What You Need to Know About ISO 21469 and Food Safety

New Standard Leads to Changes for Certifications

Lube Practices ... Refined
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Lube Program Can Address Plant’s 500-Pound Gorilla

In scanning the press release wires recently, I was drawn to the following headline: “Institution Obtains World’s First Voluntary Gorilla Blood Pressure Reading”. I couldn’t help but laugh, and I couldn’t stop. (To this day, the thought of it still gets me going.) Before delving into the article, all I could picture were the poor fellows who went through trial after trial with uncooperative gorillas before getting the breakthrough result. Failure can be pretty extreme when you’re working with gorillas. (You think you have tough days at work?) But you know what? Somebody has to have the guts to fight off the gorillas – to keep trying, keep believing – until there’s success.

As the article states, “Gorillas aren’t typically keen on the idea of inserting their arms into inflatable blood pressure cuffs.” Really? I’ve also heard that lions don’t like to have their tails put in bench vises. In the case of gorillas, it turns out that all it takes, though, is “months of patience and diligent voluntary positive reinforcement training” – that plus a cuff bolted to a casing made of acrylonitrile butadiene styrene plastic which is zip-tied to a rectangular mesh trap temporarily attached to the gorilla cage. Oh. That makes sense.

What’s the point of all this? Failure. You have to experience it before you achieve success. Whether you’re trying to get a gorilla to stuff his arm in a box or pushing for maintenance improvement through machinery lubrication, victory isn’t going to come on the initial attempt (unless you get real lucky). You have to be patient. You have to build buy-in (how about a banana?). You may have to scratch a few hairy backs.

If you’re in the gorilla blood pressure device business, you probably experienced pullback ... somewhere in the neighborhood of 1,500 pounds per square inch. You probably had a mesh trap or two snap down or lock onto a patient’s arm. In this business, that’s downtime no one wants to experience.

If you’re in the business of trying to bring machinery lubrication excellence to your company in the manufacturing or process industry, you too probably have experienced pullback. “Why do we have to do a fancy overhaul of the lube storage area?” “This is going to cost how much money?” “Why do we need to train the people who lube the machines?” “You don’t think I know how to use a grease gun?” “Why do we in operations need to get involved?” Some won’t be keen on the whole idea. Really!

Given the choice of trying to make change happen in a plant full of over-stressed executives, tightwad bean counters, silo-separatist operators and 25-year maintenance mechanic lifers vs. trying to see if Mighty Joe Young has hypertension issues, a percentage of you may opt for the latter.

The maintenance manager or appointed hourly leader pushing lubrication excellence will have to deal with roadblocks and cutbacks and back-burners. There will be failures, hiccups and re-dos.

It takes months of patience. It takes diligent voluntary positive reinforcement training (Noria’s Machinery Lubrication and Oil Analysis classes will give you direction). It takes volunteers to raise their hands. It takes efficient use of science and technology and commonsense principles (no gorilla traps, though).

Somebody has to have the guts to fight for this program – to keep trying, keep believing – until there’s a successful result. And, yes, in time (whether it’s six months, one year or three years from now), there will be success – one that will bring increased mechanical reliability, increased line and labor productivity, improved end-product quality, and cost savings that will impact the bottom line.

When that happens, your plant or company newsletter will run an article, hopefully not with an odd headline that makes readers laugh.

Until next time, keep wrangling those gorillas. 

- Paul V. Arnold, editor-in-chief
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Without the lens of a microscope, bacteria and viruses might only be recognized as painful symptoms of sickness and disease by those who are infected. Just as technology is an important enabler in human pathology, it also serves in the detection and diagnosis of a host of machine health issues, including the invasion of lubricant contamination.

However, for most machinery maintainers, the threat posed by fluid contamination runs contrary to human intuition. Just like a viral infection, in lubrication, it’s what we can’t see that hurts us most. The naked eye is generally blind to the destructive potential of most types of contaminants. In fact, none of our “unaided” human senses can be relied upon to detect and recognize significant concentrations of contamination.

When I first entered the oil analysis field in the 1980s, portable and user-level oil analysis technology was years ahead of its time. This is not so today. Contaminant monitoring instruments have advanced rapidly in the past two decades as has the awareness of its importance. What was previously only the domain of analytical chemists is now an essential maintenance tool available to field technicians and condition monitoring specialists. Thankfully, the “now generation” is largely a population of sophisticated consumer electronics users who also have an insatiable appetite for instant information.

Outfitting Your Toolbox

Astute lubrication professionals know that measurement and feedback are critical to contamination control. There are a variety of user-level contaminant monitoring instruments and methods to gain quick readings on lubricant cleanliness, dryness and other contaminant levels. Putting the right tools in the hands of maintenance teams enables far greater awareness of transient contaminant conditions and the need for a quick, corrective response.

As with any oil analysis program, the process should begin by identifying the machines and lube points to be included for contaminant monitoring. Don’t overlook the importance of properly located live-zone sampling ports. Consider installing both primary (routine analysis) and secondary (troubleshooting only) sampling ports on circulating systems. Document the appropriate sampling procedure and train your staff accordingly.

In selecting contaminant monitoring instruments, emphasize “ease of use” as being of greater importance than precision and diverse functionality. Often the simplest of instruments will prove to be the most effective from a maintenance perspective. The reason is that they are used more frequently and the data is often easier to interpret. In the world of reliability, tests of moderate precision but performed frequently will almost always win out over high-precision but infrequent analysis of lubricants.

Because of the dozens of available instruments at wide-ranging costs, you would be well advised to be a smart shopper by first defining needs and comparing options. As an aid in navigating the process, I’ve included a few pointers below:

**Target contaminants:** For most machines, particles and moisture are the most serious contaminants, so this is an essential starting point in setting up an onsite laboratory. Fortunately, there are numerous particle counters, patch test kits and moisture analyzers from which to choose. Many of these instruments have gone through years of refinement to adapt to the needs and expectations of the user community. Additionally, there are glycol kits, fuel dilution testers, soot instruments, microbial contaminant testers and even field acid-number (AN) kits.

**Daily sample volume:** Many user-level instruments have slow throughput times – say 10 to 20 minutes per sample. This is not a problem if the expected sample volume is low. However, if high sample traffic is expected, then instruments that can quickly process samples are going to be an important requirement for quick data turnaround.

**Range of sensitivity:** Before you select your onsite contaminant monitoring instruments, it would be advisable to quantify your alarm levels. Most instruments have upper and lower limits of sensitivity. Your alarms and limits need to fall within the instruments’ dynamic range of performance.

**Wet chemistry:** Not all onsite oil analysis instruments require the use of solvents and reagents. Many chemicals have special handling and disposal requirements. Ventilation may also be needed. In most cases, instrument options exist that don’t require the use of dangerous solvents and reagents.

**Portable vs. benchtop instruments:** Not all instruments require a laboratory countertop to operate. Many instruments are portable or at least “luggable”. They can be used directly on the machine without the need of a sample bottle or near the machine from a bottle sample. For large plants with many lubricants in non-circu-
lating applications, the best option is often to set up a small bench-level laboratory where samples can be periodically analyzed.

**Microscopic analysis:** While automatic particle counters are a mainstay of most onsite oil analysis laboratories, they almost always need to be flanked by microscopic analysis for particle identification. Microscopic analysis enables particle color, shape and texture to be evaluated. To do this, a simple means to make membrane patches should be made available along with a suitable microscope and lighting.

**Calibration and check fluids:** Even the most basic onsite oil analysis instruments need to be checked periodically for precision. Source check fluids of known properties and contaminant levels to provide a quick means to confirm instrument accuracy.

**Target fluid compatibility:** All instruments are going to have basic application limits relating to the fluid types with which they will be used. These include viscosity range, fluid opacity (darkness), chemical compatibility and interferences (e.g., from additives, soot, water, air, etc.) among others. Verify that the target fluids are suitable for the instruments being considered.

### Important and Effective

Onsite instruments have changed the landscape of the oil analysis industry in the past couple of decades. Users are now empowered to perform quick and frequent screening tests themselves. The most important include the assessment of fluid contaminants. This enables the routine practice of proactive maintenance. In my opinion, proactive maintenance stands alone as the most effective benefit-generating strategy for machine reliability. To be performed successfully, there is an absolute requirement for continuous feedback from onsite measurement tools such as contaminant monitors. *ML*

### About the Author

Jim Fitch has a wealth of “in the trenches” experience in lubrication, oil analysis, tribology and machinery failure investigations. Over the past two decades, he has presented hundreds of lectures on these subjects. Jim has published more than 200 technical articles, papers and publications. He serves as a U.S. delegate to the ISO tribology and oil analysis working group. Since 2002, he has been director and board member of the International Council for Machinery Lubrication. He is the CEO and a co-founder of Noria Corporation. Contact Jim at jfitch@noria.com.
For food and beverage producers, pharmaceutical manufacturers, and producers of containers used to package food-related products, there’s no more important lubrication issue than the use of what are typically referred to as “food-grade lubricants”. In the United States, lubricants intended for use in food production are registered with the National Sanitation Foundation (NSF) as either H1, H2 or H3, depending on the intended application and formulation. Registration is voluntary and simply requires a review of the product ingredients with a list of compounds known to be “safe” for incidental food contact at low levels.

Of the three, H1 is by far the most important classification and is typically referred to as a lubricant designated for “incidental food contact”. This relates to applications where it is possible for the lubricant to touch the product (food, beverage, pharmaceutical, etc.) in low concentrations due to leakage or over-lubrication. (You will find more details on the difference between H1, H2 and H3 lubricants, together with information on the selection and application of food-grade lubricants, in Stephen Sumerlin’s article found on Page 28 of this edition of Machinery Lubrication.)

Recently, a new terminology has entered the vernacular of food-grade lubricants: ISO 21469 certification. ISO 21469 is not a new standard; in fact, it came into effect in February 2006. Like many voluntary standards, it has taken a while for mainstream adoption. However, a number of major suppliers of food-grade lubricants recently have been successful in obtaining ISO 21469 certification, which is why the timing for an article such as this is now appropriate.

