades rolled, up to 30 billets can be saved each day. Furthermore, the continuous charging of the rolling train results in stable operation conditions, gaining further valuable mill run time.

Today if the RDMS were to fail, the run-in times would increase, and it would be more difficult to intervene quickly and appropriately. It would also necessitate cutting more samples once again, requiring re-establishment of permanent manual control. This would result in reduced process capability.

It is most important to von Moos that the RDMS provides traceable values to comply with newer quality assurance standards like ISO/TS 16949, and that the system can be interfaced with mill automation systems. The storage of the measured results allows traceability of every billet, statistical evaluation of production data and long-term

archiving. Both RDMS profile gauges interface with the process information and control system and the material tracking system. In both control pulpits and in the QC department, the different graphical screens and the statistical functions are available in real-time, providing full functionality to every user. This ensures the continuous monitoring of the production and comprehensive quality control. von Moos plans to further network the gauges to also allow full data access by management.

Conclusions

The decision to install the RDMS gauge for the commissioning phase of the 3-roll technology already has paid off for von Moos with a very short time for return on investment. The targeted goals have been far exceeded and RDMS has become an indispensable tool for the mill operating crew. The measured values are so dependable that von Moos will completely eliminate sample cutting for off-line measurements in the QC department once a process capability index C_{pk} of better than 1.33 has been achieved. The RDMS results alone will then be used for release of shipments and documentation for the customers. Based on the successful use of RDMS, von Moos are convinced it will be able to further improve process capability and to assure even tighter tolerances on its products.

The manufacturer of the RSB, Friedrich Kocks GmbH & Co. KG, confirms that the use of the RDMS gauge proved to be very efficient for commissioning of the block, leading to the decision to use the RDMS gauge as a standard tool for commissioning of RSBs in the future.

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