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A Grip on Grease

Why Quality is Worth the Cost

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Lubrication Engineers provides an engineered grease that is made in a batch process to ensure quality and consistency.
PHOTO: LUBRICATION ENGINEERS INC.

THE HIGH COST of Low-Grade Grease

Total cost of ownership, not just price per pound, should be the gauge by which pellet mill grease is measured.

BY RON KOTRBA

Wood pellet production facilities consume significant quantities of grease daily. The equipment at the heart of operations, the pellet mill, consistently runs so hot and hard that the larger plants can spend hundreds of thousands of dollars per year on this consumable component essential to their operations. According to Harish Doshi, a lubrication reliability consultant with Lubrication Engineers Inc., a plant manufacturing 2,040 tons of pellets a day consumes on average more than 130 pounds of grease in that time. Holger Streetz, the director of international business development for Bathan, a Switzerland-based lubricant supplier, says North American pellet plants consume twice as much grease as their European counterparts, on average roughly 800 pounds per month. He says there are three reasons for this.

"The wood is different," Streetz says. "Pelleting hardwood is challenging due to the much higher load. The Southern Yellow Pine is a great tree for biomass, but it is challenging for the equipment due to its relatively high hardness compared to other softwood, and it is rich in resin." He also says in Europe many producers add starch as a lubricant, thus extending the life of their grease. Third, Streetz says the different type of mills used in Europe vs. North America plays a role in the disparate grease consumption rates between the two continents. Max Jaworski, North American market manager for the wood industry with Klüber Lubrication, says factors that influence the frequency and amount of relubrication include raw materials, facility climate and operation schedules.

With such high consumption volumes of what many consider a commodity, the natural approach for bean counters crunching numbers in the accounting department might be to buy the lowest cost product to shave tens of thousands of dollars per year

from expenditures. "Selection of grease for a pellet mill operation must be an engineered solution—certainly not a commodity product," Doshi says. "Pellet mill grease must be treated as an asset." As is often the case, the cheap comes out expensive when only one metric—price—is considered. But when the total cost of ownership is factored in, a premium grease should improve the bottom line of a pellet mill operation.

Streetz

Basic Considerations

Grease is a vital component in many aspects of wood pelleting. Depending on the setup of the plant and whether the pellet manufacturing facility is adjoined with a sawmill or raw material flow, grease is essential from start to finish. "Everything from the green end including wire ropes on overhead cranes, take-up rolls on conveyor systems to transport raw materials, trunnion bearings on dryers to remove moisture from the raw material, and the heart of pellet production facilities—the pellet mills," Jaworski says. If a pellet facility is directly connected to a sawmill, then the sawmill itself can rival pellet mills in grease consumption, Streetz says. Naturally, the pellet mills are where a great deal of grease is consumed in the pelleting process. "Especially the roller bearings," Streetz says. "Depending on the type of equipment, the main shaft and jackshaft of the pellet mill consume grease too. Besides that, hammer mills need regular relubrication as well as conveying equipment." Jaworski adds that high temperatures, loads and moisture of pellet mills, along with constant operation, require suitable lubricants to ensure efficiency and reliability of operations.

The type of grease best for the mill is typically determined or specified by the mill OEM, according to Doshi, but Streetz advises it is not a binding obligation to use the recommended lubricants to maintain the manufacturer's warranty. "However," he says, "it makes sense to choose a lubricant that matches the recommended lubricants in terms of viscosity, temperature range and additives, especially extreme pressure additives." Doshi says the basic type of proper grease for pellet mills is usually an NLGI 2 high-temperature grease with additives for wear protection. "Generally, OEMs will allow the use of alternative greases not listed in the OEM specification," Doshi says, "but they usually require the alternative grease of interest to be submitted for OEM approval prior to use in their equipment to preserve the warranty."

Grease consists of two main components—base oil and thickener—plus performance-enhancing additives. "The base oil is either mineral oil or synthetic oil," Streetz says. "Thickeners range from aluminum, calcium or lithium, to complexes of those thickeners and perhaps bentonite for food-grade applications." He adds that, for pellet production, grease must have extreme pressure additives to withstand the loads. "The temperature range should be between negative 20 and 360 degrees Fahrenheit because the bearings in a wood pellet mill can get very hot," Streetz says. "The temperature range depends on the base oil, the viscosity and additives."