What ISO 21469 Addresses
Like the pre-existing NSF H1, H2 and H3 designations, ISO 21469 is all about trying to insure that consumers are protected from the deleterious effects of contaminating food and food-related products with the lubricant. However, the first important distinction is that ISO 21469 only addresses products intended for “incidental contact” (so-called H1 products in the old terminology). It does not cover the NSF H3 category of lubricants where product contact is inevitable (e.g., a meat hook), nor does it address H2 lubricants. Second, unlike the NSF H1 designation, which simply addresses the potential toxicological, carcinogenic and mutagenic effects of the lubrication by comparing a list of the lubricant’s “ingredients” with a list of approved food-safe products (per 21.CFR 178.3570), ISO 21469 addresses the whole process of lubricant design, manufacturing, packaging and transportation.

Key to achieving ISO 21469 certification is conducting a thorough “hygiene risk assessment” to address not just the chemical safety of the lubricant (non-toxic, non-carcinogenic, non-mutagenic) but also the potential for physical risk from the ingestion of dirt, dust or metals, or biological risk due to the formation of pathogens or other biologically active agents from long-term storage, spoilage, etc.

Steps to Certification
Achieving ISO 21469 certification is a six-step process.

Step 1 is simply an administrative step whereby the manufacturer submits details such as product name, manufacturing locations, container size, shelf life, etc., along with the completed risk assessment documents.
Step 2 requires a review by the assessing body (e.g., NSF) of product details, including a list of ingredients (e.g., additives), their suppliers and the acceptable range of those ingredients in the finished product. Products are classified based on related product families (e.g., anti-wear fluid, gear oil, etc.). Grouping products into classes based on their chemical constituents helps to reduce the amount of compliance testing required as part of obtaining and maintaining ISO 21469 certification. Just like the H1 classification, ingredients must come from the list of known food-safe products according to an appropriate listing such as Food and Drug Administration (FDA) regulation 21.CFR 178.3570.

Step 3 is an onsite audit of the lubricant manufacturing facility to look at recordkeeping, quality control policies and procedures, overall “good manufacturing processes” (GMP), and to allow for representative product samples to be collected. As part of the onsite audit, the manufacturer’s hygiene risk assessment protocol is reviewed and verified. The onsite audit is conducted by a qualified representative of the assessing body such as NSF.

Step 4 requires that a representative baseline be established using Fourier transform infrared (FTIR) analysis. Samples are taken from different manufacturing batches as well as any repackaged products to verify that the supplier has appropriate control over the manufacturing process. Sample baselines are used to compare with future samples to insure continued quality control compliance and formulation stability.

Step 5 allows for the issuance of accredit certification. In the U.S., certification is provided through the American National Standards Institute (ANSI) based on the findings of the assessing body such as NSF. A list of certified suppliers and products can be found online at http://www.nsf.org/Certified/iso_21469.

So, what’s the benefit of ISO 21469? Both the NSF H1 and ISO 21469 designations help to insure that the ingredients in any lubricant are “safe” in the event of incidental food contact. But with ISO 21469, there’s an added layer of oversight that looks not just at the makeup of a given product but the manufacturing process and level of quality control applied to the formulation, manufacturing, distribution and storage of the lubricants. Because of this, it’s likely that manufacturers of food-grade lubricants will continue to strive to attain ISO 21469 certification as an added measure of comfort to both the end-users of food-grade lubricants and, most importantly, to all of us as consumers!

About the Author

As a skilled educator and consultant in the areas of oil analysis and machinery lubrication, Mark Barnes has helped numerous clients develop effective machinery lubrication programs and troubleshoot complex lubrication problems through precision lubrication and oil analysis. As vice president of Noria Reliability Solutions, Mark and his group work on projects in the areas of: plant audits and gap analysis, machinery lubrication and oil analysis program design, lube PM rationalization and redesign, lubricant storage and handling, contamination control system design and lubrication, and mechanical failure investigations. Contact Mark at mbarnes@noria.com.
I'm a big fan of lean business. I believe lean provides organizations with the “burning platform” they need to strive to be their very best and minimize waste and risk. As a reliability engineer, I believe it provides the business platform in which to deploy reliability management systems, which help us to quantify and analyze profit-eroding losses to the organization. I get all that and am second to none in my admiration of the merits of lean. What I don’t get is why so many U.S. companies that implement a lean business system insist on using Japanese words in the process.

I spent more than a few years studying at various universities. Several of those years were dedicated to advanced graduate study in business administration. One thing that was very evident to me at the time (and nothing since has convinced me otherwise) is that clear communication is essential to business success. Just to be sure, I referred to the textbooks I used in school. There was plenty of attention paid to communication. We learned about the various elements of communication (encoder, decoder, etc.), the communication process, systems of communication, barriers to communication, communication enablers, etc. I grant you that my circa 1989 MBA is a little yellow around the edges, but I don’t recall any major breaking news announcing that effective communication is no longer thought to be important to success in business or any other aspect of life for that matter.

I also learned in business school that people and organizations frequently resist change, a phenomenon sometimes referred to as “psychological inertia”? They do so for a variety of reasons. They may not understand their role in the new system, which is frequently called role ambiguity. They are concerned about a loss of stature or quality of life. Sometimes they fear that they or those they’re close to will get squeezed out of the picture. No matter the reason, most people and organizations fear and resist change for psychological and social psychological reasons. Like the importance of communication, I don’t think people or society has suddenly and passionately embraced change to the point where it’s all of a sudden become a welcome stranger. I suspect that graduate business students are still taught how to carefully navigate the maze of challenges we face when changing an organization.

Working on the assumption that other business leaders (those responsible for deploying lean business systems) were trained using the same or similar textbooks from which I was taught business management, I must ask, “Why do we insist on using Japanese words when deploying lean systems of business in organizations where nobody speaks Japanese?” For most people, lean is scary business because it represents change. When we present it using unfamiliar Japanese terms, it is scary and confusing. Three parts of organizational change combined with two parts of poor communication is a recipe for disaster.

I’m not sure if it is arrogance or ignorance, but I am certain that it exhibits a lack of common sense to implement a major change initiative and knowingly sabotage communication by rolling it out in a foreign language. Lean should be reduced to its simplest elements. Let’s face it: There is little that can’t easily be translated into English, Spanish, French or whatever language is most common at the plant.

Sure, Japanese makes sense for Toyota, the company most responsible for the architecture of what we call lean business. They’re a Japanese company. But for American firms, it’s best to stick with the language of the plant, which for the most part is English, with notable exceptions where Spanish is required. I proudly hail from Oklahoma and am fiercely proud of my Western pioneering heritage. But honestly, I wouldn’t want to walk up and say “poka-yoke” to some good ol’ boys working in Oklahoma factories. Unless they’d been through Lean 101, I might find myself with a rearranged face!

Honestly, it’s tragic that I had to write on this topic. When it comes to lean business, common language is common sense. Keep it simple. The KISS method still works!

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**Figure 1. Examples of Lean Terms**

<table>
<thead>
<tr>
<th>Lean Term - Japanese</th>
<th>Lean Term - English Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoshin planning</td>
<td>Long-term strategic planning</td>
</tr>
<tr>
<td>Kaizen</td>
<td>Continuous improvement</td>
</tr>
<tr>
<td>Poka-yoke</td>
<td>Error-proofing</td>
</tr>
<tr>
<td>Jidoka</td>
<td>Ergonomic design</td>
</tr>
<tr>
<td>Kanban</td>
<td>Visual plant</td>
</tr>
<tr>
<td>Heijunka</td>
<td>Leveled/constant production</td>
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Lube Practices ... Refined

Valero Energy’s Refinery in New Jersey Shows Discipline by Taking its Lubrication Storage and Dispensing Practices to the Shed
Valero Energy’s 950-acre refinery in Paulsboro, N.J., was preoccupied, busy, absorbed with its primary task of converting more than 175,000 barrels of sour crude oil every day into polished lubricant base-stocks, liquefied petroleum gases, gasolines, jet fuels, mid-distillate products, asphalt, petroleum coke and molten sulfur. The management mantra “nothing is wasted from a barrel of crude” was established to underscore the business goals of efficiency, productivity and profitability.

Valero paid great attention to the oil products being refined and then sold by the company. However, opportunities existed to upgrade the refinery’s system for purchasing, storing and dispensing oil products for use in production equipment at the site.

“Each (operations department) operating unit was previously responsible for inventorying, ordering and storing their own oil,” says senior reliability engineer Steve Immordino.

This resulted in excess inventories and poor storage conditions, which contributed to equipment reliability problems. As is common at many refining and processing sites, the Paulsboro plant stationed some of its drums of lubricating oils outside in holding and dispensing areas.

Tom Gaskill, a machinist who has worked 38 years at the refinery, states: “Without controlled storage conditions, the rotating equipment suffers, as the oil continues to be exposed – to water and contaminants – before it ever goes into a piece of rotating equipment.”

Contaminated oil poured into production equipment can negatively affect component productivity, health and life. Bearings and seals can be impacted, which in turn can impact pumps and pump systems.

When contamination was identified ahead of time, Valero incurred additional costs to have an outside entity and/or its own personnel dewater, filter or properly dispose drums of such oil.

“We saw the need to address pump reliability, cleanliness and safety, and consolidation and cost reconfiguration,” says maintenance superintendent Matt DiGiacomo. “Those were the targets that we have addressed over the past two years. This is a work in progress, but the results have been significant.”

Taking Control of the Situation

The refinery created the position of lubrication improvement leader in the spring of 2007 after seeing lube management as an area to improve. This person would be 100 percent focused on formulating game plans for equipment lubrication and serve as the point person for internal and external contacts. Gaskill, a specialist in troubleshooting rotating equipment, was chosen for this job.

“I welcomed the challenge,” says Gaskill. “I knew this would be difficult, but I enjoy solving difficult problems. I told management, ‘I know where our problems are. I have seen them first hand.’ I asked my supervisor, ‘Where do you want me to go with this?’ He said he wanted to give me the autonomy to decide how to proceed.”

The first step was oil consolidation. The Valero plant in Paulsboro needed to consolidate its lubrication requirements and minimize the number of oils that it handled. On December 5, 2007, Gaskill began a feasibility study with a cross-functional team comprised of Valero reliability engineers and representatives from ExxonMobil (technical sales
and product engineering) and the site’s lubricants distributor to identify types and grades of lubricants that could be removed or replaced based on redundancy or specific application.

“Every piece of equipment was studied to see if a change was possible or not,” he says. “We examined what the process was, what was required from a lubricant perspective and what oil was presently used.”

By July 2008, the overall inventory requirements were reduced from 27 different lubricating oils down to 14. The efforts elicited an immediate and annual cost savings of $140,000. That figure is based on past volume of purchase. With better control of lubricant procurement and consumption, that figure will increase in 2010 and beyond.

