Services to target improved VRM efficiency and productivity

Vertical roller mills (VRMs) play a decisive role in ensuring efficient, stable and cost-effective cement production. However, over years of operation, many mills - regardless of manufacturer - gradually lose performance, leading to higher energy consumption, reduced throughput and increased stress on upstream and downstream processes. A comprehensive VRM service provides plant operators with a clear, data-driven path to recover lost efficiency, stabilise operation and optimise long-term performance.

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After years of operation, vertical roller mills require an advanced, holistic inspection and optimisation programme to improve their performance

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Vertical roller mills (VRMs) are the beating heart of modern cement production. These mills combine grinding, separation and drying within a compact machine, and their efficiency determines energy consumption, product quality and overall plant availability. Over recent decades, numerous VRMs have been installed.

However, many of these mills are no longer in optimal condition after several years of operation. Furthermore, the development of these mills also continued, and mill concepts have been constantly optimised and redeveloped since then. Often, the reduced throughput of the mills results in a decrease in the productivity of the upstream and downstream plant sections, as well as a considerable increase in specific energy consumption.

To address these challenges, an advanced, holistic inspection and optimisation programme is designed to restore and elevate mill performance. Besides a possible on-site enhancement of the mill, this programme also includes recommendations for possible mechanical and digital upgrade packages.

Expert Service: the mechanical and process technological check for VRMs

Through an in-depth mechanical and process technological assessment of the entire grinding circuit, operators gain full transparency on the current state of their mill.

During the Expert Service, specialists analyse the entire mill system. In addition to the mill, they examine the complete grinding circuit, including the separator, coarse feed valve, fan, cyclone and filters.

The check includes measurements during operation as well as inspections, such as of the grinding compartment during stoppage. This ensures a complete picture of the mechanical condition and the specific operating conditions of the plant. Following the analysis, clear statements can be made concerning the condition of the dam ring, guide vanes or separator, the grinding bed height, the quantities of false air, the air velocity in the nozzle ring area, the gas flow volumes, the wear behaviour and the feed material. Additionally, the establishment of a heat balance or the calculation of specific energy consumption can also be part of

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Figure 1: model of a VRM separator

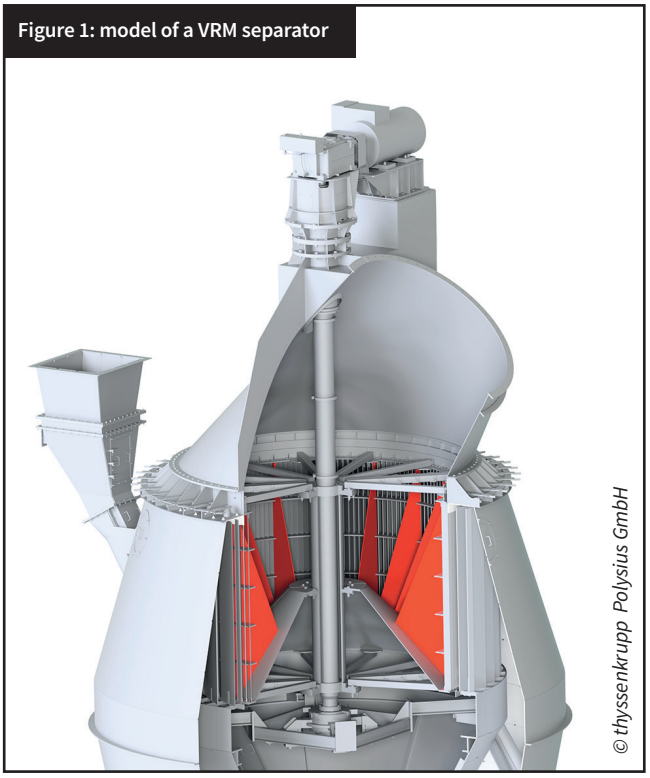

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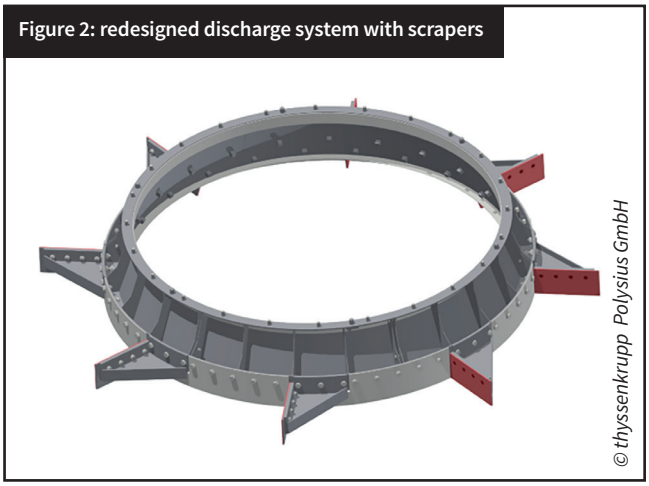
Figure 2: redesigned discharge system with scrapers



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the Expert Service.

