THE RIGHT LUBRICANT FOR THE RIGHT JOB HELPS LOWER MACHINE OPERATING COSTS

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Rather than a "one-size-fits-all" approach, reliability managers should examine major machine sections to determine well-suited oil and grease characteristics.

Today's global economy has put many paper facilities under pressure to lower operating costs and increase efficiency. This often means doing more with fewer people in aging facilities using older equipment. The challenge is magnified by the loss of an increasing number of senior reliability managers who retire and take their many years of valuable experience and knowledge with them.

The necessity for improvement has prompted more attention to lubrication and its role in operating equipment safely, reliably, and less expensively. As a result, the industry is focusing more on the two factors that collectively determine the quality of lubrication—lubricant selection and lubrication management.

LUBRICANT SELECTION

In its most rudimentary form, lubricant selection is nothing more than selecting the appropriate type and viscosity of lubricant for each piece of equipment requiring lubrication. This information is usually found in the original equipment manufacturer's manuals.

The first step is to compile a list of lubricants for all equipment requiring lubrication (a lubrication survey). The second step is usually to consolidate this list into a more practical and manageable number of different types and viscosities of lubricants to be inventoried and used in the plant.

Lubricant consolidation always involves certain trade-offs. Informed choices must be made regarding how far lubricants can be safely consolidated without materially affecting the performance and reliability of the equipment being lubricated.

There are four distinct sections of paper machines requiring lubrication. They are the forming section, the press section, the drying section, and the reel. Each section performs specific functions and creates particular demands that must be considered in lubricant selection. The first three sections create particular lubrication challenges.

The large volume of water in the forming section puts unusually high demands on a lubricant, which must seal, keep water out, and purge contaminants from the bearing. Typically, grease is the best choice for forming section bearings. One should seek high-quality aluminum complex grease with high water-repelling qualities and outstanding corrosion protection. Sheer stability—a lubricant's ability to prevent additives from dropping out of the base oil—is also critically important. Lubricants in wet environments are often prone to sheering. A lubricant with poor sheer stability will lose its additives and its ability to lubricate properly and quickly, increasing the likelihood of bearing failure.

In the press section, plain (or "solid") press rolls are common, and heat press rolls are becoming increasingly common. As with the forming section, water is the predominant lubrication challenge. High temperature pressing with heated rolls exacerbates the lubrication challenge. Grease and circulating oil are common in the press section. In addition to repelling water and preventing corrosion, the lubricant must be able to disperse heat quickly.

The dryer section exposes bearings to high temperatures over a long period of time. The trend toward larger, faster machines has compounded the temperature challenge even further. Regardless of which combination of rolls and configurations may be found in a dryer section, the circulating paper machine oil chosen should be selected based on real-world data on heat dispersement and / or temperature reductions that lubricant suppliers should be able to provide.

If all lubricants performed equally well, involvement in lubrication selection would end with selecting the appropriate type and the correct viscosity. Recent advances in lubricant technology provide users with a broad range of quality options, and many of these lubricants can provide significantly improved machinery efficiency and reliability.

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There are no specific types of lubricants that can be predicted to underperform. Each lubricant manufacturer's unique blend of additive chemistry and base oil gives each lubricant its performance characteristics / capabilities. For instance, the conventional "wisdom" is that synthetic lubricants are better than mineral oil-based lubricants. This isn't necessarily true. A mineral-based lubricant with a superior additive package can out-perform a synthetic lubricant with a lesser additive package. Testing lubricants against each other in real-world situations is the only way to determine which works best.

Because high-performance lubricants can cost more, opting to use one of these lubricants almost always involves overcoming the additional hurdle of "price justification." This becomes somewhat of a "Catch 22" situation, wherein the cost justification required for purchase approval cannot be documented until after the lubricant has been purchased and put to use. Thus a commitment to lubricant upgrades often requires a leap of faith.