The next task was procurement. Gaskill brought together a team that set up a vendor-managed inventory and just-in-time (JIT) delivery system with a lubricants distributor located 15 minutes from the refinery. No longer would an extensive turnaround time necessitate bulk purchase of drums. The distributor holds stock at its warehouse for Valero until it is required. A company representative visits

Crude Facts on Valero


Plant size: 950 acres.

Plant employment: The site employs approximately 450 workers, including 150 in maintenance and reliability roles.

Products: The refinery produces polished lubricant basestocks, liquefied petroleum gases, gasolines, jet fuels, mid-distillate products, asphalt, petroleum coke and molten sulfur.

FYI: Paulsboro’s sister facility in Port Arthur, Texas, won the ICML’s John R. Battle Award for Excellence in Machinery Lubrication in 2007.
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**Shedding Light on a Solution**

An adjunct to consolidation and procurement was storage. Valero could reduce inventory and buy only as needed, but if the Paulsboro site didn’t change the manner in which it stationed and drew from its drums, the efforts never would be maximized.

Because of the extreme conditions present throughout the year in the northeastern part of the United States, the refinery needed a concept that would allow a controlled environment for storing lubricants.

“We needed a lasting solution,” he says. “We had to promise to management that the money we were going to spend would be sufficient. We couldn’t come back in 10 years and ask for more money to replace what we had built. The equipment we were going to put in place had to last.”

Doing some research, Gaskill found the solution: a fiberglass-body, steel-reinforced shed made exclusively for lubricant storage by an Ontario-based company. The shed design included a grated floor with the ability to contain spilled fluids and configurability allowing for lighting, electricity and complete climate control.

Before placing an order, he and a project consultant from Valero drove to Maryland in January 2008 to see a shed in use at a school district’s fleet maintenance yard. “We wanted to physically put our hands on the product before making the final decision,” he says.

Gaskill and members of the lubrication team opted for 12 sheds that would handle the specific needs and inventory of 12 refinery process areas spread out around the property. Existing facilities would house lubricants for the refinery’s other two process areas.

The size of each shed was determined following the consolidation and JIT work. Sheds would be either 12 feet wide by 14 feet

**Taking an Inside/Outside Approach to Oil Analysis**

Valero Energy’s refinery in Paulsboro, N.J., has utilized oil analysis for several years to diagnose the health of lubricants used in production equipment.

The site had alternated between two off-site vendors before settling on ExxonMobil’s Signum program in 2009.

Valero’s trained machinist SMETs (subject matter expert technicians) take a total of 60 to 70 samples per month from critical pieces of equipment. Annette Harrje, a member of the maintenance and reliability organization, collects the samples and ships them to a lab in Kansas City. The results are sent electronically to senior reliability engineer Steve Immordino (the point person for oil analysis) as well as other members of the M&R group. Meetings are held once a month to discuss data trends and determine action plans, when required, for particular findings.
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long by 10 feet high or 12 x 12 x 10. They would be laid out to handle six in-use 55-gallon oil drums and a backup drum for each, plus several five-gallon pails for lesser-used oils. Grease cartridges, grease guns, cleaners/degreasers, sorbents and shop towels also would be stored on shelving units.

“I made sure that the operators and maintenance crew in an area would have everything that they needed and nothing else,” says Gaskill. “The sheds weren’t to be used to store anything other than items related to lubrication.” (Regular audits would ensure compliance.)

The first shed was installed and fully operational in August 2009. By the end of November, five additional sheds were placed and the two existing facilities were remodeled and made functional.

“Winter is here, but we have put our available oil in a controlled temperature environment,” says Immordino, noting that the temperature ranges between 75 and 80 degrees Fahrenheit.

Taking it to the Next Level

Prior to purchase, the shed strategy was centered on storage, but it would evolve into something more in-depth. Speaking with representatives from Valero’s refinery in Port Arthur, Texas (the 2007

A Valero employee dispenses oil from a color-coded spigot into a transfer container.

A Trico closed oil system is installed on a piece of rotating equipment at the Valero refinery.

Lube Excellence through Education, Certification

In recent years, Valero Energy has supported lubrication education efforts through participation in the International Council for Machinery Lubrication’s certification process. In 2009, its Paulsboro, N.J., refinery had 10 maintenance and operations personnel pass Level I exams for the Machine Lubrication Technician (MLT) and/or Machine Lubricant Analyst (MLA) designations.

Overall, 23 Valero employees currently hold ICML certifications, including: Mark Blanton (MLT I), Joey L. Burnaman (MLT I), Jack Craighton (MLA I), Matt DiGiacomo (MLA I), Nicholas DiMarcello (MLA I), Tom Gaskill (MLA I), Cary Gray (MLA I), Randall Hack (MLT I), Ricky Hill (MLT I), Stephen Howe (MLA I), Steve Immordino (MLA I), Mark Kavanaugh (MLA I), Clint McGuire (MLT I), John Miller (MLA I), Barry Myers (MLA I), Dan Sanders (MLT I), Jerry Spikes (MLT I), Michael J. Stump (MLA I), Anthony Suggs (MLA I), Allan Thibodeaux (MLT I, MLA I), Jimmy Thomson (MLT I, MLA I), James R. Wilson (MLA I) and Mike York (MLT I).
winner of the International Council for Machinery Lubrication’s John R. Battle Award for Excellence in Machinery Lubrication), Gaskill latched onto the philosophy of “Clean, Dry, Right”.

- Clean = the oil has no contaminants
- Dry = the oil has no water
- Right = the right oil is used in the right equipment

“If you incorporate that into your plan, everything else will fall into place,” he says.

As a result, funding was obtained to purchase bypass filtration systems. These were installed for all in-use drums in every shed (37 filtration units were in place by mid-November). Drums coming into the refinery have a cleanliness level of approximately 22 microns. Running continuously, the filtration system brings that level down to 1 micron or less in seven days. While 22 microns by no means constitutes “dirty” oil, super-cleanliness enables envelope-pushing performance in mechanical systems that have very tight tolerances, such as those associated with gas and steam turbines.

Desiccant breathers are placed on in-service drums to absorb moisture.

A color-code scheme addresses the “right” portion. A wall chart displays three columns: a piece of equipment in the area, the particular lubricant that it requires and the color code for that lubricant. For instance, 60-K-7A motors in the H2 plant require DTE 10 EXCEL 68 lubricant; the code for that lube is orange. The operator or maintenance technician takes an orange-labeled lubricant transfer container off a shelf in the shed and finds the orange-balled spigot on the lube-dispensing bar. That draws clean, dry, filtered oil from the DTE 10 EXCEL 68 drum.

While the system is sound, Noria Corporation was hired to provide additional training to operators and techs on lubrication and oil sampling fundamentals.

“Training and constant communication is important to lasting success,” he says. “This isn’t something where we build it, hand it over to them and then turn our back. It is important to me and everyone else that, when all is said and done, this is a best-in-class solution.”

**Return on Hefty Investment**

This lubrication improvement initiative is an evergreen process, so feedback is constantly sought in order to improve it over time.

“I have been surprised and pleased how well this is being accepted. Ninety-five percent of the time, the process is being followed to the letter in the areas where we have made changes,” Gaskill says.

Maintenance supervisor DiGiacomo knows why.

“The investments that the company has made (more than $500,000 to date) show that we are serious and we care about what we are putting into the equipment,” he says. “If we care that much to make that commitment, then it must be important.”

The maintenance and reliability department is showing the company a return on its high-level investment.

- Mean time between repairs for the plant’s 1,300-plus production pumps has increased to 48 months, and the goal over the next few years is to push that to between 60 and 66 months. “If we can simply improve our bearing-related failures by 15 percent, we will have paid for the investment,” says DiGiacomo.
Plant availability is approaching 98 percent, an impressive figure for a refining plant.

The “Clean, Dry, Right” philosophy has reduced slip/fall and environmental hazards, and more ergonomic-friendly tools for handling drums and pails have led to fewer injuries.

And, consolidation and procurement practices have reduced the total spend on lubricants. “We now track costs for the oil we are using,” says Gaskill. “I anticipate a significant cost savings in addition to the initial $140,000 per year in savings.”

Further Refinement

While this is all good, there is still plenty of work to be done. The new strategy is in place in the north half of the refinery.

“Change is coming to the rest of the refinery,” says Immordino. “We’ve gone too far to turn back.”

One by one, the six south-end sheds will be installed in the near future.

“Overall, I think we are at a grade B right now because we are halfway done,” he says. “We have to stay the course and keep pushing. What we have put in place is a good plan.”

Extra steps in the plan include attempts at a further consolidation in lubrication oils from the current 14 to perhaps as few as 10 and further refinements to shed installation (savings are possible by having the shed manufacturer install all of the electrical and heating components).

The goal was (and is) to make this a lasting solution. The Paulsboro refinery is committed to seeing this through...
“...we extended drain intervals from every 15 days to every three months AND reduced engine repairs and replacements.”

Luis Garza
Kingfisher Marine

Most efforts to improve operating efficiency and lower maintenance costs are labor intensive and involve painful cultural changes. Numerous progressive companies have experienced significant cost savings simply by upgrading lubricants. You can learn how by reading the special report ‘Lowest Total Cost of Ownership’. This special report includes extensive case studies that document real-world savings through lubricant upgrades.

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Why the Tank May Well Be a Hydraulic Fluid’s Best Friend

Your hydraulic fluid has a big job to do. It’s a power transmission device, a lubricant, a heat-transfer medium and even a sealant (in some hydraulic components, at least). This is why I often refer to hydraulic fluid as the most important component of the system, and certainly not something to be purchased on price alone.

But regardless of whether you use a synthetic, a high viscosity index maximum-efficiency hydraulic fluid (MEHF), ashless, zinc-free, multigrade or monograde, or any other of the myriad of options available today, to do its job well, your hydraulic fluid needs a little help from its friends. The first of these – and possibly the hydraulic fluid’s best friend – is the reservoir or tank.

Size Matters

Traditionally, recommended tank size for mineral hydraulic oils has been three to five times Q plus a 10 percent air cushion (where Q is pump flow per minute – or mean pump flow per minute where a variable pump is used). For some special fluids, recommended tank size is even larger. For example, for hydraulic systems using HFC and HFD fluids, a tank volume of five to eight times pump delivery per minute is recommended.

