Maintaining Rolling Mill Performance

Part 1: Why Does Rolling Mill Performance Decline?

By Tom Farley & Dan Miller, Innoval Technology Limited

The performance of a rolling mill will be a combination of several key parameters including mill productivity and product quality from the mill.

The performance will decline for many reasons as the mill ages and these will be discussed below. However, it is also important to consider the development of performance in a **new** rolling mill and how this can decline for comparable reasons which must be controlled to maximise the benefits from such a capex investment.

Figure 1 shows a schematic graph to illustrate potential changes in mill performance from installation and commissioning to later periods in the mill's operating life.

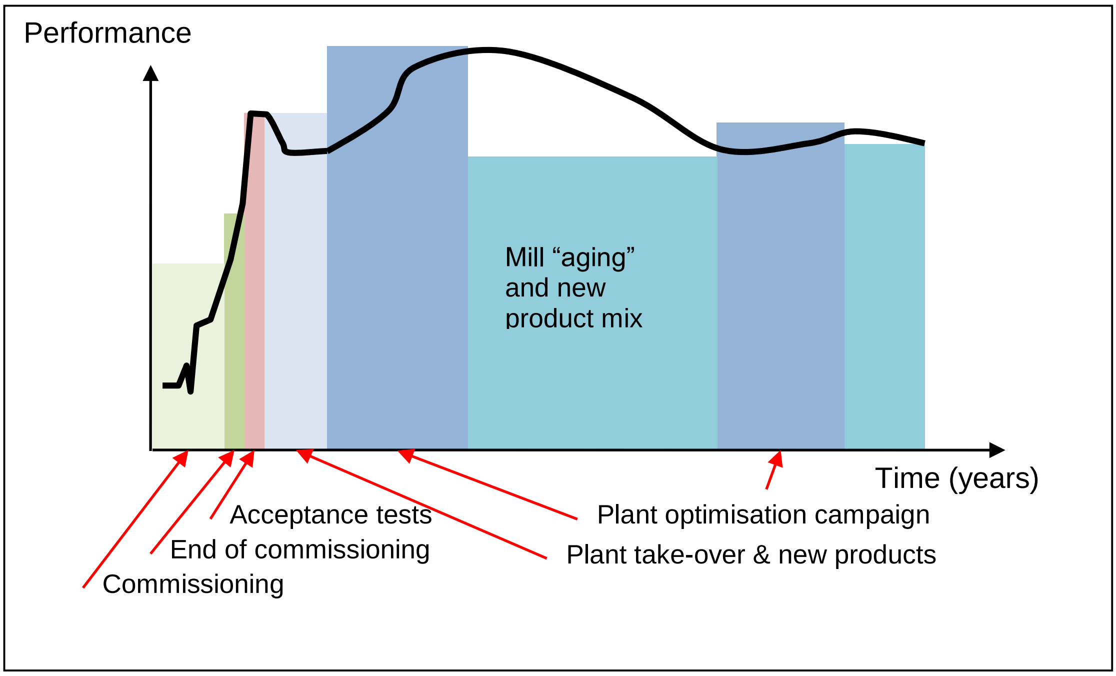

Figure 1 Typical performance characteristic of a mill during its lifetime

When the mill commissioning period ends there may be a drop in performance as the client takes complete control of the mill, rolling without the experienced support of the supplier's engineers before the client is fully used to all new features, and because the client may also start to roll a wider mix of products compared to those defined by the guarantee tests. Gradually performance recovers as the client optimises the process. It is worth noting that when the client buys a Danieli rolling mill, Innoval Technology can be on-hand to support the client during this difficult post-commissioning phase to ensure faster and continued improvement in performance up to world-class levels.

Once peak performance is achieved, there is always a need to counter any issues arising that will lead to a decline in performance if left unsolved. Often performance will decline over several years and this will trigger campaigns of mill optimisation to return performance to previous high levels. This article will identify and discuss some of the factors that can result in a declining mill performance.

There are several reasons why a mill's performance declines. As the mill is utilised more, the owner will push the mill to its limits, increasing speeds and reductions. At the higher values, the ancillary functions of the mill may perform less well and problems with surface quality, oil carry-over and ironing roll control may become constraints. Moreover, during a period of years, the product mix may change, the customer specifications are likely to become tighter and competition from home and abroad requires cost cutting and product differentiation. Unless the plant has the skills to adjust the tuning parameters of the mill's on-line control systems, a mill that was tuned at the time of commissioning may not meet the desired quality requirements of the new products. External support may be required to retune control systems to achieve high levels of performance.

