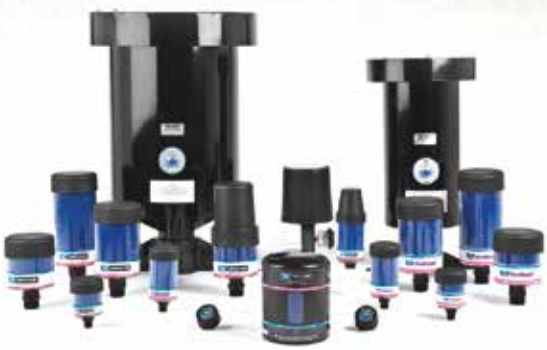
LUBRICANT MAINTENANCE — THE FOUNTAIN OF YOUTH

Preserving oil cleanliness through proper filtration methods pays dividends.

By Michael Powers



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IN RECENT YEARS, THE GROWING emphasis on finding alternative power sources that are renewable, affordable and sustainable have caused tremendous growth in the wind energy industry. Wind turbines, though basic, have key components that are difficult to access and expensive to maintain.

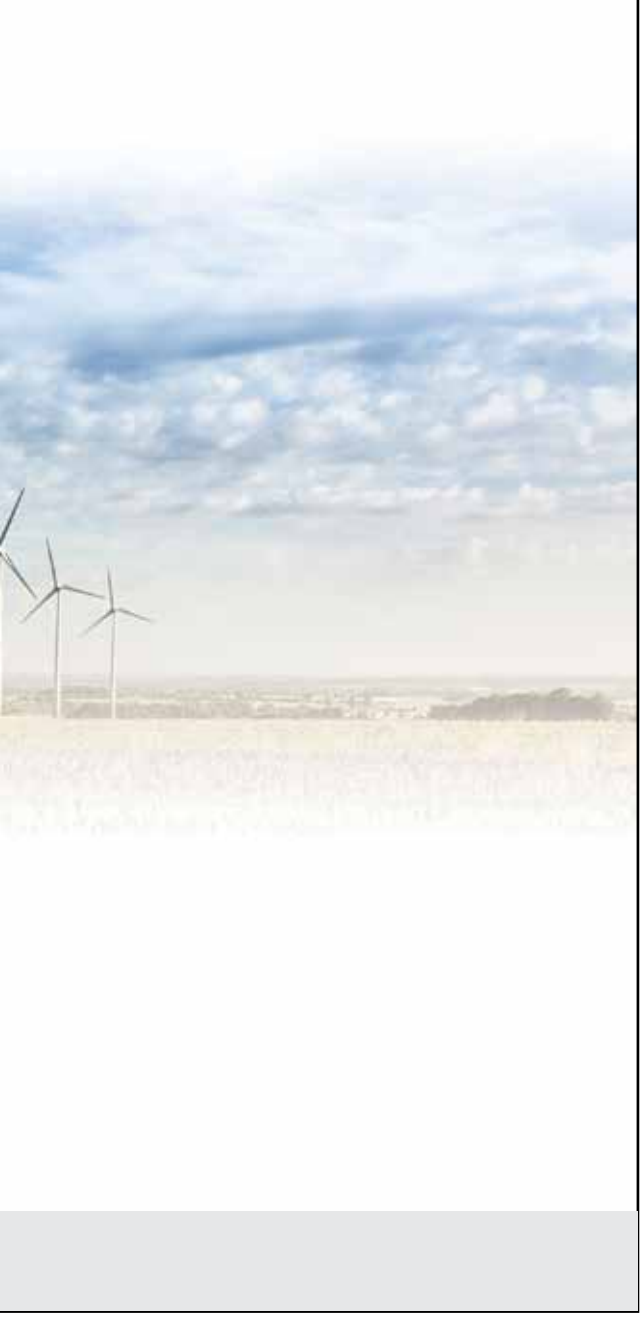
Machinery reliability in wind turbines is especially tasking as poor lubrication practices can cause failures in system gearbox, hydraulic systems and bearings, which are costly to fix. Maintaining clean oil is one of the best investments a company can make to prevent problems, yet contamination often remains an overlooked factor behind premature machinery failure and diminished lubricant life.