LUBRICANT UPGRADES

When is it appropriate to upgrade lubricant quality? Lubricants should be upgraded whenever the upgraded lubricant produces benefits or savings that exceed the additional cost of the oil.

What is a lubricant upgrade and who defines it? Some attempts to make lubricant upgrade decisions are based solely on comparative ASTM test results on various oil candidates. While ASTM tests can be indicators of how oil may perform, there is only one final arbiter for performance—the equipment being lubricated. The equipment will indicate what makes it work best!

Observed changes in oil and bearing temperatures, bearing vibration levels, energy demand, oil life and re-lubrication intervals, equipment cleanliness, how the oil handles water and other contaminants and machine repair frequency and costs are all indicators of lubricant performance. There simply is no substitute for running the candidate oil upgrade in the equipment.

When considering a lubricant upgrade, the lubricant supplier should be able to provide long term user references that can provide information to help determine whether the candidate lubricant is likely to deliver the targeted results.

COST ANALYSIS CRITERIA

Too often the cost of the oil becomes the main focus in purchasing decisions. In the absence of empirical evidence to the contrary, cost per gallon becomes the defining measure of value. Though unintentional, this leads to the most myopic view of lubricants possible. It is not the cost per gallon of the oil that is ultimately important. The only meaningful measure of value is the "applied cost" of the lubricant in the equipment it lubricates, which encompasses the lubricant's contribution to increasing or decreasing each of the following:

- Purchase price
- Machine efficiency as represented by energy use
- Oil service life as represented by oil drain frequency
- Downtime and lost production
- The cost of labor and replacement parts
- The disposal cost of used oil.

It is common for 80% of a plant's maintenance efforts to be expended on just 20% of its equipment, commonly called "bad actors." These machines are the most likely candidates that can benefit from lubricant upgrades. They are also the machines in which the reliability benefits of the upgrade will be most quickly observable. While the need for improved equipment reliability may be the primary motivation for manufacturers to upgrade lubricant quality, the cost reductions attainable through energy savings can be significant and are the most easily documented.

Repairs and unscheduled downtime can drive up costs considerably. The following case illustrates how upgrading lubricants can dramatically reduce maintenance costs.

CASE STUDY: WET END SAVINGS

A major paper mill had experienced five unscheduled bearing failures on two wet ends in a two year time-frame. These failures were very costly and forced a review of the mill's lubrication practices and lubrication selection. The decision was made to test the impact of upgrading lubricants.

Bearing temperatures and vibration readings were monitored on the two paper machines before and after switching to high-performance synthetic grease. Equipment temperatures were taken four weeks after lubrication with the original synthetic grease and then four weeks after lubrication with the high-performance synthetic grease. Changing to the high-performance synthetic grease dropped temperatures an average of 30° F (Figures 1 and 2). The lower temperatures have been stable for 19 months.

Vibration levels prior to the lubricant upgrade were normal but since the change, many vibration frequencies have dropped. No bearing vibration reading on either machine increased.

Most importantly, neither paper machine experienced a single unscheduled or scheduled bearing replacement since upgrading lubricants during the first two years of service. The annual production loss in dollars from bearing failures during two years of using the original grease was $64,625 (5 failures x 5.5 hours per failure x $4,700 per hour lost time / 2 years).

In addition to eliminating the downtime expense due to the failed bearings, upgrading lubricants enabled the mill to reduce maintenance expenses by reducing the frequency of lubrication intervals. The plant was originally using forty 120-lb kegs of synthetic grease annually for two machines at a cost of $500 / keg. The annual cost was $20,000.

The high-performance synthetic grease allowed the mill to extend lubrication intervals from four weeks to twelve weeks. Although the high-performance synthetic grease had a higher purchase price at $632 / keg, only sixteen 120-lb kegs were needed annually, for a total cost of $10,112. The combined annual financial impact of reduced maintenance cost and lubrications purchases was significant.

