JANUARY 2020

International Cement review

Ralph Viebrock, Head of LOESCHE Customer Service, in front of a LM 63.3+3 in Cim Ivoire, Abidjan (Cote D'Ivoire)

Guillaume Becker, Commissioning Engineer at LOESCHE with customers at DG Khan Cement plant in Pakistan

Selfie from Mirza Fazal at Lucky Cement Plant in Pezu, Pakistan, with the LOESCHE vertical roller mill type LM 56.3+3

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Sustainable lubrication

Open-gear drives of kilns and ball mills are often exposed to harsh operating conditions. While considerable advances have been made in terms of the design and manufacture of drives, tooth flank damage remains an issue due to excessive wear or material fatigue. Correct lubricant selection and application play a vital role in addressing the problem.

■ *by **Werner Gschwandtner and Hermann Siebert**, Klüber Lubrication Austria GmbH, Austria*

To ensure the continuous operation of a cement plant, the reliability of girth gear drives is of great importance to the operation of rotary kilns and ball mills. Therefore, they represent a key component of maintenance in terms of monitoring and service. However, girth gears are exposed to a wide range of operating conditions such as varying loads, variable speeds, temperatures and dust.

In addition, the pinion and the girth gear have to be aligned during assembly. Consequently their axes are often not parallel, making operating conditions even more demanding. This often leads to high area loads resulting in excessive wear and other tooth flank damage. Further contributing factors can be inadequate foundations or insufficiently sealed girth gear covers allowing dust ingress.

To support cement plants in their requirement for smoothly running gears, lubricant specialists such as Klüber Lubrication have developed various lubricants and concepts. While in the 1980s bituminous products were still used to lubricate girth gear drives, which were then replaced by saponified adhesive greases, today additivated high-viscosity transparent fluid lubricants which are free of solids have become more and more standard.

A-B-C-D lubricant concept

To achieve the desired optimum load-carrying area of >80 per cent on the tooth flanks of the girth gear drive, the condition of the tooth flanks has to be assessed.

Klüber Lubrication has developed an A-B-C-D lubrication system that allows achievement of good load distribution over the tooth flanks. Depending on the gear system in question (eg, new gears, which have been in operation and are paired with new gears, or gears with damage on the gear teeth), the A-B-C-D lubricant concept can be applied.

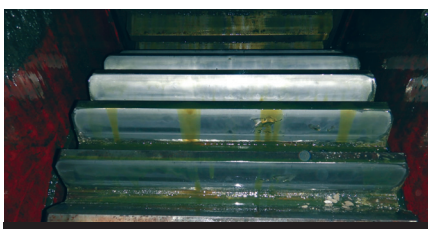

Figure 2: pinion lubricated with high-viscosity transparent fluid

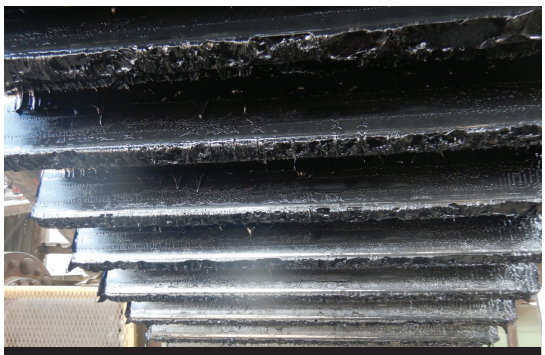

Figure 1: pinion lubricated with solid containing adhesive grease

The first three stages of this four-part concept are used to optimise the contact area of the teeth while providing adequate wear protection during the process.

A – priming and pre-start lubrication

The lubricant type A protects the gears against corrosion caused during equipment assembly. During the first turns at the start-up, this lubricant provides sufficient lubrication to the girth gear drive to avoid initial damage on the tooth flanks. In addition, it contributes at the time of start-up to assess the load-carrying area. The priming lubricant also serves as a contrast lubricant for a first impression of the dynamic contact pattern.

B – running-in lubrication

The lubricant type B ensures the quick optimisation of the load-carrying area and surface roughness of new gears, as well as in the case of scuffing on gears in operation, eg due to short spray system failure.

When used for running-in, the goal is achieved when a load-carrying area of ~80 per cent of the tooth surface is met.

C – operational lubrication

After completion of the running-in process, the changeover to the operating lubricant, type C, takes place. The selection of the various operating lubricants depends on the operating temperature, ambient temperature and application method. Currently, the most common operational lubricants are high-viscous transparent fluids.

D – repair lubrication

Tooth flank surfaces could become severely damaged for a variety of reasons, which can lead to an inadequate contact pattern and cause breakdowns. Even in such cases of particularly severe damage, the repair lubrication D can be employed instead of mechanical treatment such as grinding and milling. This will provide an extension of the gear life. The advantage of this gear rescue is that it is carried out during operation and does not result in any loss of production.

Factors in lubricant selection

During operation of ball mills and kilns, the maintenance department can select suitable lubricants that minimise wear on the tooth flanks and prevent lubricant-related failures such as scuffing and pitting. Therefore, the maintenance department can decisively influence the reliable operation of the open gears by selecting the correct lubricant.