Thermal stress is typically the reason grease fails in pellet applications. "A rule of thumb with lubricants is the 15-degree rule," Jaworski says. "What this means is for every 15 degrees of temperature increase, the life of the lubricant is effectively halved." When vibration is coupled with high temperatures, the grease breaks down from both oxidation and oil separation, according to Doshi. "Contamination from dirt and process materials can also become a concern when trying to extend bearing life," he says. "These issues can typically be avoided by using a high-quality grease that does not separate under these conditions, as well as by relubricating with sufficient quantities of grease at the appropriate intervals to adequately purge harmful, abrasive contaminants from lubricated points."

Streetz says provided the right grease for the application was chosen, a well-performing grease is stable and does not decompose within the given temperature range. "The lubrication abilities do not decrease too much over time and ideally provide some emergency features," he says. "However, the best grease is for nothing if the wrong amount of grease is used. Over-greasing leads to self-friction of the grease shown by increasing temperatures when the bearing is still intact. Under-greasing leads to lack of lubrication. The bearings run dry and overheat with the potential threat of a fire. Additionally, the lubrication system needs to be checked on a regular basis to ensure functionality." Thus, Doshi suggests that for pellet mill applications, the most vital properties of a grease are resistance to oil separation in the presence of high temperature and vibration, good oxidation resistance, good pumpability where automatic lubrication systems are employed, and appropriate base oil viscosity to provide adequate film thickness for specific operating conditions.

Jaworski explains that grease quality can be judged in part by tribological testing, including industry test methods such as FAG FE-8, 4-ball wear and EMCOR corrosion testing, but Streetz says performance is often subjective and based on personal experiences. "I often hear, 'The red grease is better than the white,' or, 'The beige better than the blue.' Besides these soft factors, the additive package differs from supplier to supplier. There are only a few grease producers that mix base oils with thickeners and additives. The biggest difference in the greases is the additive package. Expensive lubricants tend to have more additives and therefore perform longer or better."

Raw materials and the manufacturing process employed in grease production largely influence the quality of lubricants, according to Jaworski. "For example," he says, "a synthetic oil isn't just a synthetic oil. There are numerous different grades and methods of achieving the end product, including the addition of viscosity improvers to achieve the desired viscosity. These additives have the tendency to break down from shear stress in applications, greatly reducing both the viscosity and the usable life of the lubricant."

Synthetics revolutionized the automotive engine oil industry, and while Jaworski says synthetics have certainly influenced grease development, the consumable nature of grease in pellet applications has produced a more marginal impact. "The performance

Pellet Mill Grease

	Daily Pellet Production (MT)	Daily Grease Consumption (lbs)	Grease Cost (per MT)	Annual Pellet Production (MT)	Annual Grease Consumption (lbs)	Grease Cost (per lb)	Annual Grease Cost
Current Grease	2,040	140	$0.34	701,760	48,160	$4.95	$238,392.00
Engineered Grease	2,040	98	$0.27	701,760	33,712	$5.70	$192,293.25
					Annual Savings		$46,098.75

TABLE 1: Cost of Grease per Metric Ton of Pellet Production

Pellet Mill Roller Bearing Life Extension

	Bearing Life (hrs)	Hourly Production (MT)	Cost per Minute	# of Roll Bearings Per Plant	# of Unexpected Downtime Events Per Year	Cost of Bearings	Replacement Labor (per hr)	Replacement Labor (hrs per failure)	Downtime (hrs per failure)	Annual Labor Cost	Annual Loss of Production	Annual Cost of Bearing Replacement
Current Grease	1,000	85	$190.00	120	8.3	$270.00	$65.00	4	4	$2,146.56	$533,337.60	$267,494.40
Engineered Grease	3,300	85	$190.00	120	2.5	$270.00	$65.00	4	4	$650.47	$161,617.45	$81,058.91
							Annual Savings			$1,496.09	$371,720.15	$186,435.49

TABLE 2: Bearing Life Extension

In concert with Daniel Roberts, technical service manager for Lubrication Engineers, Doshi has developed these metrics to evaluate current and engineered grease costs and bearing life extension.