Clearly, the above formulas were not devised to sell more oil or increase the spill risk. They were devised with hydraulic system performance and reliability in mind. But these days, with increasing demand for lighter, more compact hydraulic equipment (particularly in mobile markets), tank oil volumes of this order are becoming more of a dream than reality.

If tank oil volume – or more precisely, the lack of it – affects hydraulic system performance and reliability, then it follows that less-than-ideal tank volume hog-ties the hydraulic fluid. How? In order to answer this question, the traditional functions of the hydraulic tank – and how these functions can (or can’t) be subrogated to the hydraulic fluid’s other “friends” in the system – must be considered.

Beyond its most rudimentary role of providing fluid storage, the main functions of the hydraulic tank are to dissipate heat and allow contaminants to settle out of the fluid. In practice, the amount of heat dissipated from even a large tank is relatively small, so this function is easily and more efficiently subrogated to a heat exchanger.

When it comes to contaminants, the tank’s role in settling out particles and water can be largely subrogated to the system’s filters.

This leaves one important function of the tank for which there is no clear substitute (other than adequate oil volume and, therefore, dwell time): the release of entrained air.

Air entrained in hydraulic fluid affects the performance and reliability of the hydraulic system in a number of ways, including:

• reduced bulk modulus, resulting in spongy operation and poor control system response;
• increased heat load;
• reduced thermal conductivity;
• increased oxidation and thermal degradation (dieseling) of the fluid;
• reduced fluid viscosity, which leaves critical surfaces vulnerable to wear;
• cavitation erosion (gaseous cavitation);
• increased noise levels; and,
• decreased system efficiency.

I’ve seen much anecdotal evidence over the years which suggests skimping on tank volume compromises hydraulic system reliability. One example that comes to mind is the case of a hydraulic excavator manufacturer who, after increasing tank size and installed cooling capacity, saw typical pump life increase from 12,000 hours to 20,000 hours. This reinforces the point that no matter how good the hydraulic fluid is, it needs help from its friends.

Shape is Important, Too

When it comes to releasing entrained air from the fluid, oil volume and dwell time in the tank is very important, but so too is the way the tank is constructed.

If you refer to the diagram, you’ll see that the reservoir tank has a diffuser baffle. The diffuser is a plate of material that disperses the flow, which then flows across the diffuser and goes out either way, either upwards or downwards. The purpose of this is to help with the release of air. It also helps with the level of the fluid. If you have too much fluid in the tank, then it will fill up the tank and fill up the space between the baffle and the top of the tank. This will help to level the fluid in the tank and prevent it from overflowing.

When the air enters the tank, it will be forced to move through the diffuser and baffle, which helps to break up the air bubbles and make them smaller. This makes it easier for the air to be released from the fluid.

Another key feature of the diffuser baffle is its ability to help with the release of entrained air. When air is entrained in the fluid, it can cause a spongy effect in the system, which can affect the system’s performance. The diffuser baffle helps to break up the air bubbles and make them smaller, which helps to reduce this spongy effect.

Lastly, the diffuser baffle helps to improve the overall reliability of the hydraulic system. By helping to release entrained air and keep the fluid level in check, it helps to prevent system failures that can be caused by poor fluid management.

In conclusion, the diffuser baffle is a critical component of the tank design. It plays a key role in improving the performance and reliability of the hydraulic system by helping to release entrained air, level the fluid, and prevent system failures. By incorporating this feature into your hydraulic system design, you can help ensure that your system runs smoothly and efficiently for years to come.

BRENDAN CASEY

HYDRAULICS AT WORK
Figure 1 shows ideal tank construction for air release. The tank shown has a longitudinal baffle separating the return from the pump intake. Return fluid is made to travel the full length of the tank twice and pass through a diffuser (designed to collect and float off air bubbles) before re-entering the pump intake.

As an aside, with this tank construction, if the pump was to become noisy, aeration can be ruled out as a possible cause in this design because it is “filtered” out by the diffuser. This leaves vaporous cavitation as the likely cause of pump noise because such cavitation can’t be filtered out.

Also, note that the tank design in Figure 1 features an angled bottom plate to better facilitate drain-off of settled contaminants.

**Take Care of Your Friends**

From a maintenance perspective, little can be done (economically, at least) about installed tank volume other than specifying minimum required tank volume when ordering new equipment. But the tank, like the hydraulic system’s heat exchanger and filters, must be cared for. This involves regular drain-off of settled contaminants and occasional internal cleaning.

**About the Author**

Brendan Casey has more than 20 years experience in the maintenance, repair and overhaul of mobile and industrial hydraulic equipment. For more information on reducing the operating cost and increasing the uptime of your hydraulic equipment, visit his Web site, www.InsiderSecretsToHydraulics.com.
Advice on Pump-Related Oil Changes, Oil Mist Lubrication

BY HEINZ P. BLOCH, P.E.

We'll never know if my guess is right, but the pages that have been written about pumps, laid side-by-side, would probably go to the moon and back. After all, only 2.75 billion 11-inch-tall pages would be needed to go that distance. On the other hand, if we counted the people who know all about pumps, we would see zero instead of any real number.

But instead of pondering useless estimates and statistics, we might simply assess the “state of pump knowledge” by reviewing questions asked and opinions voiced. So, this article deals with interesting pump-related issues that arrived in my e-mail in a single month. I will share my answers and conclusions in this article.

Address More Than Oil Change Frequency

One question came from a plant located in the Middle East. The writers sought advice on the number of oil changes to be planned for centrifugal pumps at their ethylene and polyethylene units. The facility is currently running a time-based preventive maintenance (PM) program – essentially, oil changes every six months, irrespective of whether a pump is operating or perhaps waiting to be used as a spare. The plant intended to reschedule oil changes based on actual operating hours and was wondering if this “new PM plan” should be carried out after 2,000 running hours or 4,000 running hours. A specific request was made for supporting explanations or references.

As is so often the case, an answer must point out best practices. In this instance, I had to assume that there are two pumps for each service at the ethylene and polyethylene units. Moreover, I assumed that these units had not availed themselves of oil mist lubrication/standby bearing protection. Oil mist is customary for true best-of-class plants; it both lubricates the bearings of pumps and drivers and protects running and non-running pumps against atmospheric contamination. The importance of this protection is intuitively evident and becomes even more valuable in harsh climates. But for facilities with the more traditional modes of liquid oil application, best practice would include well-defined action steps and procedures. Among them, I would suggest:

1) In each service, run the “A” pump in January, March, May, July, September and November, and run the “B” pump in February, April, June, August, October and December. This would be done in the interest of bearing and seal protection for the non-running machine.

2) Once a facility has implemented this best practice, it is clear that each pump will operate slightly more than 4,000 hours per year and would stand still close to 4,500 hours per year.

3) After these switch-over practices have been explained and accepted, one would (for about one year) assign part of the machinery maintenance workforce to the monitoring of operating pumps. This once-per-month monitoring is for the purpose of identifying potential bearing distress or other signs of defect development (seals, etc.).

4) Pumps suspected of incipient failure would be taken out of service and upgraded for uptime extension. The remaining maintenance workforce would be engaged in this well-defined and substantive upgrading work (Reference 1).

5) Upgrading for run length extension means any pump taken to the shop would be subjected to a number of action steps:

- It would be retrofitted with advanced bearing housing protector seals. It should be noted that advanced bearing housing protector seals will not incorporate risk-prone design features (Figure 1). To be suitable for use in a reliability-focused plant, bearing housing protector seals must employ two clamping rings to achieve a good hold on the pump shaft. Please note that I would very much caution against older-style bearing isolator seals. Although still prevalent, there are vulnerabilities in the older-style products that often employ only a single O-ring for clamping the rotor to the shaft and use

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Figure 1. In bearing housing protector seals, avoid dynamic O-rings in proximity of sharp-edged O-ring grooves and rotors attached to shafts with only a single O-ring.
another “dynamic” O-ring perilously close to a sharp-edged O-ring groove located in the stator (shredded O-rings can contaminate the lubricant).

• It would be retrofitted with pressure-balanced constant-level lubricators (Reference 1). The traditional (and still widely used) pressure-unbalanced lubricators would be phased out.

• Only high-quality synthetic lubricants would be used in the upgraded pump bearing housings. Mineral oils would no longer be used after the upgrade.

• Whenever possible, flinger discs would replace the still rather common abrasion-prone slinger rings (Reference 2).

6) With pure oil mist, the issue of oil changes would no longer apply. With conventional oil lubrication and after implementing the above upgrade measures, the oil would be changed in the A pumps and in the B pumps on the second anniversary date of their upgrading. At that time, an upgraded pump will have accrued close to 9,000 operating hours and 9,000 stand-still hours.

Knowledge Base Must Be Supported by Facts

A question dealing with pump lubrication was sent from the United Kingdom. Its writer commented on an article that had briefly discussed the advantages of using oil mist and synthetic oil for superior bearing protection of pumps and drivers. The protection of standby equipment through the use of oil mist was given special emphasis in books and many articles (References 2 and 3).

The U.K. writer raised two questions, stating first his point of main concern was about using oil mist lubrication in Zone 1 or Zone 2 environments. Claiming that oil mist is categorized as a flammable medium, he feared using this lubrication method in such environments would increase the potential hazard. He went on to say that any failure in an oil mist piping system will release a flammable mixture. This, he opined, may require additional protection and detection equipment which will increase the material and maintenance cost. So, he asked for advice and practical guidance to reduce these risks.

Well, his fears are certainly unfounded and the statement regarding oil mist being a flammable medium is simply incorrect. There have
never been, nor can there ever be, such fires. The reason is that the air/oil mixture is several orders of magnitude too lean to sustain combustion.

My answer also quoted, from Reference 3, “The oil/air mixture is substantially below the sustainable burning point. Experiments had shown the concentration of oil mist in the main manifold ranged from 0.005 to as little as 0.001 of the concentration generally considered as flammable.”

With respect to oil mist heaters, the U.K. engineer had further stated and asked: “As far as I know, most of the oil mist systems need air heaters and sometimes also require an oil reservoir heater to control the temperature. ... Please advise how much energy is needed for the oil mist heating system?”

A heater (typically 200 watts) is needed only at the point of mixing air and oil. This heater facilitates maintaining a proper proportion of 200,000 volumes of air per one volume of oil at the point of mixing. The heater is built into the small reservoir of the console (see Figure 2) by the oil mist system manufacturer. Once produced, the oil mist will migrate in unheated, uninsulated header pipes to the point(s) of application. It will do so successfully even where ambient temperatures of minus-40 degrees have been encountered.

