SMOOTH OPERATIONS

Preston Rubottom, Lubrication Engineers, details how to increase a kiln's efficiency through effective lubrication.

Kiln maintenance can be extremely difficult in cement plants because of the harsh conditions associated with this industry.

As the physicist and mathematician William Thomson Kelvin said, "What is not defined, cannot be measured. What is not measured, cannot be improved. What is not improved, will always degrade."

To determine the current health of the rotary kiln's rotational components that require lubrication, an assessment should be conducted during which lubricant health and lubrication practices are reviewed and scored against industry standards and best practices.

All necessary information is gathered including lubricant specifications based on the kiln manufacturer's requirements, lubrication points, and operating conditions. With the completion of the assessment, a detailed list of lubricant types, application amounts, application methods and a detailed oil analysis programme should be provided. Additionally, lubrication-related reliability solutions may be suggested to protect the lubricant, extend its lifespan, and enhance its performance.

Lubricant selection

Even though kiln manufacturers recommend lubricants that provide baseline protection from friction and wear, the operating conditions in the cement industry often require a high-performance lubricant to provide optimum wear-reducing protection. Determining factors in lubricant selection include operating temperature, load size, and speed of machinery. Lubricants are not all formulated the same. In high-impact, heavily contaminated applications such as those found in cement plants, a high-performance lubricant can have a significant impact on reducing operating and maintenance costs.

Open gears

Kilns and ball mills are two of the most critical pieces of equipment for cement plants; downtime is not an option for these applications. However, their open gears regularly suffer from pitting and other wear due to insufficient lubrication and shock loading. The use of asphaltic-based open gear lubricant is still a common practice with many end users, and the use of these opaque lubricants means that wear cannot be seen by maintenance personnel. Instead, elevated temperatures and vibration are the first indicators that there are problems.

Lubrication best practices for open gears include selecting the right lubricant and the right method of application to combat these challenges. Choosing wisely will help protect the gears from wear, increase uptime, and, in most cases, dramatically reduce gear set operating temperatures, lubricant consumption, energy consumption, and

Figure 1. Large open gear prior to lubricant conversion.

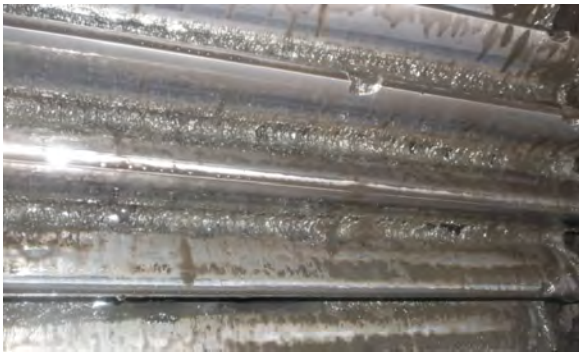

Figure 2. Large open gear after conversion to Pyroshield.

Figure 3. Before conversion to Pyroshield 9011: Spray nozzles blocked by excessive lubrication buildup affect the required intersecting spray pattern, causing an irregular spray pattern.

Figure 4. After conversion to Pyroshield 9011: No lubrication buildup on spray plate and no blockage on spray nozzles creates an equal distribution of lubricant.

waste disposal. This will lead to a cleaner, safer working environment.

The right choice for open gears is a heavy-duty, high-viscosity lubricant with extreme pressure, anti-wear additive package. A typical open gear lubricant will have a Timken rating of 70 lb or more in order to reduce wear and extend gear life. In the past, open gear lubricants were asphaltic-based, had Timken ratings of 20 – 25 lb, and relied on excessive volume for adequate protection. Most open gear lubricants on the market today use a variety of thickeners, such as graphite, silica and traditional soap thickeners. Nonetheless, even with the newer types of lubricants, operators still report issues with excessive consumption, leading to lubricant buildup around the shrouds, poor drainage, and significant housekeeping challenges.

Other concerns include needing to be heated for pumpability, plugging spray system nozzles, not spraying in low temperatures, drawing in contaminants, obscuring the gear from visual inspection, and not reducing gear temperatures.