SOURCE: LUBRICATION ENGINEERS INC.

improvement most likely does not justify the costs," Streetz says. Doshi says in his experience, greases with synthetic base oils are not as popular in the pelleting industry. "The vital properties needed in the pelleting industry can generally be provided by high-quality, petroleum-based greases, making it difficult to justify the additional cost of using a synthetic grease," he says.

Jaworski

Jaworski says synthetic greases make up roughly half the greases used in the pellet industry. "The ability to improve the viscosity-to-temperature relationship, increase relubrication intervals and increase upper service temperature are all benefits," he says. "In addition to improvements in base oils, greases have benefited from the development of new thickening agents. Complex soaps and synthetic thickeners have helped improve on older, simple soap technology. Synthetic thickeners boast many of the same benefits as synthetic base oils with improved viscosity-to-temperature relationships, increased relubrication intervals and increased upper service temperatures."

When changing lubricant types or brands, Jaworski says it's always important to consider compatibility, including compatibility between the thickening agents and base oils and whether the recommended grease provides benefits to the user. Doshi adds, "The main consideration when changing products is the thickener compatibility of the two products. There are industrywide standards on what types of thickeners are compatible or incompatible. A thorough purge of the application or lube lines, if an auto-lube system is being used, is recommended when changing products to realize the full benefit of the new grease." Streetz says some thickeners do not mix well, therefore it is important to verify the miscibility of lubricants or purge the lubrication system well.

Other considerations in lubricant selection beyond the manufacturer's recommendations, according to Jaworski, include the customer's specific needs. "This can include increased service intervals, reduced wear and cost reduction," he says. "All are influenced by differences in the production process and must be addressed individually."

Operating temperatures and environmental conditions should also be taken into account, Doshi says. "In addition," he adds, "grease with the correct base oil viscosity should be selected to provide adequate film thickness under specific operating conditions—bearing size, and operating temperature and speed."

Grease quality and consistency are two of the main variables between suppliers, Doshi says. "A grease can typically be broken down into thickener type, base oil type or viscosity, and additives, but there are countless variations in the quality of the raw material options, as well as in manufacturing processes."

"All pellet producers I talked to have tested several lubricants in their plants," Streetz says. "Most greases do not differ from another, because the base oil, thickener and

additive packages are similar. Therefore, the price has become a major decisional parameter."

Price vs. Cost

The per-pound price of grease is one way to look at costs, but the better, more preferred method is cost per ton of pellets produced. "We show our customers that the price per pound is not the key indicator for the performance of a lubricant," Streetz says. Rightly or wrongly, price per pound can influence purchasing decisions. "Unfortunately," Doshi says, "it can be a large obstacle for customers who look at grease as price per pound instead of from a perspective of total cost of ownership. The use of a premium lubricant at a higher price per pound to reduce downtime, increase production capacity and reduce maintenance costs can usually negate the higher price of a premium lubricant. The use of a premium lubricant may also allow for these benefits to be obtained while reducing consumption, which can help close that gap

Klüber Lubrication says a customer-focused support structure, including engineering, continuous product development and tribological testing, defines a superior lubricant brand.
PHOTO: KLÜBER LUBRICATION

even further." In addition, Doshi says pellet producers can invest in a high-quality lubrication system to further increase the longevity of their grease and, in turn, their equipment. "By providing the right type and the right quantity of grease at the right time, a large portion of equipment failures can be avoided," he says.

Pellet mills are high-value capital assets, and grease provides protection to the wearable components of these investments, Doshi says. The four criteria Doshi suggests for grease selection in pellet applications—resistance to separation, strong oxidation-resistant chemistry, good pumpability, and appropriate base oil thickness—have a weighted average of greater than 80 percent, he says.

When considering changing greases, Doshi says performance evaluations from a business and profitability standpoint should yield significant improvements over current lubrications, including bearing life extension of three to four times over current practice, at least a 30 percent reduction in downtime and up to a 40 percent reduction in grease consumption—all at a cost of 34 cents per ton of pellets produced.