To increase scheduled time between maintenance, reduce cost of lubrication replacement, and protect the system from failure, the prevention and treatment of contamination — from the time oil enters a facility until it leaves — is key.

THE PROBLEM: CONTAMINATION

Two primary types of contamination include dirt and water.

If the atmosphere is contaminated (and most are to some degree), the oil is probably dirty and lubricant



quality is compromised. Particulate contamination, once inside an operating system, will accelerate the generation of new contaminants. These contaminants damage critical components and act as a catalyst for oxidation, further degrading lube condition.

If the atmosphere is particularly humid or has frequent temperature fluctuations, the oil is probably moisture-laden and lubricant quality is compromised. Often, plant wash-down activities are responsible for inducing conditions that lead to moisture ingression and corrosion.

The good news is that these factors, which work together to threaten equipment reliability, can be effectively controlled with some preventative maintenance techniques. The best and easiest way to exclude contaminants is to avoid practices that risk exposing lubricants to contaminants.

A multi-faceted program that includes some simple proactive steps will conquer contamination.

THE GOAL: THE RIGHT TARGETS

Every application is unique — and what's right for one environment isn't what's needed for another. There are a number of sources in which to refer in order to get a bit of help. Noria Corporation, Reliability Web and other publications and manufacturers offer a wide variety of published and training materials that can get you well on your way. To complete an introductory survey, you can visit www.descase.com/contact to request an complementary online self-assessment.

OPTIONS

It has been said that prevention is the best cure. Ideally, all of us would have a brand new plant and machinery and begin with a solid program of preventative measures that would ensure the longest life for our equipment and oil. That, of course, never happens. Once you know how big the problem is, you can combine several options to help bring the current situation in line with your cleanliness targets, and add components that will help keep your oil clean and "dry."

Reservoir filters:

Today's options for restricting the ingression of contaminants are a far cry from yesterday's open tube turndown pipes that did little more than keep the birds out (Table 1). Proper installation and maintenance of contamination control breathers can significantly reduce ingression of airborne contaminants.

Breather filters:

The breather filter continues to be at the top of the list for preventative maintenance and conquering contamination. Conventional vent ports or breather caps provide little or no protection. They are typically rated at 40 micron and offer no means of capturing moisture. Retrofitting these ports with breathers will provide 24/7 protection against uninvited contaminants, both dirt and water (see Table 2). Clean lubricants extend the life of equipment, and lower the total cost of ownership with lower oil, repair, downtime and maintenance costs (a search for "Lubricant Life Extension Table" on the internet will show a number of sources of information).

Breathing starts the same day the machine is put into operation or a static tank is filled. The correct approach to preventing dirt and moisture damage is to proactively control ingress points. Since the most common point of entry is the conventional vent port, installation of desiccant breathers is imperative.

Breathers are essential to the health of machines and lubricants. A properly fitted and maintained breather is a critical step toward reliability optimization. Combining

