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THE SECRET OF A HIGHLY PRODUCTIVE CEMENT PLANT

Klüber Lubrication looks at prescriptive maintenance solutions...

Above: Between 50% and 70% of failures in cement plant kilns, mills, crushers and conveyors are in some way related to lubrication.

A large number of gearboxes, bearings and open gears work 24/7 in challenging conditions in the kilns, mills, crushers and conveyors of cement plants. If they fail, productivity drops and, in the worst case, the plant comes to a standstill. Between 50% and 70% of failures in these components are in some way related to lubrication. They could have been avoided with the use of suitable high-performance lubricants. When applied properly, lubrication can help to significantly improve machine availability and energy efficiency, while reducing total cost at the same time.

When working with cement plants, Klüber Lubrication has found enormous potential savings of up to Euro750,000 per plant that can be attained with optimised lubrication.[1] However, many cement plants do not yet utilise the opportunities that high-performance lubricants, combined with innovative service solutions, offer.

Here we will share some best practices that can help users in cement plants to reach the next level of productivity. Field experience shows that these optimisation opportunities can be found in the majority of cement plants across the globe, offering benefit to a wider range of operators.

1. Gearbox oils

Gearbox oils offer a huge opportunity for optimisation, as 50% of gearbox failures in kilns, mills, elevators and conveyors are lubrication-related.[2] With many mineral oils, friction in the gearbox may be 30-50% higher than the optimum, resulting in reduced lubricant life. This means frequent oil changes and high lubricant waste. Another unwanted result of efficiency losses is high power consumption, as gearboxes typically account for up to 60% of a plant's electricity bill.

Swapping from mineral oils to energy-efficient oils helps operators to reduce friction and therefore experience less wear and damage of the gear flanks and bearings. This will lead to longer equipment lifespans and an extension of the lubricant life by a factor of 3-5. Benefits also include energy savings of 3-5% and a significant reduction in CO_2 emissions. This can result in net cost savings of Euro100,000/yr or more for a single gearbox. An example comes from a cement producer in Brazil, which uses a Polysius ball mill for cement grinding. The mill is equipped with a Combiflex direct drive that has a nominal power rating of 5.5MW. By switching to Klübersynth GEM 4-460, the plant saw energy savings of 6.5%, around 2.3kW/t.

2. Open gears

About 70% of open gear failures in mills and kilns are lubrication-related.[3] Many are still operated with greases that contain black graphite. Their low viscosity leads to low wear protection under normal operation. The graphite powder in these greases can clog the nozzles of the spray system. This can lead to lube starvation and, if that happens, the girth gear can break within just two days. It can also lead to unnecessarily high lubricant consumption. Furthermore, as the gear flanks cannot be inspected visually, no adequate preventive maintenance approach can be implemented.

The optimisation method Klüber Lubrication proposes is to change over to a high-viscosity, transparent fluid. The benefits will be 3-7 times higher wear protection that leads to longer gear life and a reduction in lubricant consumption by up to 50%. Clogging of the spray nozzles and lubricant starvation will be prevented, while the transparency of the lubricant allows the detection of any damage during operation.

At a UK site of an international cement manufacturer, the pinion of a ball mill used for raw meal grinding had to be replaced continuously, because it kept deteriorating in just three months. The mill was operating with a graphite grease. The experts from Klüber Lubrication were, first of all, able to perform an onsite reconditioning of the deteriorated gear set, using the special reconditioning lubricant Klüberfluid D-F 1. This helped to smooth the surface of the gear flanks and to increase the contact pattern of the gears. In turn, this resulted in reduced temperatures on the gear and lower vibrations. Ultimately, it helped to avoid further shutdowns.

Then the gears were changed over to a high-viscosity transparent fluid from the Klüberfluid C-F Ultra series. The lifetime of the pinion has now been extended from an initially scheduled six months to more than three years, and the lubricant consumption was reduced by 68%, resulting in overall cost savings of about Euro30,000/yr.

3. Heavy-duty greases

Heavy-duty greases are often used in roller press main bearings. In this case, 55% of bearing failures are lubrication-related.[4] If a grease with a viscosity of around 1000mm^2/s and an NLGI grade of 2 is currently in use, switching to an energy-efficient specialty lubricant will increase efficiency enormously.