Reading and Math Homework

There are really two points I wanted to make in this article. One is to go beyond maintenance whenever possible and to cost-justify. Upgrading and failure avoidance should be the objectives. The second point is to encourage reading and researching the many excellent books and articles that explain virtually every element of equipment technology. Don’t guess. Add value instead.

Suppose we employed six reliability professionals and taught them to view every maintenance event as an opportunity to upgrade (Reference 3). Suppose each of these pros would read two pages a day and finish a 400-page book in 200 days. And suppose that each of the six pros could take credit for even a single pump failure avoided in a year’s time. You do the math and determine the benefits.

References


About the Author

Heinz Bloch works as a consultant for Process Machinery Consulting. He is the author of more than 400 technical papers and similar publications. He has written 17 books on practical machinery management and oil-mist lubrication published by major engineering publishers. To learn more, e-mail Heinz at hpbloch@mchsi.com or visit www.heinzbloch.com.
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The Power of Knowledge Engineering
For a food, beverage, cosmetic or pharmaceutical company, or any other firm that manufactures products that will be directly consumed or used by people, processes must be highly scrutinized for cleanliness, contamination, sanitation and quality. For this reason, such companies have a particularly difficult task when it comes to lubrication – not just the task of lubricating correctly, but in determining which lubricant to use and where.

**Food-grade Lube Performance**

As with any lubricant, food-grade lubricants must meet the needs of proper lubrication. That means a lubricant must provide the metal-to-metal surface separations, contain performance properties like anti-wear (AW) and rust and oxidation inhibitors (RO), and employ any other performance properties and base oil classifications that the application requires. In addition to these typical needs, food-grade lubricants must also stand up to a wide range of contamination issues. For example, in a meat processing plant, equipment is subjected to large amounts of steam and high-pressure caustic water cleaning. Lubricants in these types of facilities must withstand the probability of water washout as well as help in controlling rust formation within bearings and gearboxes.

Another requirement of food-grade lubricants is their need to withstand contaminants (like sugars, dust, chemicals, etc.) that occur as a direct result of the manufacturing process.

While most facilities requiring food-grade lubricants are conscientious of the operation and condition of their equipment, lubricant leakage does happen. Leaks can cause a severe amount of downtime, ranging from containing the leak to documentation to clean-up. Food-grade lubes are made and required to be tasteless, odorless and physiologically inert. These properties greatly reduce the hazard level that lubricant exposure has on the product.

Food-grade lubricants also should be able to withstand and deter the growth of fungi, bacteria and other pathogens. The formation of bacteria is very likely in the wet environments of meat processing plants. Bacterial contamination is another critical factor to consider and control in the food and beverage industry.

**Lubricant Classifications**

Historically, the U.S. Department of Agriculture (USDA) and the U.S. Food and Drug Administration (FDA) were responsible for compiling, determining, and writing the standards and classifications for food-grade lubricants. In February 1998, the USDA changed the way manufacturers assessed and organized the usage of food-grade lubricants. It allowed manufacturers to assess each point in production and determine its critical limit for risk of contamination, which warranted the decision to use food-grade or non-food-grade lubricants. This led the way for development of the Hazard Analysis and Critical Control Points (HACCP) program.

The primary current food-grade lubricant classifications are:

- **H1**: Lubricants used in food processing environments where there is the possibility of incidental food contact.
- **H2**: Non-food-grade lubricants used on equipment and machine parts in locations where there is no possibility of contact.
- **H3**: Food-grade lubricants, typically edible oils, used to prevent rust on hooks, trolleys and similar equipment.

In order for food-grade lubricants to be classified in one of these three categories, they must comply with certain codes within the FDA’s Title 21. These codes dictate and approve what ingredients can be used in a particular food-grade lubricant that may incur incidental contact. Samples of the FDA Title 21 codes are:

- **21.CFR 178.3570**: Outlines allowed ingredients for the manufacture of H1 lubricants
- **21.CFR 178.3620**: White mineral oil as a component of non-food articles intended for use in contact with food
- **21.CFR 172.878**: USP mineral oil for direct contact with food
- **21.CFR 172.882**: Synthetic iso-paraffinic hydrocarbons
- **21.CFR 182**: Substances generally recognized as safe

Even though H1-classified food-grade lubricants are made with the ideology of incidental contact with food, the allowable lubricant contamination constituted by the FDA is 10 parts per million.

**Food Contamination Hazards and Control**

With an ongoing battle between production, quality and food safety, most manufacturing facilities have implemented some type of identification process for food-grade lubricant usage, but it usually falls short of being comprehensive.
In the 1960s, the U.S. National Aeronautics and Space Administration (NASA) developed a strategic program that adopted traditional inspection techniques with a science-based food safety system. The program uses a proactive and preventive method for identifying risk by inspecting and examining any production point, or “critical control point”, for food contamination risk. This is known as the Hazard Analysis and Critical Control Point (HACCP) program. HACCP can be implemented through the entire manufacturing process, production to packaging.

HACCP has been a success in monitoring and controlling food and beverage industry contamination risk, and is now being used in cosmetic and pharmaceutical industries. In the United States, HACCP is in compliance with and regulated by 21.CFR 120/123. Seven principles help guide companies to develop and implement a successful HACCP program. They are:

**Principle 1: Conduct a hazard analysis.** Plants determine the food safety hazards and identify the preventive measures that the plant can apply to control these hazards.

**Principle 2: Identify critical control points.** A critical control point (CCP) is a point, step or procedure in a food process at which control can be applied. As a result, a food safety hazard can be prevented, eliminated or reduced to an acceptable level. A food safety hazard is any biological, chemical or physical property that may cause a food to be unsafe for human consumption.

**Principle 3: Establish critical limits for each critical control point.** A critical limit is the maximum or minimum value to which a physical, biological or chemical hazard must be controlled at a CCP to prevent, eliminate or reduce to an acceptable level.

**Principle 4: Establish CCP monitoring requirements.** Monitoring activities are necessary to ensure that the process is under control at each CCP. The USDA’s Food Safety and Inspection Service (FSIS) requires that each monitoring procedure and its frequency be listed in the HACCP plan.

**Principle 5: Establish corrective actions.** These actions are taken when monitoring indicates a deviation from an established critical limit. The final rule requires a plant’s HACCP plan to identify the corrective actions to be taken if a critical limit is not met. Corrective actions are intended to ensure that no product enters commerce that is injurious to health or otherwise adulterated as a result of the deviation.

**Principle 6: Establish recordkeeping procedures.** The HACCP regulation requires that all plants maintain certain documents, including its hazard analysis and written HACCP plan, and records documenting the monitoring of CCPs, critical limits, verification activities and the handling of processing deviations.

**Principle 7: Establish procedures for ensuring the HACCP system is working as intended.** Validation ensures that the plans do what they were designed to do; that is, they are successful in ensuring the production of safe product. Plants are required to validate their

---

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How to Gain HACCP Success

To create a successful HACCP program, consider all other quality- and manufacturing-related tasks. A proper and successful lube program should be at the top of the list. To successfully identify critical points, consider the manufacturing environment and process and all lubrication requirements of the equipment. Manufacturing processes expose food and beverage products to equipment that requires proper lubrication to operate at optimum performance and reliability. This exposure increases the likelihood of food contamination due to lubricant leakage or contact. To help combat such contamination, employ successful relubrication regimes and equipment modifications for contamination control. These are two fundamental aspects of a successful lube program.

Proper relubrication for greasing and oil top-ups help control the amount of lubricant exposure to which the manufacturing process is subjected. Many times, food processing plants regrease too frequently due to the severe washdown environment. Overgreasing increases the risk of lubricant contact with the food or beverage product. Oil top-ups provide less exposure to the food or beverage product by means of equipment location. Most oil-lubricated equipment is located farther away from critical production areas, with the exception of overhead conveyors and agitators. For these two applications, sensitive top-ups should be a top priority to avoid spills that cause timely loss of production. To assist in avoiding spills, top up oil-lubricated components using high-quality containers.

Equipment modifications are another important factor in creating and implementing a successful lube program. These modifications range from breathers to quick couplers for offshore filtration and top-ups. By reducing the amount of outside contamination ingress, water or dirt to which a piece of equipment is subjected, it greatly reduces the need for more frequent relubrication. This lowers the risk associated to a particular CCP for lubricant contamination.

Once you have developed your HACCP and lubrication programs, maintaining their consistency and effectiveness should be an ongoing process. Constantly refine and improve them based on past experiences of what worked or what did not. An example could be lubricant cross-contamination. This is a big issue, especially with food-grade lubricants, as many H1-classified lubes are not compatible with H2 and H3 lubes simply due to different performance properties. To help avoid cross-contamination, utilize the following:

**Identification:** All lubricants from the storage area to the lube technician’s cart to the application should be well identified using a standard identification system. Complete this by implementing colored labels on each lubricant container (bulk, top-up and grease gun). These match the same colored label on the lube point.

**Consolidation:** Consolidate the quantity and types of lubricant you keep, but do not sacrifice the right product for the application based on consolidation. Doing so may cause premature equipment failure.

It Takes Time and Resources

You can see just how difficult it can be to deal with the restrictions that food, beverage, pharmaceutical and cosmetic companies face when dealing with quality and cleanliness control and implementing proper lubrication techniques. With the limited selection of food-grade lubricants, it is critical to take the time to determine the correct product per application.

The implementation of any program (HACCP or strictly lubrication) takes time, resources and confidence to complete successfully. Many times, facilities look for an immediate return on these types of programs and investments. While that is not wrong to expect, it just does not happen immediately. These types of programs take time to develop and reach their full potential and must keep evolving with the demands of the facility. Luckily, programs can evolve and morph as many times as required.

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About the Author

Stephen Sumerlin is a technical consultant with Noria Reliability Solutions, working on Lubrication Process Design Phase II projects for Noria clients. He is a mechanical engineer and a certified Level I Machine Lubrication Technician (MLT) through the International Council for Machinery Lubrication.
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Fluid Defense Systems recently debuted the OIL SAFE Premium Pump. Sharing the proven efficiency and reliability of the OIL SAFE Standard Pump, this heavy-duty, quick-connect-enabled discharge pump is color-coded and capable of handling up to ISO 680 viscosity fluids. The product also features a comfortable D-shaped handle grip design and fully serviceable internals for maximum life. OIL SAFE containers can be filled through the pump body quick-connect. Quick-connects kits with breathers provide ultra protection against contamination when operating or filling the container or equipment. This product helps you to get the right lubricant in the right equipment in the right condition. Color-coded collars and other spares are also available.