Option	Description/Comments
Open Port	• Although less common in most facilities today, you might be able to walk through a facility and find a reservoir open to the air. Not quite as uncommon is a similar scenario with a shop rag acting as a filter – especially after the original cap was lost or misplaced.
Turndown Pipe	• In some cases, older units can be found that have a 'snorkel tube' opening vented to the atmosphere. • Prevents entry of large objects into the reservoir.
Typical OEM Cap	• Typically mesh type strainer that captures particles down to 40µ. • Captures insects and large dust particles. • Does not effectively control most clearance size particles and the many forms of contamination that cause the most damage to bearings, pumps or valves
Low Micron Filter/ Breather	• Ratings from 1 to 3 µ • Higher airflow ratings • Not as effective if humidity is a concern • Hydrophobic/"deliquescent" membrane breathers are effective at stopping free water, but not humidity
Oil Coalescence	• Help prevent plant emission byproducts, as well as prohibit entry of contamination into machines. • Captures oil mist and recycles oil back into the system. • Can be incorporated with desiccant. • Non-desiccant versions ideal for continuous operation (24/7) machinery. • Pressure/Vacuum relief valves and sight glass indicators allow for condition-based monitoring.
Desiccant Breather	• Designed to prevent atmospheric moisture ingression by stripping the air of moisture before it enters the system. • Typically incorporate filtration media for capture of particulate matter. • Color indicating silica gel is commonly used as the water adsorbing agent, changing color as it becomes saturated, indicating the need for a condition-based replacement. • Some incorporate both hydrophobic and oleophobic media. This type of dual protection breather keeps free water out of the system and oil mist contained within the headspace (where it belongs).
Hybrid Desiccant Breather	• Next generation breathers being widely used in exceptionally wet and humid environments. • Incorporate an air filter, water adsorbing desiccant, and an expansion chamber, allowing for changes in lubricant and headspace volume caused by temperature changes. • Pressure and vacuum relief valves activate when air displacement exceeds the volume capabilities of the expansion chamber. The outside air is allowed into the headspace only after passing through particulate and moisture filters. • Considered an alternative to installing a costly closed loop system - closes a system under normal operating conditions while continuously protecting the headspace from dirt and moisture and safeguarding against pressure changes.

Table 1: Reservoir filter options.

breather use with other contamination control tools, such as mechanical seals, proper sampling techniques, downstream filters and appropriate lubricant storage/ dispensing systems will increase the overall level of maintainability and increase the chances of meeting or even exceeding life expectancies.

In-line / Off-line filtration:

In-line and off-line filtration (sometimes referred to as bypass, kidney-loop, or auxiliary filtration), consists of a motor, pump, filters, and proper hardware connections. Fluid is continuously pumped out of the reservoir, through the filter(s), and back to the reservoir. In-line is, of course, a permanent part of the overall system. An off-line filtration loop has the extra advantage of being relatively easy to retrofit on an existing system that has insufficient filtration. Also, the off-line filtration device can be serviced without turning off the main system.

Filter Carts Capture Contaminants:

A hand cart is a portable, off-line filtration system used to filter fluid inside the reservoir. It is a transfer cart when used to move lubricants from a drum to a reservoir. In either mode, it is an economical solution to off-line filtration requirements.

Filter carts should be used to remove particles and moisture, thereby preserving the working life of the oil. They are not just a tool for emergency remedial measures when dealing with contaminated lubricants and hydraulic fluids. To avoid cross-contamination of fluids, make sure there is a dedicated filter cart for each type of lubricant in use. Filter carts should be fitted with quick disconnects and with particle removal and water — absorbing filter elements. Filter carts should be part of a routine that includes new oil filtering, transferring, and dispensing oils.

New oil filtering, you may ask? Many plant personnel feel new oil is clean enough to use right away. However, many new fluids have initially high contamination levels. Fluids should always be filtered before being put into service. Contamination, both particulate and water, may be added to new fluid during processing, mixing, or handling. This contamination can be removed with the use of a filter

Applications	Hydraulic reservoirs, gearboxes, storage tanks, electrical transformers, etc.	
Operating Hours	**Less than 24 hours per day or long shutdown period**	**Operating continuously (24/7)**
Problem #1	The presence of water in systems using biodegradable lubricants presents many problems: Temperature variations → condensation → rust, corrosion, and overconsumption of inline filters and lubricants. A waste of money for curative maintenance.	Little condensation, but may be subject to moisture ingress through washdowns
Problem #2	Ambient air surrounding machines can become contaminated with airborne particles. Dirt, especialy clearance size particles, is detrimental to the health of lubricants and equipment. Dirt accumulation → friction → severe debris entrainment, scoring, abrasive wear, cavitation, potentially leading to system shutdown if not removed or controlled. Costs 10x more to remove contaminants than to keep them out in the first place.	
Solutions	**Desiccant breathers**	**Hybrid** **Hydrophobic / Oleophobic**
Features/Benefits	• Stop dust using filtration media • Stop humidity with silica gel to prevent and protect against condensation. • Wide variety of applications	• Stop dust and free water/oil mist • Oleophobic media captures and recycles oil in heavy mist applications, prevents contamination of working environment • Does little to stop humidity
	Breather/diaphragm combination creates virtually-closed system design. Ideal for high humidity, steam quenching and frequent washdown applications where increased breather life is required. Examples include: outdoor environments, coastal, offshore and oil platforms, food and beverage plants, minimal airflow applications, et cetera.	

