A multi-million dollar opportunity

Markus Burbach, Klüber Lubrication, explains how energy efficient lubricants can unlock overlooked energy saving opportunities in cement plant grinding mills.

Energy costs are a huge (and growing) consideration for the cement industry. An often-underestimated factor is the extent of energy loss due to the inefficient lubrication of friction points. A significant increase in energy efficiency can be achieved by switching to a purpose-formulated energy efficient speciality lubricant. For example, an average of 3 – 4% of the energy consumption in gearboxes could be saved in this way. It is estimated that by switching to energy-efficient speciality lubricants, the global cement industry could save up to €500 million per year.

It is well known that the cement industry is a major emitter of CO_2 emissions, causing 8% of global CO_2 output. Furthermore, cement plants display excessive electric power consumption. Driven by carbon reduction technologies, such as carbon capture or the electrification of kilns, power consumption will continue to increase over the next few years – all of this in the face of rising energy costs.

These challenges add up to an enormous pressure to increase energy efficiency and reduce power consumption – whether driven by stakeholders, local regulations, the ISO 50001 certification, or any other local energy management system. Energy efficient lubricants are an often-underestimated component that can help cement plants to significantly reduce electricity consumption.

Energy wasting gearboxes in grinding mills

Grinding mills account for up to 60% of a cement plant's electricity costs. Grinding is a very inefficient process where a lot of the power that goes into the drive is not actually used for grinding, but is instead turned into heat, vibration, wear, friction and noise. For example, a typical mill rated at around 5500 kW, which runs at a load of 90% and for about 6000 operating hours per year, will consume close to 30 MW of electricity per year.

At a price of €0.10/kWh, this results in roughly €3 million of electricity costs for that one single mill.

Considering that every cement plant has multiple mills and often multiple production lines installed, it is easy to see that this can result in enormous annual electricity costs.

When striving to save energy through energy-efficient lubricants, the gearboxes of grinding mills are an obvious starting point. This includes ball mills, which typically have one or two main gearboxes, vertical mills with typically one gearbox, roller presses with typically two main gearboxes.

Insights and practical experiences

Roughly two-thirds of cement plants globally are still running with conventional mineral oil in these applications. By switching from conventional mineral oils to energy-efficient lubricants, the energy consumption per gearbox can be reduced by approximately 3 – 4%.

Over the years, Klüber Lubrication has supported operators in converting all kinds of gearboxes supplied by major gearbox OEMs from conventional mineral oils to energy-efficient lubricants such as the Klübersynth GEM 4 N series or the Klübersynth GH 6 series. Irrespective of the specific type of gearbox, energy saving results were consistent.

Typically, the nominal power of these mills is around 2000 – 5000 kW, with an oil volume in the range of 1000 – 5000 l. The energy savings that Klüber Lubrication has been able to realise have ranged from 2% up to 6.5%. While the latter figure – which was achieved in a cement plant in Brazil – is exceptional, savings between 3 – 4% are absolutely to be expected. In all of these cases payback times ranged between 3 – 20 months.

Hard facts

Table 1 shows the electricity cost savings potential resulting from a single mill in relation to its gearbox power, and the electricity savings from energy-efficient lubricants assuming an operation of 6000 hrs/yr and electricity costs of €0.10/kWh.

Depending on the setup of the cement plant and the number of mills installed, savings of up to €500 000 per year can be achieved. This translates into a reduction of up to 10 000 tpy of CO_2. Payback times are typically less than 6 months.

Making the change

To give an idea of the overall dimensions of the potential savings, it can be estimated that by changing to energy-efficient lubricants, the global cement industry as a whole could save up to €500 million per year, with the top 20 global cement producers ranging somewhere from €4 million up to €70 million in electricity cost savings.

Considering such enormous benefits, it is remarkable that only an estimated 20 – 30% of the cement plants make use of energy-efficient lubricants in the gearboxes of their mills. This hesitancy is due to a variety of reasons.

Pointing out the potential

The first and most obvious reason is the fact that there is no awareness of the potential savings made possible by energy-efficient lubricants. One way of overcoming this is by making as many stakeholders in the cement plant as possible aware of this opportunity for savings. This includes the maintenance staff, who are most frequently concerned about lubricants, as well as the production personnel, who typically use power consumption as a KPI. It also includes all staff members responsible for environmental issues, as well as energy managers, all the way up to plant management and C-level managers, because any savings that can be realised here go straight into the bottom line.

Raising awareness

Another reason why these potential savings are not unlocked is a lack of awareness of the

Table 1. Energy savings – the most common scenarios.