From these findings, optimisation potential is identified and a detailed action plan is developed. Many measures can be implemented directly on site in close collaboration with plant personnel. Plant operators benefit from practical advice, staff training, recommendations for spare parts management and strategies for further optimisation.

Experience shows that plants typically achieve a production increase and a reduction in energy consumption of 5-25 per cent within just one week after implementing the recommended measures. Additional benefits of the Expert Service include:

- lower operating costs
- optimised mill operation
- extended service life of mechanical components
- calculable spare parts stocking and improved maintenance planning.

An Expert Service was recently carried out at two plants in Africa where two different VRMs were assessed.

The first analysis focussed on one of the largest and oldest VRMs of its type, commissioned in the 1980s. An on-site audit enabled a full mechanical and process check. Several key findings were identified to help restore stable and reliable VRM performance. The audit highlighted the root causes behind operational instability and mapped out corrective measures designed to improve availability and reduce power consumption. Short-term corrective actions were defined to achieve stabilisation, while long-term improvement measures and critical spare parts were identified to ensure sustained energy efficiency, lower life-cycle costs and a strong return on investment (ROI).

The second case concerned a third-party VRM. A detailed mill review was conducted jointly with the plant's operations and maintenance team, examining operating data, machine specifications and the impact of several proactive upgrades introduced during the latest shutdown. These measures had already contributed to improved operating behaviour and provided a solid basis for further optimisation. Building on this foundation, the Expert Service identified opportunities to reduce wear, enhance output stability and strengthen long-term process efficiency. Clear operational recommendations were formulated to ensure consistent mill performance and secure future savings in energy demand and maintenance costs. This collaborative approach underlined how even high-performing mills benefit from targeted checks that reveal additional optimisation potential.

For operators of dorol and quadropol® mills, as well as third-party VRMs, the Expert Service provides a rapid, data-driven path to sustainable improvements in mill performance, energy efficiency and operational reliability. By combining in-depth technical analysis with practical on-site solutions, these services can help cement producers worldwide to maximise the value and longevity of their VRMs.

Mechanical upgrades

With the ongoing pursuit of higher energy efficiency and increased throughput, many cement producers are looking for ways to enhance existing VRMs. Because mill development has continued over the years, earlier equipment generations can benefit significantly from further developments or retrofitted design improvements.

It is evident that some machines installed many years ago, and now operating for decades, can be enhanced by adapting these advancements.

One of these developments is the swirl breaker – a retrofit component designed for the separator of dorol and quadropol VRMs as well as the stand-alone separator sepol® (see Figure 1). It offers a straightforward yet highly effective way to optimise the volume flow and unlock additional production capacity.

By installing these swirl breakers, the gas airflow is optimised, reducing the pressure loss over the separator and ultimately improving overall energy

"Beyond mechanical improvements, digital solutions allow plant operators to unlock further optimisation potential based on real-time process data. The machine protection system (MPS) and the advanced mill control (AMC) system."