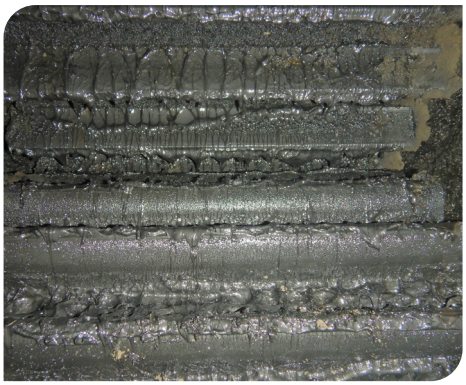
Lubricants with a low base oil viscosity cause high wear rates in bearings and shorter lifetimes, while lubricant consumption is typically high. They have no optimal grease pumping ability, which can result in the lubricant not properly reaching the area that needs to be lubricated. This may go hand in hand with high temperatures and, in some cases, high vibrations.

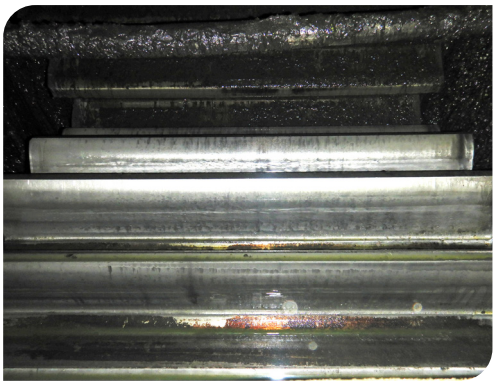
After the changeover to a high-performance grease with a viscosity of 1500mm^2/s and an NLGI grade of 1, bearing life can been extended by a factor of 1.5. In many cases bearing lifetimes of more than 30,000hr can be achieved, with Klüberfluid BE 41-1501 or the even higher-performing Klübersynth BE 44-2001. These high-performance greases also ensure better pumpability and will reliably reach the area that needs to be lubricated. Temperatures and vibrations are reduced and grease consumption will be 20-40% lower.

An impressive example is the case of a cement mill in Indonesia, operating a roller press with four main bearings. After switching to Klüberlub BE 41-1501, performance improvements included temperature reductions by around 17% and vibration reductions ranging between 27% up to 49%. On one bearing there was a vibration reduction of close to 8mm/s.

Similar results were achieved in a plant in Slovakia, operating the same kind of roller press with four main bearings. Again, by using Klüberlub BE 41-1501 a reduction of lubricant consumption by 45% and total cost savings of ~Euro30,000/yr were achieved, which represented a 42% reduction compared to the previous setup.

Below: An example of before and after switching to a high-viscosity transparent lubricant (See '2. Open gears').





4. Prescriptive maintenance solutions

In cement plants, typically one of the following four maintenance scenarios is in place:

1. Reactive maintenance: The equipment is in use until it fails and will then be fixed or replaced;

2. Preventive maintenance: Time-based maintenance routines in order to prevent failure;

3. Predictive maintenance: Routines are based on the condition of machinery, often with sensors used to determine conditions that require maintenance;

4. Prescriptive maintenance: The most sophisticated maintenance approach. This concept builds on predictive maintenance, but in addition helps to understand what needs to be done in order to prevent the failure from happening. It is a complex approach that requires the integration of experts from various fields. This is why only a few plants have implemented this approach so far.

More than the sum of its parts

Klüber Lubrication and DALOG, a global leader in condition monitoring solutions for the cement industry, have combined their expertise in order to help customers to transition to prescriptive maintenance. One of the partnership's solutions is the monitoring and optimisation of the availability of open girth gears. Typical challenges associated with girth gears include enormous stress and wear due to misalignment, overloads and contamination by dust, and lubricant starvation due to spray system failures, which can severely damage the girth gears. A visual inspection of the girth gear is often not possible because it is frequently covered in black lubricant that covers any damage.

An effective preventive maintenance approach is the use of a high-viscosity transparent lubricant, which helps users to identify damage as it arises on the one hand, and periodic analyses of the vibration of the pinion bearings and the temperatures of the gear flanks, periodic inspections of the spray system and spray pattern, as well as periodic visual inspections of the gear set on the other. Klüber Lubrication carries out these inspections for its customers on a regular basis.

The DALOG part of the solution consists of a multi-sensor monitoring system that monitors all crucial components remotely, automatically and in real time. This also includes infrared measurement of the gear flank temperatures. The parameters measured by DALOG's sensors can be used by DALOG and Klüber Lubrication for the real-time analysis of the performance of the machines and lubricants used.

