Keeping rolls in trim

Strip mill rolls are at the heart of an efficient, high quality operation. Automated management of roll handling logistics and grinding can improve quality, output, operator productivity and safety, and reduce roll inventory and movements. Automated roll grinding facilities are modular and can be retrofitted or green-field installations.

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Strip producers who do not have a well designed roll management system as an integral part of their operations are at risk; in the worst circumstances, work rolls can literally explode. The quality of resurfaced mill roll assemblies from the roll shop are a constraint on the overall quality and safety of all types of mills. Leading mills keep rolls in good condition to ensure that their strip output consistently stays within ever tightening customer specifications for surface quality, flatness and thickness.

For decades rolls have been kept in trim by removing them from the mill stands and resurfacing them in a roll grinder to restore their dimensional, geometrical and structural characteristics. As the components at the heart of producing flat steel, work rolls in particular take a great deal of punishment. Made from a range of sophisticated ferrous alloys, they and their supporting collection of back-up and intermediate rolls need regrinding at various intervals.

Back-up rolls might loose 0.5 to 3mm from their diameter on grinding, the frequency of which varies from several days to several weeks. Work rolls are ground more frequently, typically varying from a few hours to a few days. Usually 0.1 to 1.2mm is ground from the diameter to restore surface finish, remove damaged material or roll defects detected with automatic roll inspection systems, and restore dimensional accuracy around and along the roll.

Worn rolls in cold mills show deterioration in surface roughness, which means that there is not a significant change in the diameter of the roll. Cold mill work rolls, therefore, might need only 0.1 to 0.3mm ground from their surface to continue imparting the exact thickness and surface finish needed for cold rolled flat products. Hot mill rolls show measurable wear, which accounts for more material removed in the roll shop to restore dimensional accuracy. Newer roll materials are increasing roll life, particularly in the hot mill but, not surprisingly, these are also more resistant to grinding, demanding more sophisticated grinding wheels and tighter control of machine setup.

Both hot and cold mills need rolls with consistent, high surface quality, as well as an optimised roll shop layout. Often these shops are shared between several mills, and consequently must have the flexibility to change setup easily, and to process rolls quickly to service complex rolling programs.

AUTOMATING THE PROCESS

While the long established fundamental purpose of a roll shop is fairly straightforward, the manner in which the work is done has been transformed by automation over the last 15 years. Advances in IT are enabling the benefits of automation to reach into every corner of plant operation. The reasons for automating a roll shop are safety, quality, predictable output, increased operator productivity, reduction of routine human intervention and optimised management of roll inventory and movement.

Since mill rolls normally weigh between 5 and 50t, conventional manual rigging with steel cables or fabric webbing slings, or lifting with manually controlled cranes risks damaging both them and the grinding equipment, and also has inherent risk for work crews. It is, therefore, much safer to automate the process. Efficient roll transfer to and from the mill bay and roll shop bay, sometimes through a cooling station, and movement within the roll shop itself - between grinding machines and storage racks - needs careful planning. Roll flow is a key aspect for the success of a fully automated roll shop; the study of roll movement into, out of and around the roll shop is the starting point of any good engineering plan to determine its layout.

If the mill bay is close to the roll shop, Tenova Pomini can supply a fully integrated transfer system, or it can provide control software for transfer cars or other hardware provided by the mill manufacturer. A modern, fully automated roll shop supplied by Tenova Pomini in the Netherlands has a roll transfer car supplied by the mill manufacturer, but Pomini installed the software to control the transfer car movements in the roll shop bay, in order to fully automate loading and unloading.

In a fully automated roll shop system, each roll has a...
The number of different roll designs runs into the thousands and, while most can be accommodated automatically, a few cannot. Every roll shop has to be tailor made, but while an automatic loader to move rolls in and out of the grinding machine is the fundamental and mandatory part of a fully automated system, additional levels of automation can be added to this basic system in a modular fashion.

Properly equipped with safety barriers, a fully automated roll shop needs no manual intervention apart from occasional scheduled equipment maintenance and replacement of consumables, like the grinding wheel itself. A planned maintenance check can be timed to coordinate with the mill overall planned maintenance activities, and a roll shop predictive maintenance system can automatically inform the operators if they need to intervene in the meantime. This can be done by conventional alarms on operator screens and via internet-based systems to alert supervisory or support groups.

SOME EXAMPLES AND TRENDS

Supplied by Tenova Pomini in 1989, an installation in Indiana, USA, was probably the first automated roll shop...
in the world. The package included two roll grinders and one roll loader for the cold mill roll shop, and four roll grinders and one roll loader for the hot mill roll shop. The hot mill roll shop initially comprised a single loader and three work roll grinders - all controlled by one operator from a remote control room. A fourth work roll grinder was added to the automated roll shop area served by the same roll loader in the early 1990s, owing to a significant increase in production of the mill.

Since then an increasing number of mills have automated at least part of their roll shops, while a few have chosen total automation (see Figs.1 and 2). In the mid 1990s, an Australian client installed a remotely controlled Tenova Pomini system for a cold mill, and another customer in Italy, installed a hybrid plant serving both hot and cold mills in 1998. Subsequently, mills in the USA, Taiwan, the Netherlands, Mexico, Finland, Canada, Spain and China have installed Tenova Pomini’s flexible and highly automated roll shops. Globally, a low percentage of mills are fully automated and, although there is a trend for increased automation, there is still a large potential market for future automation. A mill contemplating installation of four conventionally operated roll grinders would be advised to compare the capital expenditure required for fewer grinders integrated into an automatic roll shop system.

Unsurprisingly, Western steel producers have been the most enthusiastic installers of automated roll grinding equipment to date - keen to counterbalance their more significant labour costs in comparison with other areas of the world, and to deliver consistently high quality products. Tenova Pomini has an estimated 40-45% of the global market for roll grinders, but a much bigger portion of the automated roll shops being installed, and is optimistic that more orders for automated systems will come from both Eastern and Far Eastern countries in the future.

The split between the installation of automated roll grinding equipment in new mills and retrofitting for existing ones is roughly equal. Tenova Pomini supplies complete turnkey packages or separate modules to order, leaving space in full roll shop designs for extra modules when required.

The company has a continuing R&D program calling on the extensive expertise of its own engineers and technicians, as well as partnerships with cooperative and supportive customers. It also draws on feedback from university projects and independent research centers, and activities with both mill and roll suppliers. Tenova Pomini can also call upon the steelmakers within the Ternium Group - Siderar, Sidor and Hylsa - which are part of the Tenova organisation, as the company strategy has been the parallel and coordinated development of hardware and software by remaining the owner and the developer of the expertise. Dedicated engineering resources within the team work on R&D and automation, supported by the other engineering offices within our business unit. This provides the best opportunity to find advanced solutions to optimise designs and plant performance for customers. A very wide range of tailor made software solutions has been developed using increasingly reliable and widespread platforms such as the Siemens 840D system and Advantech industrial PCs. In this way it is easier to integrate the roll shop in higher level mill computers. The programming languages and operating systems are also market standard, as they offer a greater potential for application evolution and development.

Tenova Pomini is certified to ISO 9001, 14001 and ISO 18001.

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