Figure 3: power consumption of a mill with and without an AMC

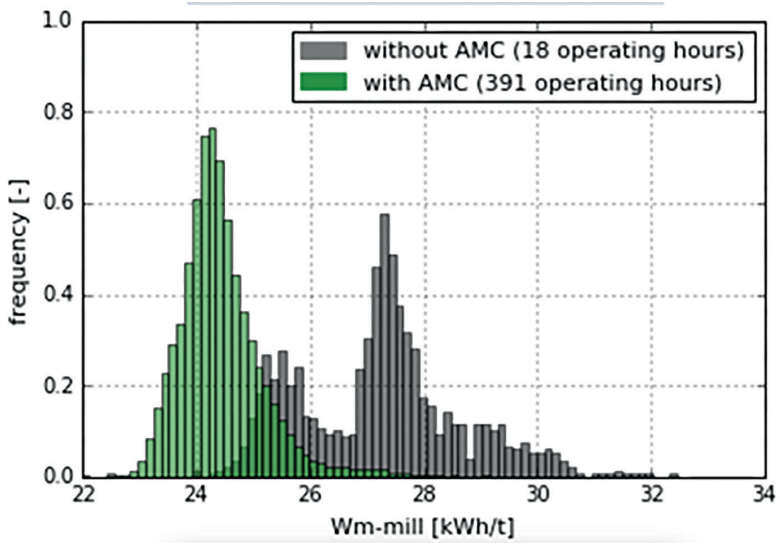

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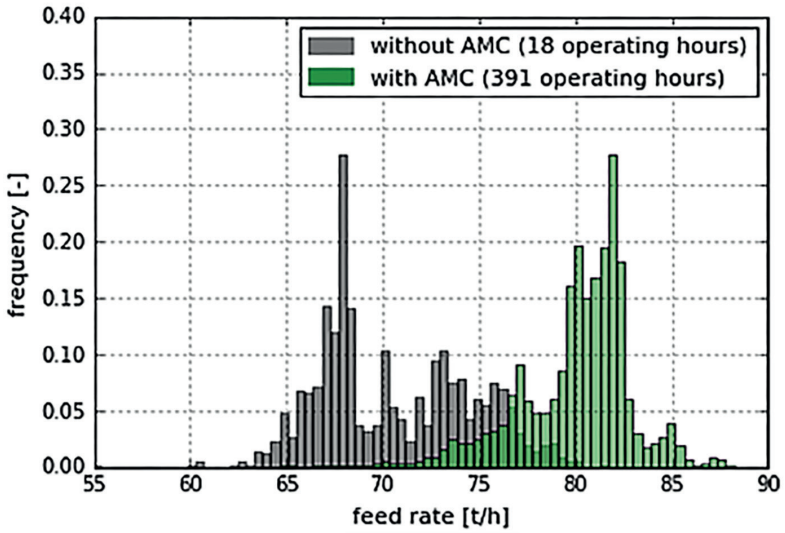
Figure 4: feed rate of a mill with and without an AMC



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efficiency. The reduction in pressure loss results either in a reduction in power consumption for the separator drive as well as the mill process fan or can lead to an increase in production due to higher air volumes. This production increase can be quantified by up to six per cent and an ROI of a few months.

Another mechanical upgrade which distinguishes itself by its compatibility with all grinding tables is a newly designed discharge system (see Figure 2). This system has significantly fewer spare and rotating parts, which decreases the overall maintenance effort and offers much better accessibility to the working area for maintenance staff. The wear parts of the newly designed scrapers are divided according to their exposure to wear and tear.

Digital features

Beyond mechanical improvements, digital solutions allow plant operators to unlock further optimisation potential based on real-time process data. The machine protection system (MPS) and the advanced mill control (AMC) system.

Both have emerged as transformative solutions, enabling producers to optimise the grinding process within the limits of the permissible load while reducing energy consumption and preventing unplanned shutdowns.

"The quadropol MPS goes beyond the analysis of vibration and torque measurements and forms the basis of an automatic process optimisation programme."

The quadropol MPS goes beyond the analysis of vibration and torque measurements and forms the basis of an automatic process optimisation programme. The AMC is an intelligent control system designed to continuously monitor and adjust key mill parameters such as feed rate, rotational speed, hydraulic pressure and water injection. Unlike traditional manual adjustments, An AMC uses real-time data and predictive algorithms to maintain optimal operating conditions. This ensures that mills run at their most efficient operating point, minimising vibration, which results in fewer (unplanned) mill stoppages, and preventing overloads.

Figures 3 and 4 from real plants show the significant impact of the AMC. This can be quantified as an ~22 per cent increase in throughput or a decrease in specific power consumption of ~12 per cent.

As cement producers face mounting pressure to cut costs and carbon emissions, the AMC offers a practical, high-impact solution. By combining advanced control strategies with digital technologies, plants can achieve measurable gains in efficiency, sustainability and profitability, without the need for major capital investments.

Conclusion

Whether through Expert Service, mechanical retrofits or the implementation of digital solutions, plant operators gain data-driven, practical solutions to maximise the performance and longevity of their VRMs. These measures increase efficiency, reduce costs and support sustainable operation – for dorol and quadropol mills as well as for VRMs from other manufacturers. In particular, the Expert Service can be applied to third-party equipment and helps cement producers worldwide achieve stable and competitive plant performance. ■