Table 2: Compairison of several breather types.

cart. They are the ideal way to pre-filter and transfer fluids into reservoirs.

WHERE TO LOOK: SAVINGS EVERYWHERE

Area #1 – Storage:

Many improvements to your storage procedures can be made with minimal cost. A little time spent simply reviewing your current storage and handling procedures can be informative and useful.

Some simple procedures to improve your storage maintenance operations:

- Stored oil should be kept indoors.
- Add breathers to vented storage containers.
- Controlling temperature is important for proper drum storage. Drums "breathe" as the internal pressure increases and decreases with temperature variations. Moisture and other contaminants are forced into the drum when the internal pressure decreases. It is recommended to store drums or containers in enclosed, temperature-controlled storage facilities.
- Shielding storage containers from dirt and moisture is another procedure that will keep your cleaned and filtered oil in good condition. Be as careful with pumps and transfer containers as with your storage containers. This will minimize the chances of cross-contaminating with other lubricants and introducing contaminants into machines when filling.

Area #2 – Handling:

Some simple procedures to improve handling maintenance operations:

- Transfer hoses should be equipped with quick-connects to prevent contamination of the hose from the environment, provide leak-free connections to tanks and reservoirs and allow a method for off-line filtration.
- All oil-dispensing equipment, including tanks, drums, pails, hoses and reels, should be clearly labeled to avoid cross-contamination of products. Color-coding is helpful in avoiding cross-contamination.
- The use of an industrial filter cart is one of the most economical ways to protect your system from destruction caused by contamination.

Area #3 – Equipment:

Nearly every industrial application is a candidate for a contamination control solution. Gearboxes, pumps, turbines, transformers, hydraulic systems... all of them can be looked at as an opportunity to save money through the reduction of downtime, increased oil life (and decreased oil replacement and disposal costs), and increased machinery life and reliability. Examining seals, ensuring the application has the correct sized breather for the application and environment, and the regular

filtration of oil can extend the life as much as four times what a non-systematic approach would yield, saving tens if not hundreds of thousands of dollars.

THE PAYOFF: MONEY IN THE BANK (AND BUDGET)

Contamination control is the single greatest opportunity for gains in the average lube program. Significant gains in machinery reliability can be made with minimal investments.

Your program's effectiveness can be measured through the following metrics:

- Maintenance of targeted ISO cleanliness codes
- Reduction in moisture levels (% or ppm) measured by Karl Fischer titration
- Lubricant life extension, extended drain intervals
- Extension of MTBF (mean time between failures), decreased unscheduled downtime
- Cost savings (e.g. reduced component repair, decreased oil disposal expense, decreased oil purchases)

There is an inverse relationship between lubrication quality and maintenance costs. Financial gains can be made by implementing procedures which maximize lubrication effectiveness.

There are a good number of documented examples of the effectiveness of using these methods. Maintenance publications and textbooks list case studies from plants around the world that have brought "youth" back to their equipment. There's the case of the water treatment plant in Ohio that saved money by just adding one type of breather to their equipment, or the bulk storage application that went from an ISO cleanliness rating of 21/19/17 to 18/16/14 with a 20 percent reduction in moisture by using these methods, or the mobile equipment that went over 30,000 hours without needing an oil change.

THE BOTTOM LINE

Tribological losses can be greatly reduced through proper lubrication maintenance which effectively starts with breather protection, off-line filtration, and oil sampling. In today's competitive market with ever climbing oil prices, it is more important than ever to maintain system integrity and extend equipment life.

By utilizing options outlined above and implementing several contamination control techniques, maintaining clean, dry lubricants is easier than ever.