Remote monitoring and recommendations provide operators with actionable insights regarding what should be done in order to prevent equipment failure. This could be trigger-based corrective actions at the right time by Klüber Lubrication service engineers, automatic protective actions such as a machine shutdown if desired, or reconditioning of open gears on site, if needed.

The Klüber Lubrication part of the solution is to support customers with the changeover from a black to a high-viscosity transparent lubricant providing higher wear protection, as well as with trigger-based onsite support by a service engineer at the right time. In this way, instead of periodic analysis inspections, inspections are implemented when they are truly needed. The effectiveness of the corrective actions is monitored by the Klüber Lubrication service team.

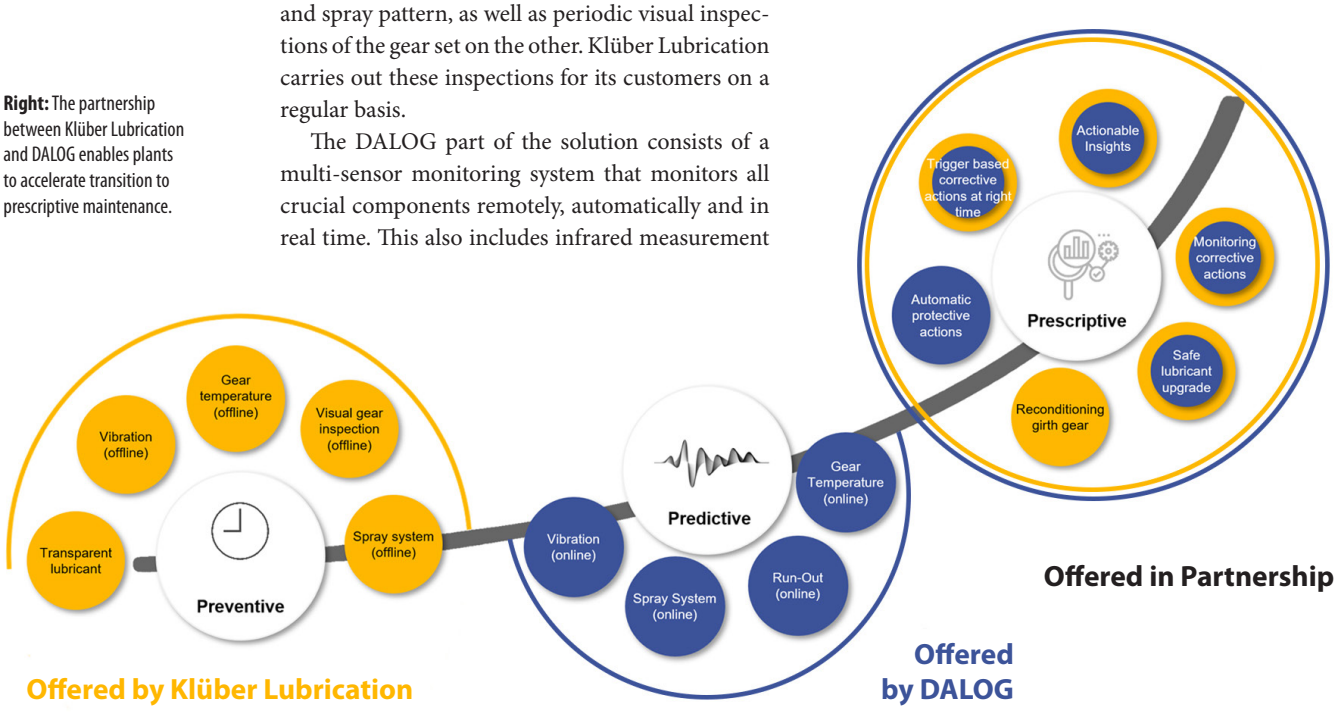
References

1. Klüber Lubrication research, 2021.

2. CMD Gearbox Maintenance Tutorial, Episode 1 (2020). https://www.youtube.com/watch?v=VNRC5cAxlsA.

3. FLSmidth Webinar Open Gears for Heavy Duty use in Cement and Mining, 2021.

4. FAG/Schäffler Wälzlagerschäden - Schadenserkennung und Begutachtung gelaufener Wälzlager, 2000. https://www.schaeffler.com/remotemedien/media/_shared_media/08_media_library/01_publications/schaeffler_2/publication/downloads_18/wl_82102_2_de_de.pdf.



Right: The partnership between Klüber Lubrication and DALOG enables plants to accelerate transition to prescriptive maintenance.