Keep the Kiln Running!

Alan Lockett, Certified Lubrication Specialist (Society of Tribologists and Lubrication) and founder of C&C Oil, USA, describes the need for kiln tyre bore lubrication in order to save money and decrease maintenance downtime.

Introduction

"The kiln turns fine. We do not need to lubricate the tyre." "We throw a little lube in there every once in a while." Do these statements reflect your company's approach to kiln tyre lubrication? If so, it may be costing you a lot of money!

In a market where demand for cement generally exceeds supply, cement plants routinely run at full capacity. The importance of keeping the kiln 'turning' is paramount and maintenance managers struggle to stretch the interval between maintenance shut downs. Ironically, however, the importance of kiln tyre lubrication is often minimised, or overlooked entirely, even though, for over 25 years, the benefits of properly lubricating kiln tyres have been well known and documented.

As long ago as 1979, Donald P. Giencke, an engineer with Allis-Chalmers Corporation (now A.C. Services), stated in an article in *Pulp and Paper* that, 'if the riding ring bores are not lubricated properly, an accelerated wear condition will occur. This will eventually cause excessive clearance and will result in a cyclic deformation of the shell'.[1] In a later article in *World Cement*, Walter Gebhart, Vice President, Phillips Kiln Service, concludes that, 'lubrication [between the tyre and the kiln shell] with appropriate solid lubricants is one step contributing to a well-maintained kiln'.[2]

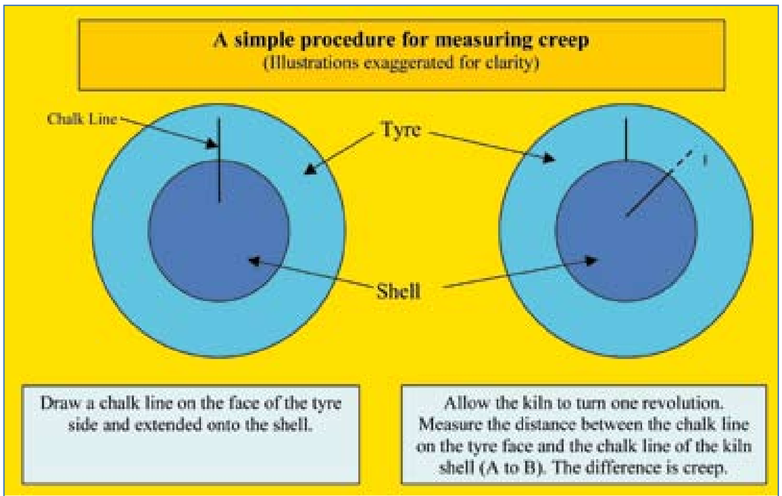

Figure 1. A simple procedure for measuring creep.

Figure 2. Wear pads in poor condition.

Basics

As the kiln rotates, its tyres cradle the free moving shell, obviously resulting in immense pressures, severe friction and metallic wear. Designers mitigate potential kiln damage with sacrificial wear pads (wear/filler pads), which are in part designed to protect the kiln shell from direct contact with the tyre bore.

The fact is that the systematic application of proper lubrication to the tyre bore is a major factor in avoiding


Figure 3. Wear pads in good condition.


Figure 4. A kiln tyre coated with grease lubricant: note the collection of dust and debris that has contaminated the grease and the resulting sludge consistency of the lubricant.

kiln downtime, by extending the life of wear pads and delaying the need to replace them.

Creep
In simple terms, creep can be defined as the difference between the distances travelled by the tyre and the kiln shell during a single revolution of the kiln. Maintaining creep is vital and necessary to proper kiln operations and, although not conclusive by itself, the amount of creep that a kiln is experiencing can be an important indicator of the need for tyre lubrication. Appropriate tyre lubrication will insure that creep is maintained by preventing the wear pads (and shell) from "sticking" to the tyre.

Poor lubrication causes problems
The heavy loads associated with cement kilns result in extreme metal-to-metal stresses, including sliding and rolling friction. These stresses can cause damage that is expensive to repair, including scoring, galling and cold welding of the kiln tyres, wear pads and stop blocks.

The *ASM Handbook of Friction, Lubrication and Wear Technology* defines scoring as, 'a severe form of wear characterised by the formation of extensive grooves and scratches in the direction of sliding', and galling as, 'a severe form of scratching associated with gross damage to the surfaces'. Cold welding, which can be the most severe symptom of excessive wear, is defined as 'adhesion between solid surfaces in direct contact at normal or ambient temperatures'.[3]

Even under ideal conditions, the kiln tyre and wear pads are subject to extreme pressures and temperatures, including rolling and sliding friction. Add the likelihood of tyre wobble, which is present in many kilns, and the inside of the tyre bore, the sides of the tyre and stop blocks and, of course, the wear pads, can all experience wear and damage. A high quality tyre lubricant will help to prevent damage from all of these.