Lubrication Engineers' (LE) Pyroshield Syn Hvy and XHvy open gear lubricants were designed specifically to provide outstanding protection for high-load, heavy-shock applications, such as the large shrouded open gears used in the cement industry. Pyroshield Syn open gear lubricants are non-asphaltic and environmentally friendly, containing no heavy metals. They are translucent in use, enabling cement plant maintenance teams to inspect their open gears daily with the use of a strobe light. In addition, LE's unique conversion process for Pyroshield allows kilns and ball mills to be converted without having to stop production.

Kiln tyre bore & wear pads

As the kiln rotates, the tyre cradles the free-moving shell, resulting in immense pressure, severe friction, and metal wear. To mitigate potential damage, sacrificial wear pads protect the surfaces from each other. If the creep (the movement between both surfaces) goes beyond originally designed-for measurements it indicates insufficient lubrication and can lead to metal-to-metal contact and erosion of the wear pads. Potential damage includes scoring, galling and cold welding of the kiln tyres, wear pads and stop blocks, as well as loss of refractory brick.

Appropriate tyre lubrication will ensure that creep is maintained by preventing the wear pads and shell from adhering to the tyre. One such solution is Easy Bar with Almasol, which brings together the wear-reducing benefits of LE's solid additive, Almasol, with the benefits of Easy Bar solid lube bar technology. When the bar is placed between the tyre bore and shell, the binder melts and the rolling action of the kiln distributes the lubricant where it is needed to protect the surfaces and maintain creep.

If solid bar lubrication is unable to be used, a frequently used alternative is a spray grease or

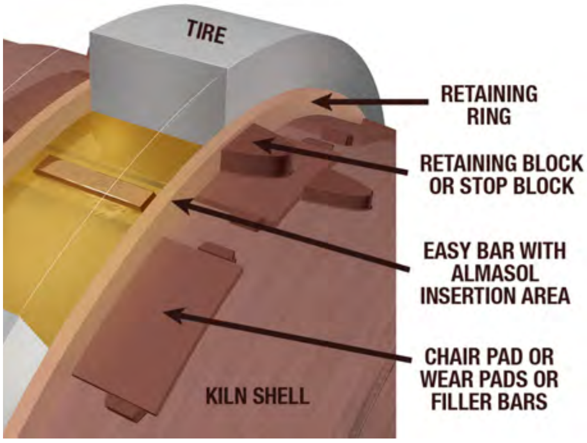

Figure 5. Proper kiln tire lubrication prevents the wear pads and shell from adhering to the tire, which is crucial to maintaining creep.

Figure 6. When placed between the tire bore and shell, the binder in the solid lubricant bar melts, and the kiln's rolling action distributes the lubricant where it is needed to protect the surfaces.

Figure 7. Asperities on touching metal surfaces.

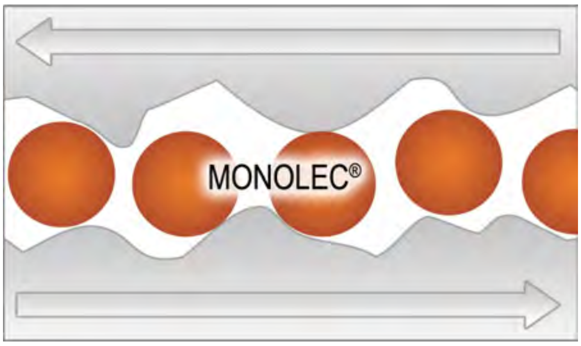

Figure 8. Asperities as smoothed by Monolec.

water-based solution containing graphite. These products contain high amounts of lubricating solids that fill the surface imperfections, resulting in a smoother surface, lower friction, and less wear. An example of a spray grease is Pyroshield Syn Kiln Grease, which features a high auto-ignition point and contains a synthetic thickener with organic and solid metallic film-forming components as well as LE's Almasol additive.