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FLUIDALL T330 Storage Tank

FLUIDALL LLC recently announced the release of a new product to its Tote-A-Lube line of tanks. FLUIDALL’s T330 330-gallon tank will feature a 4-inch access cap on the top of the tank in addition to the two 2-inch openings and side- and top-mounted inserts to attach fluid handling equipment. The T330 storage tank has the same footprint as FLUIDALL’s T180 (180-gallon) and T240 (240-gallon) tanks. This new product provides yet another modular FLUIDALL/Tote-A-Lube solution to your fluid storage requirements. These tanks are made from high-quality food-grade polyethylene. Translucency allows for quick visual inspection of fluid levels.

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Try as we may to avoid it, machinery is prone to deposit oil onto plant floors. That may be the result of whirring components that fling droplets about or rattling conveyor chains that shake oil free or an outright leak in a lubrication-containment or delivery system. By whatever method, it happens.

Regardless of its size and scope, oil on plant floors has the potential to be a safety hazard, an environmental hazard, a raw material contamination hazard, an impactor on finished-product quality, and a real eyesore for workers and site visitors. One leak can have legal- and compliance-related (OSHA, EPA, FDA, USDA) ramifications.

So what are you going to do about it? Contain and clean up the mess with absorbent products.

There are a host of sorbent products available to plant organizations. Use them in a singular or collaborative manner to address the specific drip/leak/spill issues that you are facing.

What follows is a refresher course on some of the sorbent/spill containment products that can help in your quest to be safe and productive as well as clean, lean and green.

Socks and rolls soak up oil leaks from this industrial air compressor.

**Pads and rolls:** Available in universal, oil-only and chemical models, these products (generally made from polypropylene fibers) can be used for almost any indoor, outdoor and/or hazardous material application. Place them around machinery, under leaky pipes or fittings, and in messy traffic areas.

**Socks:** These flexible tubes contain and absorb liquids. They mold around corners and conform to uneven surfaces to minimize the spill area and soak up the wayward fluid. A variety of types, sizes and wicking-material interiors are available.

**Dikes:** These interlocking solid polyurethane strips can contain or divert spills. They are made for confining deeper pools of liquid and larger flows.

**Barrier spill matting:** Needle-punched polypropylene fibers and a special backing allow this product to absorb oil, water or chemicals and prevent these fluids from penetrating through to the floor.

**Loose granular:** These multi-purpose absorbents are generally made from natural products such as corn cob or sphagnum peat moss. Use them for spill clean-up and stabilization of free liquids.

**Specialty products:** These include sorbents pillows, drip pans, and drain covers and plugs.

**Product Resources:**
- Kafko International, Ltd.
  www.oileater.com
- New Pig
  www.newpig.com
- SPC - A Brady Company
  www.bradyid.com/spc

Soak Up Leaks and Contain Spills with Assortment of Sorbent Solutions

BY PAUL V. ARNOLD

ASTM OKs Method to Determine Moisture Content

ASTM International Committee D02 on Petroleum Products and Lubricants recently approved a new method which covers the determination of moisture content in new and in-service lubricants and additives by relative humidity sensor. The standard, ASTM D 7546, offers users an alternative to moisture testing by Karl Fischer titration or the less quantitative "crackle test".

More than 740 representatives from 231 companies attended the 2009 Independent Lubricant Manufacturers Association annual meeting in Miami Beach, Fla. ILMA’s members include independent lubricant companies that produce more than 25 percent of all lubricants and 80 percent or more of the metalworking fluids and other specialty industrial lubricants sold in the U.S. For more information, visit www.ilma.org.

The Connecticut Quality Improvement Award Partnership recognized Oil Purification Systems (OPS) with its gold-level Innovation Prize. OPS was cited for its Eco-Pur System, a supplemental filtration system that uses electronic controls to continuously optimize the cleaning process and remove both solid and liquid contaminants from lubricating oil. This is the third consecutive year that CQIA has honored OPS.
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ACROSS

5 Oil dispersed in water is called an ...?
6 Another name for wear caused by scuffing
7 The most destructive type of chemical reaction affecting oils in service
10 A type of engine that is particularly susceptible to nitration
11 Predictive maintenance method explored by Jeremy Wright in this issue’s “Back Page Basics” article
15 Grease thickener commonly used for multi-purpose greases
16 Type of products featured in this issue’s Product Spotlight section
17 Manual lubrication device that replaces a single-point lubricator
19 Unit of measure used with flash point and pour point
20 Type of fluids Brendan Casey writes about in Machinery Lubrication magazine
21 Term used to define the measure of a fluid’s internal resistance to flow

DOWN

1 The subject of this issue’s “Get to Know” section works for this company
2 Type of wear that can be caused by air bubbles or water vapor bubbles in a hydraulic fluid
3 Another name for both the AN (TAN) and BN (TBN) tests
4 Company featured as this issue’s cover story
8 Common polymer used as an anti-foam agent
9 Type of instrument generally used to determine the specific gravity of oil
12 Lubrication leader featured in this issue’s cover story
13 Common screening test for water contamination
14 What the W stands for in the SAE crankcase viscosity classification 0W-30
18 Acronym of program outlined in Stephen Sumerlin’s article in this issue

Get the solution on Page 50.
On-Site Condition Monitoring of Industrial Oils

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Lou Herington, the subject of this issue’s “Get to Know ...” section, is the plate mill lubrication technician at Alcoa's Davenport Works in Iowa. He has worked 32 years at Alcoa (“pretty much my entire working career,” he says), serving as an inspector before moving into maintenance in 1998. Let's learn more about Lou.

When did you get your start in machinery lubrication, and how did it happen?: One of the lube techs approached me in 1998 and explained to me the opportunities in maintenance and especially how lubrication and reliability were becoming an integral part of making a positive impact for the plant. He thought it would be a good fit for me. I believe he was right because I've enjoyed the challenges presented to me and have been impressed with the way the industry is constantly evolving.

What types of training have you taken?: I've completed Alcoa's Machinery Lubrication seminar; Lubrication Analysis, Analytical Ferrography and Advanced Analytical Ferrography courses at Predict; and Machinery Lubrication I and II and Oil Analysis I through Noria. I've also tried to attend as many of the lubrication and reliability conferences as possible.

What’s a normal work day like for you?: I start by meeting up with my co-workers at our daily management board to discuss any outstanding issues and to determine any critical lubrication leaks or failures. Upon returning to my area, I complete my route and inspections, and finish any outstanding predictive work tickets. I coordinate the outages with the department planner and order any equipment and supplies I need to complete a job. As the safety person for our group, I address any concerns and keep everyone up to speed on any policy changes.

What is the range of equipment that you service through lubrication tasks at your plant?: Davenport Works provides the industry with a wide range of mill products. The plate mill has equipment capable of stretching plate up to 8 inches and 16 million pounds of pull, as well as saws able to cut that much plate. I’m responsible for maintaining the lubricant levels and helping to pinpoint and repair leaks. With the pressure created to pull pieces of that magnitude, leaks do develop, no matter what.

What lubrication-related projects are you currently working on?: I’ve been monitoring equipment that has been fitted with a new style of filter to see if it will be more efficient. I've been working with one of our suppliers to find a high-volume breather that will allow steam to escape but still prevent small aluminum fines from getting in.

What have been some of the biggest lubrication project successes for which you have played a part?: We were having trouble with vacuum pumps burning up from continued use. After deter-
mining that there was a lube breakdown due to the heat buildup, I recommended switching from mineral oil to a synthetic. We have had very few breakdowns since. After I became the lube tech for reliability, I discovered the processes had become somewhat stagnant. I worked to revitalize our in-house oil analysis lab by getting the lab equipment updated and recalibrated. I reviewed the sampling points and worked with area mechanics to improve sampling ports, eliminate unneeded sampling, improve ergonomic issues when sampling and still keep the person doing the sampling safe.

How does your company view machinery lubrication in terms of importance, strategy, etc.? Our management has been very supportive of our lubrication group being self-directed since 1991. The gains made by improved reliability and better lubrication practices have definitely been a cost savings for the plant. Training has always been key to staying on top of such a fast-changing field as the lubrication industry, and our company has always realized this.

What do you see as some of the more important trends taking place in the lubrication field? I like seeing the improvements for quicker and more accurate testing for on-site analysis at a lower cost. The increased use of Webinars to educate us in the field – where travel has become a cost issue – is something I see as an improvement. I have always been sincerely impressed with the way everyone I’ve ever come across in this industry has been willing to help with questions or problems that I’ve encountered.

“Get to Know …” features a brief question-and-answer session with a Machinery Lubrication reader. These articles put the spotlight on industry professionals and detail some of the lubrication-related projects they are working on. If you know of an ML reader who deserves to be profiled, e-mail editor-in-chief Paul V. Arnold at parnold@noria.com.

Would You Like to Contribute? Are you a technical expert? If so, we want to publish your lubrication article in Machinery Lubrication. To submit a technical article, please send it to editor-in-chief Paul V. Arnold via e-mail at parnold@noria.com.

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ISO Standard Leads to Changes for MLA, MLT Certifications

By Suzy Jamieson, ICML

Starting January 2010, the International Council on Machinery Lubrication’s examinations in oil analysis will follow the now published ISO 18436-4 standard.

ICML is honored that its bodies of knowledge for the Machine Lubrication Technician (MLT) Level I, Machine Lubricant Analyst (MLA) Level I and Machine Lubricant Analyst Level II certifications were pioneered into the first-ever international standard on qualification and assessment of field lubricant analysts.

The ICML MLA I and MLA II certification program’s subject areas were brought into ISO 18436-4 as category II and III, respectively. To reflect this equivalence with the ISO 18436-4 standard, ICML has chosen to rename its MLA I and MLA II certifications as MLA II and MLA III, since the original MLA I is equivalent to Category II and the original MLA II equivalent to Category III of ISO 18436-4. The MLT I would be the close equivalence to Category I of the ISO standard.

The ICML MLT I was originally created by the council to focus on lubrication, not analysis, and as such did not focus on the subject areas of oil sampling or analysis. However, its body of knowledge was very desirable for a Category I of this ISO standard as it tested machinery and lubricant knowledge at an entry level. Therefore, ICML proposed a Category I body of knowledge for the ISO standard based on the MLT I.