"Cost of operation is of the utmost importance to our customers," Jaworski says. "Operating costs are affected by facility uptime, bearing life, grease consumption and preventative maintenance. We understand that grease is a large investment for pellet producers—and choosing a grease that reduces overall cost of operation is crucial." As overall operating costs are influenced by grease costs, he adds, it is specific to each facility. "Typical grease costs are estimated to be between 35 and 50 cents per metric ton of pellets produced," Jaworski says. "To properly estimate this, the tons per hour produced by each mill combined with grease relubrication quantities are required."

Streetz says Bathan lubricants have base oils and thickeners similar to its competitors, but the difference is with the additive package. "It contains ceramic particles that smoothen metal surfaces, thus reducing friction and wear," he says. "The operating temperature drop of 8 to 10 percent is an indicator of the friction modification effect. Our unique performance proposition is a reduction of grease consumption by 95 percent. This reduces logistics to a minimum and often reduces the lubricant costs per ton." Streetz says one of its U.S. customers with a production capacity of 150,000 tons per year is saving $50,000 annually on lubricant costs alone by using Bathan grease. "Besides the environmentally friendly and often financially beneficial aspect of lower grease consumption, bearing life is extended by up to a factor of 10, thus saving substantial spare parts costs," he says. "In Europe, some of our customers detect 8 percent lower energy consumption, which corresponds with the lower operating temperatures."

With regular grease, the price is the most important indicator, according to Streetz. "With volumes and performance being similar, the price is the only adjusting screw for financial performance improvements," he says. "With our grease, customers have the chance to outperform." Jaworski says that in addition to the products, a customer-focused support structure—including engineering, continuous product development and tribological testing—defines a superior lubricant brand. Doshi says Lubrication Engineers utilizes a batch manufacturing process, which ensures quality and consistency of each batch prior to packaging.

Some have gone so far as to suggest that OEMs do not always specifically recommend the highest quality grease because they make their money on spare parts. "Equipment manufacturers profit from the aftermarket selling of spare parts and services," Streetz says. "Many pellet producers learned the hard way not to buy cheap. Since uptime is a key factor in pellet production, improving wear protection pays off."

Ultimately, Doshi says an engineered grease product for pellet mill applications should yield an internal rate of return of more than 40 percent over any other candidate product or the current grease being used.

New Developments

Like any industry, there are many new developments going on in the world of grease. "Many of the changes are being driven by the growth of electrically powered vehicles coming in the future," Doshi says. "Current research is being focused toward alternate thickener technologies instead of lithium—the most common thickener type—due to competition for use of the raw material lithium hydroxide for production of batteries. Along with that, there are anticipations that increased electrification could put new requirements on conductivity testing for greases." He says these requirements could affect additive selection, depending upon whether a grease needs to be conductive or insulatory. "Of course, efforts continue toward greases with an environmental slant," Doshi adds. "For quite a few years now, efforts have been continuing to formulate ecofriendly—meaning nontoxic, nonbioaccumlative, biodegradable—greases. Much of this is now driven by the marine industry, but other industries are now also wanting those greases." He says the other environmental option is energy savings. "This is very difficult to prove with greases, yet grease grading, thickener type, base oil selection and additive selection are all things that are hypothesized to play a role," Doshi says. "The challenge is developing tests or capturing data from applications that can differentiate grease performance."

Klüber Lubrication has created the first-ever hydro-based lubricants for gears, Jaworski says. "This is a product that utilizes the enhanced lubricity of water, reducing friction by up to 90 percent compared to oil lubricants," he says. "All this is achieved without reducing load-carrying capability, netting scuffing loads similar to that of a polyglycol gear oil."

Streetz says groundbreaking discoveries in grease technologies are rare. "We are glad to have our ceramic technology, which we formulate with more and more lubricants, ranging from sea-waterproof to H1-certified food grade," he says. "With our food-grade greases we already have a cutting-edge technology setting a new standard according to FDA regulations. New levels of lubrication can be achieved in cooperation with equipment manufacturers and suppliers. There are approaches to a once only lubrication of roller bearings and new concepts of distribution, where uptime is sold rather than spare parts."

Author: Ron Kotrba
Senior Editor, *Pellet Mill Magazine*
218-745-8347
rkotrba@bbiinternational.com