When selecting the lubricant, care must

Figure 3: pinion before (left) and after (right) repair lubrication

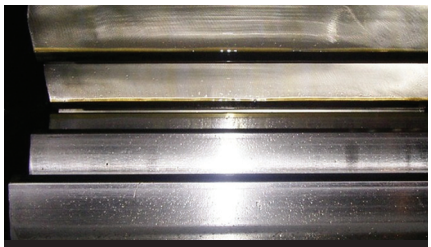

Figure 4: gear after three years with Klüberfluid CF-3 in operation

be taken to choose one that does not allow settling of any incorporated solid lubricants, to prevent blockage of lubricant pipes and spray nozzles and ensure that a sufficiently thick lubricating film contributes to wear protection. In addition, the lubricant should allow easy inspection of the tooth flanks, by making the tooth flanks visible, even when not cleaned.

Furthermore, the selection of the correct lubricant depends on the lubrication method, eg immersion/bath, paddle wheel, circulation or spray system, and on the environmental impacts on the lubricant in use, including heating, length and size of piping, and drum storage.

In the case of immersion bath, solid lubricants may settle during prolonged stoppages. In circulation systems the solid lubricants may settle or agglomerate in the reservoir leading to blockages. In spray lubrication systems solid lubricants can settle in intermediate lubricant reservoirs, clog pipes or spray nozzles leading to lubricant starvation on the tooth flanks.

For this reason, transparent, solid-lubricant-free lubricants for large girth gear drives have become widely common. Pipe blockages are prevented and fresh, clean lubricant is pumped in the required quantity, thus improving the reliability of the system.

Depending on the climatic conditions, the temperatures of the tooth flanks of the mill drives can vary between 35-60˚C. For this reason, a lubricant should be selected that offers optimum viscosity at all operating temperatures.

The fluids available on the market take the climatic conditions into account and are offering a good viscosity and temperature behaviour. For good pumpability at various ambient temperatures, different viscosities and base oils, including fully synthetic ones, are available. The fluids from Klüber Lubrication have a UV indicator to check the lubricant film while the drive is in operation. This improves the monitoring of the lubricating film during the inspection. The reduction of lubricant consumption, often desired by users, can be better monitored with the UV indicator.

Therefore, consumption can be significantly reduced while monitoring the lubricant quantities on the teeth and enabling sustainable operation of the girth gears.

Inspections and documentation

Almost 50 per cent of all damages to gears are related to insufficient inspections. Therefore, regular inspection of the girth gear drives, in addition to the selection of the optimum lubricant, makes a significant contribution to trouble-free operation of the entire drive system.

Under normal operating conditions, an annual inspection is recommended to record any changes. It is important to document the results carefully and thus create a history of the large gear drives for future reference and/or actions to be taken to maintain a good tooth flank condition.

Regular inspection by maintenance personnel should include the following:

- checking all the functions of the central lubrication system and spray pattern
- cleaning lubricant filters and other lubrication system components
- vibration measurements on the pinion bearings
- tooth flank temperature readings while the drive is operating via infrared thermometer or thermal camera
- inspection of the pitch circle alignment
- visual inspection of the tooth flanks by means of stroboscope while the drive is operating
- empty used lubricant from girth gear cover, also in area of pinion
- photo-documentation of the tooth flank surfaces and the spray pattern
- detailed reporting through inspection reports.

Latest developments

In recent decades considerable improvements have been achieved in the design and manufacture of large gear drives. The lubricants used for such applications contribute to fulfill the increasing technical demands from the markets. Today, so-called high-viscosity fluids are considered state-of- the-art for the lubrication of large gear systems.

Nevertheless, there are specific ‘niche’ applications and requirements, which only purpose-designed solutions can meet. Klüber Lubrication has taken up this challenge and introduced further innovations to the market.

These include a new lubricant concept based on the synthetic base fluid polyglycol. The innovative solution in the form of Klüberfluid C-PG 17 Ultra offers outstanding properties like very high viscosity and viscosity index which ensure maximum film thickness and consequently the highest load-carrying capacity even at elevated operating temperatures. Moreover, lower friction values provide better protection against wear damage and help save energy and reduce lubricant consumption.

A further development is based on the knowledge gained from high-viscosity fluids and by adapting appropriate additivation. Klübersynth OA 98-15000 provides excellent wear protection in case of contamination with cement dust. This special lubricant based on the SLIBF concept (Solid Lubricant Integrated Base Fluid) was developed precisely to meet the high demands of open gear drives. It provides excellent adhesion, good film formation, less splashing from gears and reduces leakage from the gear casing. This results in better maintenance practices and increased safety.

The selection of the correct lubricant and its application can significantly reduce the wear of open-gear drives and contribute to higher uptimes of kilns and ball mills in the cement plant. In addition, lubricant consumption can often be reduced by 30-60 per cent, supporting a cement plant’s sustainability drive. ■