		Power rating of gearbox (kW)								
		500	1000	2000	3000	4000	5000	6000	7000	8000
Energy saving (€)	1%	3000	6000	12 000	18 000	24 000	30 000	36 000	42 000	48 000
	2%	6000	12 000	24 000	36 000	48 000	60 000	72 000	84 000	96 000
	3%	9000	18 000	36 000	54 000	72 000	90 000	108 000	126 000	144 000
	4%	12 000	24 000	48 000	72 000	96 000	120 000	144 000	168 000	192 000
	5%	15 000	30 000	60 000	90 000	120 000	150 000	180 000	210 000	240 000
	6%	18 000	36 000	72 000	108 000	144 000	180 000	216 000	252 000	288 000
	7%	21 000	42 000	84 000	126 000	168 000	210 000	252 000	294 000	336 000
	8%	24 000	48 000	96 000	144 000	192 000	240 000	288 000	336 000	384 000

Most common scenarios highlighted blue.

magnitude of the potential savings. Positive effects which might result from the switchover to energy-efficient lubricants include the reduction of electricity costs, which are typically the highest category in terms of savings, but also the reduction of CO_2 emissions and possibly CO_2 taxes or reduced costs for CO_2 emission certificates. Furthermore, the exchange intervals of lubricants are extended by a factor of 3 – 5, causing reduced purchases of new lubricants, lowers costs for oil disposal, and less work for the maintenance team. An effect which has not even been mentioned so far is the increased wear protection and temperature reductions in the gearbox usually offered by this kind of lubricant. As a result, the lifetime of the gearbox is increased and the total cost of ownership is reduced.

Changing technology

Another reason why operators might be reluctant to switch to energy-efficient lubricants is that these lubricants are based on a different technology than conventional base oils – a technology which is 2 – 5 times more expensive than a conventional mineral oil. In order to make sure the savings actually create a positive net impact, Klüber Lubrication strongly recommends running a rigorous return-on-investment analysis for each gearbox at the outset. Later on, success can be measured by simply multiplying the results. Obviously, a lubricant should be chosen that provides these energy savings over the entire lifetime of the lubricant.

Ensuring savings

Another reason why these savings are sometimes not unlocked is that there is uncertainty as to whether these energy savings really will in fact materialise. This is why it is recommended to work with a lubricant partner who has the ability to measure the electricity savings in the field in order to get a sense of how much can be saved on a specific piece of equipment. Ideally, this can be certified in measurement and verification protocols, such as the International Performance Measurement and Verification Protocol (IPMVP) Standard. When talking about high volumes of lubricants, performance guarantees should be considered, such as the Energy Performance Contracting offered by Klüber Lubrication.

Compatability concerns

Another reason for uncertainty is that maintenance personnel might be in doubt if energy-efficient lubricants are actually compatible with the gearboxes, the seals, or the paints used in the gearboxes. This is another reason why OEM-approved lubricants should be used in order to ensure that they will function properly in the equipment. It is also advisable to work with a lubricant partner who is able to evaluate the elastomer compatibility required for the gearboxes. In this respect, Klüber Lubrication benefits from decades of joint research and development together with its sister company Freudenberg Sealing Materials as part of its Lube & Seal Partnership. The goal of this partnership is to offer operators the best possible performance and compatibility of lubricants and seals.

Making an offer

The fact that switching to energy-efficient lubricants initially involves higher acquisition costs may deter some operators. Klüber Lubrication has therefore developed a transparent payment offer, in which the risk is borne by Klüber Lubrication. EPC, the Energy Performance Contracting Model for speciality lubricants, can be booked as an additional offer for suitable projects. With this payment offer, the price of the lubricant is based on the actual, measurable savings in energy consumption. If the agreed saving is achieved, operators pay the full price that has been agreed. If the savings target is missed, the lubricant price is reduced accordingly.

In order to obtain a realistic estimate of the savings potential, the machines and systems to be optimised first have to be identified. The starting point is a measurement of the energy consumption and the process variables while the previous lubricant is still in use. The savings target can be defined on the basis of this data.

Measurements according to internationally recognised standards such as IPMVP and ISO 50015 are then carried out after the oil change to determine the actual energy savings. ■

A five step guide to getting started with energy efficient lubricants

1. Step one typically involves selecting the right lubricant partner. Look at the lubricants the provider is offering, and check that the OEM that has approved them. Look at the energy analysis capability of the lubrication partner and their experience in the cement industry in general.

2. Step two is understanding the plant-specific savings potential. Evaluate the target applications, select the optimal lubricant, and assess the return on investment with the lubrication partner.

3. Step three is planning the changeover. Prioritise applications, pick a pilot application, consider plant shutdowns and equipment replacements that are planned and set up a timeline. The implementation of the new technology only takes one or two days.

4. Step four is running the pilot. Conduct an energy efficiency study on a pilot application to obtain proof of those energy savings internally.

5. Step five is the spreading of the benefits to other equipment to maximise CO_2 reductions and electricity costs.