- Annual savings by eliminating bearing failures: $64,625
- Annual savings by reducing the amount of lubricant purchased: $9,888
- Total annual savings: $74, 513.

CASE STUDY: PRESS SUCTION SAVINGS

Paper mill reliability staff determined that the first press section roll drive side bearing was stage failing. This was determined by a temperature rise from the normal 165° F to 175° F to a temperature of 265° F and excessive vibrations.

Reliability staff decided to attempt to prolong the life of the equipment without making immediate repairs. Instead, they elected to simply upgrade lubricants. Although they were already using a major brand synthetic grease, they believed they would be better served by trying a synthetic grease from a manufacturer who specialized in high-performance lubricants.

Upon making the change, the bearing temperature went from 265° F to 160° F in less than one hour, and the vibrations decreased. The mill continued to run until its next scheduled downtime and changed the bearing even though all indications were that the bearing was no longer problematic. Reliability staff concluded that the upgraded grease prevented an approximate 12-hour downtime, which saved the mill in excess of $36,000 in downtime expense.

CASE STUDY: ENERGY SAVINGS

Energy costs for rotating equipment are many times higher than maintenance costs. Even a small percentage energy savings can quickly exceed the total cost of a lubricant purchase.

Production employees at a paper mill had attempted to put a higher pli load on a control crown (CC) roll in the calendar stack due to some new grades of paper now being made. The limiting factor had been the temperature rise of the oil in the CC roll with increased pli. The oil temperature was causing concern as it was reaching a level at which the oil viscosity and lubrication limits were being compromised. The plant had never been able to go above 650 pli.

Lubrication quality was determined to be the factor limiting equipment performance. Reliability staff made the decision to seek a better performing lubricant in an attempt to resolve the issue. They elected to upgrade from their current brand name petroleum-based paper machine oil to a high film strength paper machine oil. The high-performance synthetic lubricant allowed them to increase machine speed, reduce temperatures, and achieve a pli level they had never been able to attain: 873 pli (Table 1).

After 15 months, the oil condition had remained exceptional, with iron wear metals remaining nearly nonexistent. The vast improvement in equipment operation created annual energy savings of $27,945. Energy savings were calculated using the data in Table 2. The energy savings alone exceeded the total cost of upgrading the lubricants within a few months and created substantial cost savings long-term.

LUBRICATION MANAGEMENT

Lubrication management encompasses all of the lubrication practices and procedures attentive to properly storing, applying, monitoring, and taking care of the selected lubricant. It includes making sure the right oil gets into the right equipment in the right place in the right amount at the right time. It also encompasses used oil analysis programs, visual inspections and maintenance of fluid levels, timely oil changes, and attention to contamination control from water, etc.

The elements that constitute good fluids management are far too extensive to address in this article, but they are essential to achieving quality lubrication. It is important to note however, that good lubrication practices are not a substitute for selecting high quality lubricants with the performance properties necessary for optimum performance in equipment.

Good lubrication practices simply cannot make a poor lubricant become a high-performance lubricant. Good lubrication practices are important in helping to preserve the original lubricating properties of the selected oil.

Spray Nozzles
Spray Systems 43%
Bete 27%
Sprayco 7%

Tanks & Vessels
Mueller 7%
Pfaudler 6%

Temperature Instrumentation
Emerson Process Management 50%
Omega 10%

Vacuum Systems
Nash_Elmo 22%
Busch 15%
Sihi 11%
Graham 8%

Valves & Actuators
Emerson Process Management 35%
Neles-Jamesbury 7%
Flowserve 6%

Variable Speed Drives
Rockwell Automation 34%
ABB 16%
Toshiba 7%
Siemens 7%
GE 5%

Vibration Monitoring Equipment
GE (Bently Nevada) 56%
Emerson Process Management 13%
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Water Treatment Systems
GE 24%
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Calgon 6%

Weighing Systems
Mettler Toledo 58%
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