Since the ICML was pioneering the MLT I’s body of knowledge into an analysis standard, it was necessary that some oil health monitoring, basic oil sampling, as well as some basic wear debris monitoring and analysis be added to the body of knowledge.

ICML will continue to offer the MLT I exam (as well as the MLT II) in its original form, independent of ISO, to serve the machinery lubrication professional. In addition, ICML will offer a new exam, adjusted as per our additions to the body of knowledge, as we included on the standard. This new exam will be in accordance with ISO 18436-4 Category I and will be named MLA I (the former MLA I is now called MLA II as explained previously).

The ICML Web site (www.lubecouncil.org) is being updated to reflect these upcoming changes, with the English pages reflecting this already.

ICML strongly suggests that potential candidates for its exams, as well as companies interested in providing training in preparation for the exam, familiarize themselves with ISO 18436-4 and its bodies of knowledge as this standard will dictate the ICML bodies of knowledge for the new MLA I, MLA II and MLA III series. It is also important that trainers familiarize themselves with 18436-3, which dictates the requirements for the training bodies and the training process. Personnel interested in sitting for the exams equivalent to ISO 18436-4 are required to have received training by bodies offering its courses in accordance with 18436-3 and based on the syllabus of 18436-4.

ICML’s policy dictates independence from training. Suitability of intended courses should be evaluated by potential candidates by comparison of course outline with ICML’s bodies of knowledge as well as ISO 18436 parts 3 and 4 requirements and syllabus.

A brief summarization of the bodies of knowledge for the new MLA I, MLA II and MLA III certifications follows:

**Machine Lubricant Analyst Level I**
- I. Maintenance strategies (10 percent)
- II. Lubrication theory/fundamentals (18%)
- III. Lubricant selection (10%)
- IV. Lubricant application (18%)
- V. Lube storage and management (10%)
- VI. Lube condition control (10%)
- VII. Oil sampling (10%)
- VIII. Lubricant health monitoring (10%)
- IX. Wear debris monitoring and analysis (4%)

**Machine Lubricant Analyst Level II**
- I. Lubricant roles and functions (4%)
- II. Oil analysis maintenance strategies (4%)
- III. Oil sampling (29%)
- IV. Lubricant health monitoring (21%)
- V. Lubricant contamination measurement and control (25%)
- VI. Wear debris monitoring and analysis (17%)

**Machine Lubricant Analyst Level III**
- I. Lubrication fundamentals (20%)
- II. Fundamentals of machine wear (15%)
- III. Wear debris analysis (21%)
- IV. Analyzing lubricant degradation (25%)
- V. Oil analysis program development and program management (19%)

For more information, visit www.lubecouncil.org.
Noria Corporation, the worldwide leader in oil analysis and lubrication training, has added the following courses to its Certification Series training offering in response to changes made by the International Council for Machinery Lubrication (ICML). In January 2010, the ICML aligned its Machine Lubricant Analyst certification with the ISO 18436-4 standard (see page 42).

**Machinery Lubrication and Oil Analysis Level I**

A new three-day training course called “Machinery Lubrication and Oil Analysis Level I” is offered to help prepare students for both the ICML Level I Machine Lubricant Analyst (MLA) and Level I Machine Lubricant Technician (MLT) certification exams. Because the Body of Knowledge for the ICML Level I MLA and Level I MLT exams are nearly identical, Noria is able to offer this single course for both certification levels.

**Oil Analysis Level III**

A new three-day training course called “Oil Analysis Level III” has been created to help students prepare for the ICML Level III MLA certification exam. If you received ICML Level I MLA certification prior to 2010, your certification is now Level II MLA and you may seek Level III MLA certification if you meet the other certification requirements. If you received ICML Level II MLA certification prior to 2010, your certification is now Level III.

Here’s a snapshot of how Noria’s Certification Series training courses align with ICML certifications:

<table>
<thead>
<tr>
<th>ICML Certification</th>
<th>Noria Certification Series Training Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I Machine Lubrication Technician (MLT)</td>
<td>Machinery Lubrication and Oil Analysis Level I</td>
</tr>
<tr>
<td>Level II Machine Lubrication Technician (MLT)</td>
<td>Machinery Lubrication Level II</td>
</tr>
<tr>
<td>Level I Machine Lubricant Analyst (MLA)</td>
<td>Machinery Lubrication and Oil Analysis Level I</td>
</tr>
<tr>
<td>Level II Machine Lubricant Analyst (MLA)</td>
<td>Oil Analysis Level II</td>
</tr>
<tr>
<td>Level III Machine Lubricant Analyst (MLA)</td>
<td>Oil Analysis Level III</td>
</tr>
</tbody>
</table>

For more information about Noria’s Certification Series training courses, visit Noria.com or call 800-597-5460.

**Upcoming Dates and Location:**

**Machinery Lubrication and Oil Analysis Level I**

- March 2-4 New Orleans, LA
- April 6-8 Minneapolis, MN

**Machinery Lubrication Level II**

- February 16-18 Nashville, TN
- March 23-25 Austin, TX

**Oil Analysis Level II**

- February 16-18 Nashville, TN
- March 23-25 Austin, TX

**Oil Analysis Level III**

- April 6-8 Minneapolis, MN

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50 Lubrication Failure Modes from RCM Analysis

The purpose of Reliability-Centered Maintenance is to identify failure modes and then develop strategies to eliminate them. Take the 50 failure modes from this article and start the process of making positive changes. Find this article in the Web Exclusives section on the home page or type in “Lubrication failure modes” in the Search bar.

Putting Too Much Faith in Multipurpose Grease

Even in simple production environments, there is usually a reason for selecting several different greases to account for varying operating conditions. But time and again, companies use one multipurpose grease, either through a lack of knowledge or misguided advice. This can cause real problems. Find this article in the Archives section on the ML site or type in “Multipurpose grease” in the Search bar.

Employing Oil Analysis Metrics

Ashley Mayer discusses use-dependent parameters and use-independent parameters as metrics for measuring the success of a lubrication management program. Find this article by typing “Use-dependent” in the Search bar.

Also

Lubrication Glossary

Nearly 100 lubrication and oil analysis terms are defined in our Glossary. From “abrasion” to “zinc dialkyldithiophosphate”, we provide the explanations. Just click on the “Glossary” link on the top of the home page.

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• “Industrial Food-Grade Lubricants Guide”
• “Automatic Grease Lubricators: What You Need to Know”
• “Engineering an Effective Oil Analysis Program”
• “Elements of a Good Preventive Maintenance Program”
• “Controlling Gearbox Lubricant Contamination”
• “Choosing the Correct Oil or Fuel Purification System for Water Contamination Removal”
• “Hidden Benefits of Lubricant Consolidation”

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March 2-4 New Orleans, LA
April 6-8 Minneapolis, MN

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April 6-8 Minneapolis, MN

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**Lubricating Grease Guide**

Author: NLGI

This guide serves as a source of basic information on lubricating grease and is a handy quick-reference book. Written for the beginner or for the practitioner who wants to broaden knowledge. It includes a grease application guide for beginners. You'll know when to select the right grease for your machinery and easily determine which greases are compatible.

**Practical Lubrication for Industrial Facilities**

Author: Heinz Bloch

Helps reliability professionals, mechanics, machinists or lubrication specialists understand what matters most in a lubricant, and to distinguish mere sales talk from relevant facts. It is intended to assist the professional in ensuring that machinery operates at optimum performance levels, with a minimum of costly downtime.

**Oil Analysis Basics**

Publisher: Noria Corporation

Written by the editors of Machinery Lubrication magazine, Jim Fitch and Drew Troyer, this book is a great resource for anyone involved in oil analysis or lubrication.

*Oil Analysis Basics* makes oil analysis for machinery condition monitoring easy to understand. You will learn everything from how to take a proper oil sample to how to select a test slate for your applications.

**How to Grease a Motor Bearing Training DVD**

Format: DVD

Publisher: Noria Corporation

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**The Practical Handbook of Machinery Lubrication**

Author: L. Leugner

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**Introduction to Lubrication Fundamentals Training DVD**

Format: DVD

Publisher: Noria Corporation

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An important part of lubrication excellence is being able to identify the fiscal opportunity that a well-designed and properly executed lubrication program will provide. One of my main roles as technical director for Noria Reliability Solutions is to uncover these opportunities for clients. The first stage of any program is to take a step back and understand how the plant is performing in the current state. A simple, non-subjective benchmark analysis takes care of this. The final weighted score out of 10 identifies the gap between “business as usual” and “world class”.

An additional tool that hones in on the financial opportunity is the cost benefit analysis. In the July 2005 issue of *Machinery Lubrication*, Mark Barnes explored cost benefit analysis as it relates to lubrication excellence (Figure 1). As Mark discussed in his article, there are two obvious areas of fiscal opportunity in most plants with regard to lubrication excellence. The first and most obvious is to try to reduce unscheduled downtime. Some portion of these unscheduled events can be attributed to poor contamination control or lubrication practices. Another area of opportunity is in right-sizing the lubrication PM tasks. When evaluated on a benefit-per-cost basis, approximately half of all planned maintenance activities have no value.