Solutions
Various approaches have been used to lubricate kiln tyres. Graphite, in solid blocks, mixed in water, oil or diesel or "bagged" in cotton bags have all been used in an attempt to introduce graphite to the mating surfaces. Although these antiquated concepts were well intentioned, at best, they are now generally thought of as difficult to implement and terribly inefficient.

Case Studies
One operator explained how he tried to "un-stick" his tyre by filling cotton bags with graphite and placing them under the tyre. Unfortunately, the bags caught fire and ignited the residue left over by a grease he had used previously. Another operator tried to lubricate his tyre by inserting large "chunks" of solid graphite between his tyre and shell. After three years, and almost no reduction in the size of the graphite "chunks", he realised the blocks weren't "shedding much graphite" and that he'd have to find another way to lubricate their kiln tyres.

Greases
The application of greases, although once thought of as an ideal solution, has been shown to be anything but. In fact, some experts agree that applying grease lubricants to a tyre bore actually causes wear, rather than preventing it. Also in his 1979 article in *Pulp & Paper*, Giencke stated that, 'grease type lubricants attract dust and other debris, which act as a grinding compound, which accelerates wear.'[4]

Many grease lubricants are petroleum based and have a relatively low auto-ignition point, which can result in kiln fires – an event not generally welcomed by maintenance managers. In response, the lubrication industry has developed temperature tolerant synthetic greases that overcome this problem. When used in an open and potentially dusty environment, as is the case with virtually all kilns, the attraction to dust and debris is a problem when greases or other tacky lubricants are used.

Additionally, both petroleum and synthetic greases contain 90 – 98% liquids. When exposed to the extreme temperature of the kiln, these fluids oxidise and leave a residue of carbon and other tacky deposits. That residue, in turn, attracts dust and debris, which further contaminates the grease. Hence the conclusion that grease may accelerate wear, rather than retard it, when it is used for this application.

Lubrication bars

In response to the problems of applying straight graphite or grease, the lubrication industry developed the lubrication (lube) bar. Lube bars are safe and easy to apply and, depending on the type that is used, can offer all of the lubrication qualities that are needed in this application.

A lube bar is essentially a supply of solid, dry lubricants encased within a carrier agent. The carrying agent can be a wax, polymer or other compound. The carrier agent generally has a melting point of less than 93 °C (200 °F) and, when placed adjacent to the heated kiln shell, melts and vaporises away, releasing the lubricants. The turning of the kiln causes the lubricants to flow over the wear bars and inside of the tyre bore, coating the mating surfaces.

The application of lube bars to the tyre bore is relatively easy. While the kiln rotates, the operator simply inserts the recommended number of lube bars between the tyre and the shell. Some lube bar suppliers recommend 8 – 25 lube bars per week per tyre. Therefore, several revolutions of the kiln may be required to apply these lube bars. Other suppliers recommend as few as 3 or 4 lube bars per tyre per week, a number that can be easily inserted in a single revolution of the kiln.

In its earliest form, the lube bar had its own problems with temperature tolerance. Whereas wax carriers could be safely used where shell temperatures were less than 205 °C (400 °F), applying the early lube bars to kilns that were hotter, often caused fires. Again, the lubrication industry responded by creating temperature resistant lube bars, some with auto-ignition points in excess of 538 °C (1000 °F).

Not all lube bars are created equal

While lube bars would seem to meet all the lubrication requirements, not all are of sufficient quality to do so. Some lube bar manufacturers substitute carbon black for all or part of the vastly superior graphite lubricant. Some may use halogen based fire retardants, which, at high temperatures, can be harmful to humans.

At the other end of the spectrum, some of the higher quality lube bars contain a significant percentage of high-quality graphite and offer the added lubrication benefit of a dissimilar metal. In lubrication vernacular, the principal of dissimilar metals states that, 'a barrier of a different metal, when placed between two like metals, will act as a lubricant between the two like metals'.

Applying a high quality lubricant, which contains a substantial amount of high quality graphite and a dissimilar metal component, to a properly aligned and operating kiln, virtually eliminates the likelihood of scoring, galling and cold welding damage that was discussed earlier.

Conclusion

Without the systematic and continued application of the proper type of lubricant, the tremendous friction between the tyre bore and the wear pads can result in

Figure 5. An operator inserts a lube bar between the tyre and the shell.

severe, premature and expensive damage. Whereas straight graphite and greases were once commonly used in this application, they are being replaced by the more effective and easier to use lube bar. The best available lube bars offer a high percentage of graphite and a component of dissimilar metal.

Acknowledgements

Figures 2, 3 and 4 courtesy of Phillips Kiln Service.

References

1. GIENCKE, Donald P., 'A Guide to Rotary Kiln Alignment and Maintenance', *Pulp and Paper*, 1979.
2. GEBHART, Walter, 'Lubricating Kiln Tyres: Lubricating Between the Tyre and Shell', *World Cement*, December, 1995.
3. *ASM Handbook of Friction, Lubrication and Wear Technology*, Vol. 18, 1992, USA.
4. GIENCKE, 'A Guide to Rotary Kiln Alignment and Maintenance'.