Because the mill is a rotating machine subjected to high forces, energies and temperatures, maintenance is critical to retain a high level of performance. This may involve strategies to measure the condition of key components to ensure they are replaced before performance is compromised.

Interestingly, a new machine may actually receive less maintenance attention than an old machine, and this can lead to early deterioration of mechanical components, coupled with an increase in surface defects and vibration issues.

If the mill is not maintained correctly then there will be a decline in performance due to the following issues:

- Wear and damage in rotating components such as drive couplings, bearings, gears, etc. will lead to increased levels of forced vibration on the mill and potential mill vibration and chatter problems
- Damage to critical components such as cooling sprays (changes in orientation and nozzle angles) will degrade the performance of the hot mill profile control or cold mill flatness control systems
- Leaks in oil systems will lead to contamination of fluids such as cooling oils or emulsions and this will often result in strip surface defects

Figure 2 shows some typical damage on the bearing race of a work roll that has the potential to cause chatter marks during rolling. This type of damage can be caused even on new rolls by poor removal and re-assembly of the bearings on the roll necks. Similar damage can be found on bearing roller elements. This type of wear can be detected by vibration monitoring during rolling.

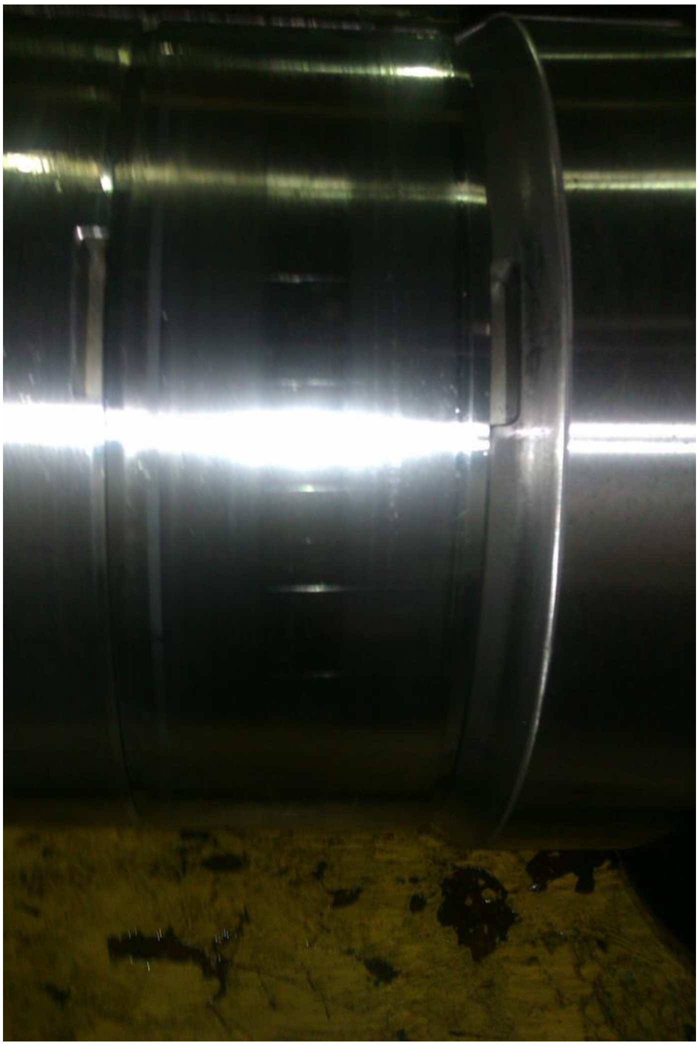

Figure 2 Example of scratches on a roll bearing surface that can cause vibration chatter issues during rolling

Figure 3 shows contamination levels in the rolling oil which indicate clearly a leak in the hydraulic circuits affecting the performance of the rolling oil used on the mill.