Even though a cost benefit analysis with input from several parties may illustrate that there is a significant fiscal opportunity

### Lube Excellence Cost Benefit Analysis

<table>
<thead>
<tr>
<th>Benefits Potential Rollup</th>
<th>Low Case</th>
<th>Likely Case</th>
<th>High Case</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input estimated total annual maintenance costs to nearest thousand</td>
<td>$12,000,000</td>
<td>$13,000,000</td>
<td>$14,000,000</td>
<td>Parts, labor, supervision, management, overhead, insurance, risk-based, incidentals, etc.</td>
</tr>
<tr>
<td>Input estimated annual downtime costs and risk-based costs to nearest thousand</td>
<td>$4,000,000</td>
<td>$5,000,000</td>
<td>$6,000,000</td>
<td>Excludes unscheduled downtime, excessive planned downtime, production derate costs.</td>
</tr>
<tr>
<td>Select percentage of maintenance and other costs attributable to repair</td>
<td>40%</td>
<td>60%</td>
<td>70%</td>
<td>Abrasion, fatigue, adhesion, cavitation, corrosion, etc. Excludes operations failures, electrical failures, etc.</td>
</tr>
<tr>
<td>Select percentage of repair that is attributable to mechanical wear of lubricated components</td>
<td>40%</td>
<td>60%</td>
<td>70%</td>
<td>Poorly selected lube, over lubrication, under lubrication, ineffective contamination control, ineffective oil analysis, etc.</td>
</tr>
<tr>
<td>Select estimated percentage of mechanical wear that is attributable to poor lubrication</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>Poorly selected lube, over lubrication, under lubrication, ineffective contamination control, ineffective oil analysis, etc.</td>
</tr>
<tr>
<td>Estimate percentage of lubrication-related wear that could have been avoided with a well-defined and executed lubrication program</td>
<td>40%</td>
<td>50%</td>
<td>70%</td>
<td>Includes parts, labor, supplies, supervision, management, overhead, etc.</td>
</tr>
<tr>
<td>Input percentage of total maintenance costs attributable to lubrication PMs, inspections, oil analysis and other non-repair-related activities</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>Includes parts, labor, supplies, supervision, management, overhead, etc.</td>
</tr>
<tr>
<td>Input estimated percentage of these activities that are waste</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>Either fail to add value or actually induce failure.</td>
</tr>
<tr>
<td>Estimated Potential Annual Savings</td>
<td>$444,000</td>
<td>$1,426,000</td>
<td>$3,640,000</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 1. Lubrication Excellence Cost Benefit Analysis](image-url)
and that a lubrication excellence program should provide a solid return on investment, many managers continue to be skeptical of the real value. Experience shows that poor lube practices will cost most industrial facilities approximately 8 to 15 percent of their annual maintenance budget. So, from where does this opportunity come?

**Diving into the Numbers**

It’s really amazing to walk through a plant with fresh eyes, free from tunnel vision, and really see which lubrication practices are costing the plant huge losses and adding no value. Overgreasing is a big problem in most facilities, but have you ever considered the real cost. I always ask clients to take me to one of their most critical machines in the plant. I’ll then query the lube technician on how much, how often and what type. Take, for example, one plant’s most critical machine, which has no redundancy. If this machine fails, the plant stops until the machine gets fixed. This is not an overly complex machine, and the critical components are two fairly large bearings with a rotational speed of approximately 600 rpm. I collected product type, volume of relubrication and frequency of relubrication. I then compared this to calculated values and illustrated the difference. (Figure 2).

The numbers speak for themselves. The difference on an annual basis is $942.03 (Figure 3). Perhaps the biggest apparent benefit to adopting the calculated volumes is the savings in time for the lube tech. In this single example, the tech stands to save almost eight hours per year, which he can redirect to more value-added activities such as oil sampling, top-ups and inspections, using a filter cart for periodic decontamination, and others. Also, the not-so-apparent benefit here, which is difficult to quantify, is the improved reliability of the machine through calculated lubrication.

**Is Time-Based Costing You?**

Another situation I try to highlight in the plant is the real cost of time-based oil changes. In the May 1999 issue of Practicing Oil Analysis, Ken Brown illustrates the real cost of changing a five-gallon sump in a nuclear facility. Ken not only identifies the apparent oil and labor costs, but the not-so-apparent costs associ-
ated with overhead, supervision, etc. He finds that the actual "real cost" to change the oil in a rather small system at a power plant requiring five gallons of oil (at $5 per gallon), two man-hours of direct labor and a purchase order to obtain the oil is $988.70 – almost 40 times the cost of the new oil.

Based on significant research, hydraulic fluid and lubricants can have a very long service life (longer than 12 months) when the oil is kept clean, cool and dry. In most cases, I suspect the lubricant in most sumps is replaced prematurely and simple activities such as the installation of hybrid-style breathers would help to extend the oil's life. A combination of appropriate breathers and storage and handling could extend the oil life to 18 or 24 months.

To evaluate the cost of time-based oil changes, understand the apparent and non-apparent costs. For a typical one-gallon sump, I list costs based on information I receive from the plant and guesstimates. A conservative cost of $54.55 can be applied to each gallon oil change in the plant.

Data suggests that this plant is spending approximately $73,400 per year based on one oil change per year on systems that use the most common lubricants in the plant (when you account for apparent and non-apparent oil change costs). Appropriate storage and handling, contamination control and condition-based oil changes could extend some drains to 24 months or more. Extending drain intervals to 24 months from 12 months would effectively redirect $73,000 annually in maintenance costs from non-value added tasks to tasks that are worthwhile (Figure 4).

The five-year net present value of the savings from not doing this non-value-added task calculated with a 10 percent discount rate totals more than $276,670.

### You Can Achieve Savings

With a few simple examples and very real numbers to back them up, it is apparent from where the estimated potential savings can come. Keep in mind that no account has been made for improved equipment reliability or reduced downtime costs. For the plant in the examples in this article, two specific activities account for a loss of almost $300,000 over the next five years. This is almost three times the cost of what a well-designed and executed lubrication excellence program would cost. To explore cost improvement opportunities at your facility or your company, e-mail me at jkopschinsky@noria.com.

#### References


#### About the Author

As technical operations director for Noria Reliability Solutions, Jason Kopschinsky’s primary responsibilities include managing numerous and varied projects in the areas of: plant audits and gap analysis, Lubrication Process Design, oil analysis program design, lube PM rationalization and redesign, lubricant storage and handling, contamination control system design, and lubrication and mechanical failure investigations. Contact Jason at jkopschinsky@noria.com.

---

### Table: One-Gallon Oil Change Costs

<table>
<thead>
<tr>
<th></th>
<th>Apparent Oil Change Costs</th>
<th>Non-Apparent Oil Change Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil (per 1 gallon)</td>
<td>$25.55</td>
<td>$20.00</td>
</tr>
<tr>
<td>Labor and Benefits (1 hour)</td>
<td>$2.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>Paperwork</td>
<td>$2.00</td>
<td></td>
</tr>
<tr>
<td>Ancillary Activity</td>
<td>$2.00</td>
<td></td>
</tr>
<tr>
<td>Supervision</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>Solid Waste</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>New Oil Overhead</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>Sum Total</td>
<td>$45.55</td>
<td>$9.00</td>
</tr>
<tr>
<td>Cost per 1-Gallon Oil Change</td>
<td>$54.55</td>
<td></td>
</tr>
<tr>
<td>Annual Cost of Most Common Lubricants*</td>
<td>$34,221.00</td>
<td></td>
</tr>
<tr>
<td>Approximate (Gallons) Volume of Most Common Lubricants</td>
<td>1,339.37</td>
<td></td>
</tr>
<tr>
<td>Volume of Oil Times Cost Per Oil Change</td>
<td>$73,062.84</td>
<td></td>
</tr>
</tbody>
</table>

---

### Crossword Puzzler Solutions:

- A: Adhesive
- C: Grease
- N: Neutron
- V: Viscosity
- E: Emulsion
- M: Melt
- U: Ultrasonic
- L: Lithium
- I: Ice
- T: Temperature
- H: Hydraulics
- S: Surface
- C: Carbon
- P: Pumps
- O: Oil
- R: Rotor
- S: Steam
- E: Exposure
- T: Time

---

*Figure 3.*

*Figure 4.*

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World-class lubrication programs are shifting away from interval-based regreasing schedules and into condition-based schedules. Choices for tools include simple high-frequency ultrasonic detectors and audio stethoscopes to digital data collectors that can directly interface with the grease gun. Lube techs face new challenges as they harness the power of the acoustic inspection. This short article demystifies the technologies and techniques surrounding acoustic regreasing as an effective lubrication practice.

All sounds are produced by vibrations in bodies. In musical instruments, the sound is emitted by vibrating strings or a reed. Our voice is the result of vibrations from our vocal cords. The number of vibrations a body makes per second is called its frequency and is commonly referred to as hertz. Ultrasound is defined as “sound waves having a frequency above the limits of human hearing, or in excess of 20,000 cycles per second (hertz).” So by definition, ultrasound is totally undetectable by human ears unless aided by instruments capable of translating ultrasound to audible sound. In the marketplace, these instruments are commonly known as ultrasonic detectors and have been used for various maintenance-related functions for more than 25 years.

**Procedure**

The lubrication practice that I am accustomed to is to pump a half-stroke of the grease gun and watch for a response on the analog meter either “up” or “down”. If the needle on the analog meter moves upward, wait 15 seconds for the needle to return to the original setting or lower before proceeding. If the needle doesn’t move downward or back to the mid-range after 15 seconds, suspend lubricating. The bearing has enough grease and is now churning. If the needle moves lower than the mid-range after a half-stroke or several half-strokes, the procedure is to continue until the needle doesn’t move downward, but starts to move upward again. Again, at this time, implement the 15-second rule before proceeding or ending the lubrication practice.

**Recommended Practice**

- No matter whose ultrasound instrument you use, always calibrate the grease gun. Use a one-ounce container (shot glass), and pump grease into the container using half-strokes while counting the number of strokes it takes to fill it.
- Be sure the area and fittings are clean. Wipe away dirt or grease before and after lubricating.
- Know the lubricant to be used. Do not mix lubricants or grease.
- Designate a grease gun to be used with an acoustic grease adapter and clean the adapter each time the adapter is moved to another grease gun.
- Use half-strokes vs. full strokes when using a manual-lever grease gun.
- When using a battery pack or pneumatic handheld grease gun, use a timing method such as 1001, 1002, etc. while holding the trigger to simulate half-strokes.
- Make sure that drain plugs are accessible, open and unobstructed.
- Know the type of bearing being lubricated. A sealed bearing can’t be regreased. Shielded or double-shielded bearings can be greased but done slowly as to not over-pressurize the cavity and push the bearing shield against the cage.
- Use a grease gun with very little or no loss of movement of the pump handle.
- Periodically clean the inside diameter of the pipe supplying grease to the lube point.
- If grease or lubricant is seen exiting the bearing, schedule to replace the bearing.

**Parting Thoughts**

Acoustic lubrication is not a cure-all. It is, however, a methodology that can be learned and used to standardize within a plant. As with any new program, everyone must be on board, from management to the man or woman pumping the grease. It takes time to implement. Time is money, and in today’s world of cutbacks, staff reductions and more for less, it may be hard to totally implement. If implemented, this practice will lessen downtime and reduce repairs. MNL

**Reference**


**About the Author**

Jeremy Wright is a certified Machinery Lubricant Analyst (MLA) Level I and Level II and Machinery Lubrication Technician (MLT) Level I by the International Council for Machinery Lubrication (ICML). In addition, he is a Certified Maintenance and Reliability Professional (CMRP) by the Society for Maintenance and Reliability Professionals (SMRP). Contact Jeremy at jwright@noria.com.
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