Trunnion rollers

Trunnion support roller bearings help carry the weight of the kiln and assist in rotation. Common challenges are severe unbalanced loads, overheating, metal-to-metal contact, lubricant starvation, and contamination. These can lead to excessive carbon buildup, bearing scuffing and pitting, and damage to the shaft.

In looking at current industry practices, a common misunderstanding arises regarding theoretical versus practical lubricant recommendations for trunnion bearings. Incorrect recommendations are often made when kiln users are experiencing high temperatures in the trunnions, as there is a tendency to address these high temperatures by using higher viscosity lubricants to stop the friction that is producing heat. While friction does indeed cause heat to be produced, it is not due to oil film loss or poor lubrication alone. It is more commonly caused by bearing alignment issues or heavy amounts of environmental contamination ingression that has interfered with the formation of an oil wedge in between the trunnion and journal. By increasing viscosity, the lubricant takes more time in the revolution of the journal to create and keep oil lift. If frequent start-stops of the kiln occur, an increase in wear is generated due to the oil being too thick and not being able to envelope the shaft to create lift. FLSmidth recommends a litre of oil be poured on top of each journal minutes before startup to aid in this initial lift.

Another recommendation when using the correct viscosity – which should be dictated by load and speed – is to seek a lubricant formulation with protective additives that are in place for scenarios when oil film is not achievable. Monolec Syn Industrial Oil is designed to prolong equipment life by combatting the effects of high temperatures, contamination, and heavy loads. It is formulated with high-viscosity synthetic base oil and an additive package that provides outstanding enhanced stability, rust and oxidation resistance, and wear resistance.

Key to the formulation is the additive, Monolec, a liquid wear-reducing additive that creates a single molecular lubricating film on metal surfaces, vastly increasing oil film strength without affecting clearances. It allows opposing metal surfaces to slide by one another, greatly reducing friction, heat and wear. Monolec protects metal surfaces with a single layer of molecules, which reduces friction through their 'ball bearing' action (Figure 8). If the oil film ruptures under high pressure, Monolec will react with the quickly heating asperities to form a chemical synthetic lubricant that allows the high points to flow and reduces wear. Monolec also greatly increases the film strength of lubricating oils through a process called particulate attraction, which is the molecular attraction one particle has for another. Film strength is critical in preventing film rupture. Maintaining film strength reduces wear and provides for smooth, relatively friction-free operation.

Preventative maintenance

A preventative maintenance programme involving routine visual inspections, surface temperature checks and oil analysis allows kiln conditions to be properly monitored. A routine oil analysis programme enables end users to be more efficient with the use of lubricants and equipment. This programme monitors oil samples for mechanical, operational, and environmental factors that can affect equipment and oil life. With consistent and accurate monitoring of oil condition, trend oil analysis can improve operational efficiency by reducing lubricant purchases, minimising the parts inventory, decreasing used lubricant disposal, lowering labour costs, and reducing downtime.

With the amount of contamination found in environments around kilns, it is imperative that oil analysis is used to drive a well-executed oil filtration programme. Studies have shown that as much as 70% of all premature machine failures can be attributed to contamination. The key is to purify the new oil as it comes into the facility and keep it clean throughout its operating life. By establishing an ISO code cleanliness goal through oil analysis and maintaining it, the lifespan of the oil and the equipment can be extended. Removing both large and small particles helps to keep the equipment protected from abnormal wear. A portable or dedicated filtration system designed to screen the oil, removing large particulates, and clean the oil from small particulates is highly recommended. Effective filtration of gear and trunnion oil can be achieved with the right equipment when built accordingly to handle the higher viscosity of fluids.

Implementation

A proactive approach to kiln lubrication can yield significant cost savings and help avoid unscheduled shutdowns. Lubricant selection is of primary importance, followed by putting in place lubrication reliability tools and best practices to maximise the performance of the lubricant and protect the equipment. Kiln users who have implemented a lubrication excellence programme have increased uptime, reduced gear and kiln wear, maintained kiln creep, lowered overall lubricant consumption, reduced energy use, minimised waste disposal, and contributed to a safer, cleaner work environment. ■