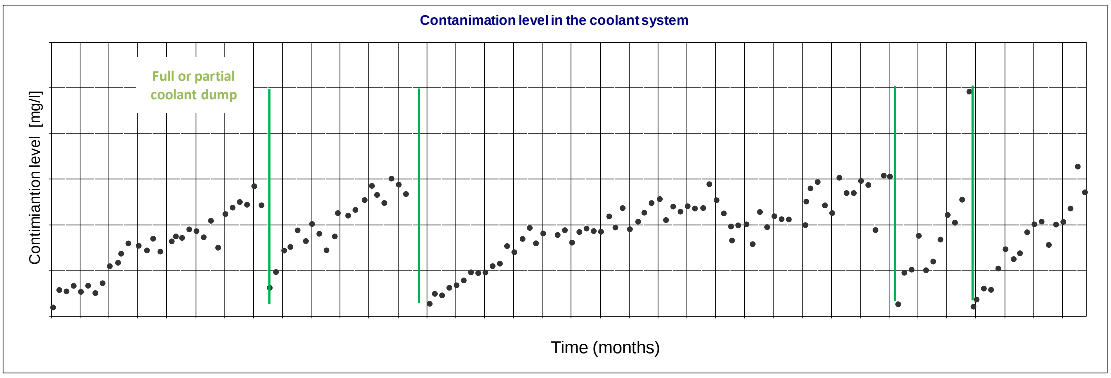

Figure 3 Contamination levels due to an unidentified leak leading to poor performance and regular oil dumps

Of course, there is also anticipated wear and consumption of materials. For example, the diameter of the work rolls will decrease after each regrind. As the diameter decreases, the hardness of the roll may ultimately drop leading to issues of roll eccentricity. A smaller roll diameter also affects the overlap of the individual spray patterns giving poorer across-width spray control and hence less ability to meet flatness targets (**Figure 4**). Only one supplier (Danieli) addresses this through a patented system for maintaining the stand-off distance between the sprays and the work roll.

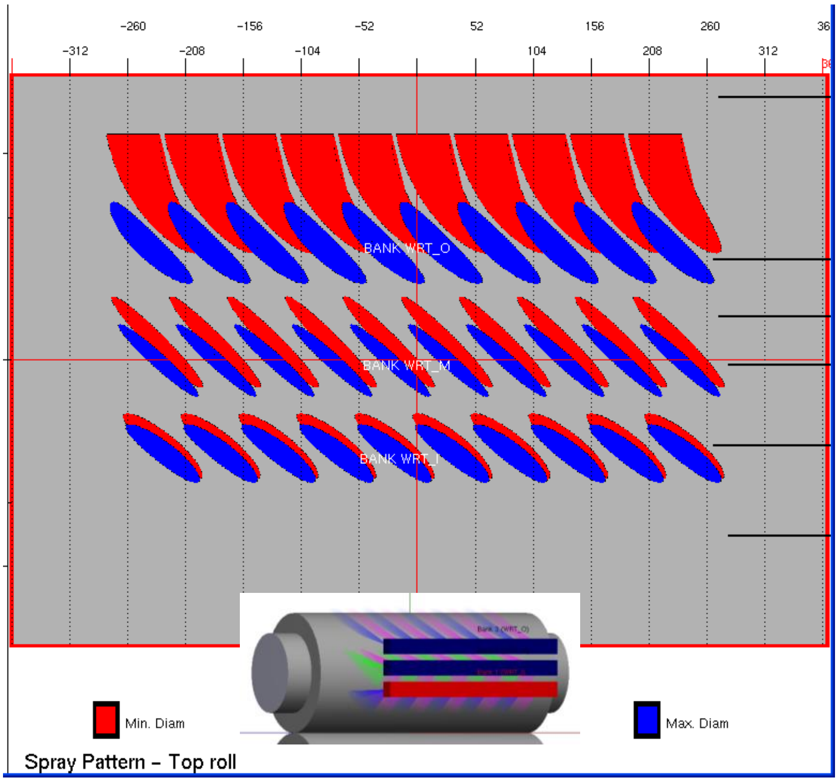

Figure 4 Impact of a smaller work diameter on spray overlap

In the next article we shall describe how auditing mills allows the key issues to be identified and permanent solutions put in place together with performance metrics to ensure the quality does not deteriorate or drift. The final article in this series will describe how to avoid the problems of new mills declining in their efficiency through good design, training and technical support.