EFFECTIVE OIL FILTERING

Extend Equipment Life, Maximize Maintenance OpEx

DES-CASE®

INTRODUCTION

Everyone is interested in extending life...and a company's equipment is no exception. While our equipment won't last forever, more and more companies are looking for processes and products that will help keep them up and running. Reduced downtime, increased lubricant life, less recycling and repair cost are becoming more important than ever as the industry moves to the next level.

Maintaining clean oil is one of the best investments a company can make, yet contamination often remains an overlooked factor behind premature machinery failure and diminished lubricant life. With the cost of oil, increased desire to minimize usage and waste, and the need to prolong the life of equipment, the economic case for protection—from the time oil enters a facility until it leaves—is stronger than ever.

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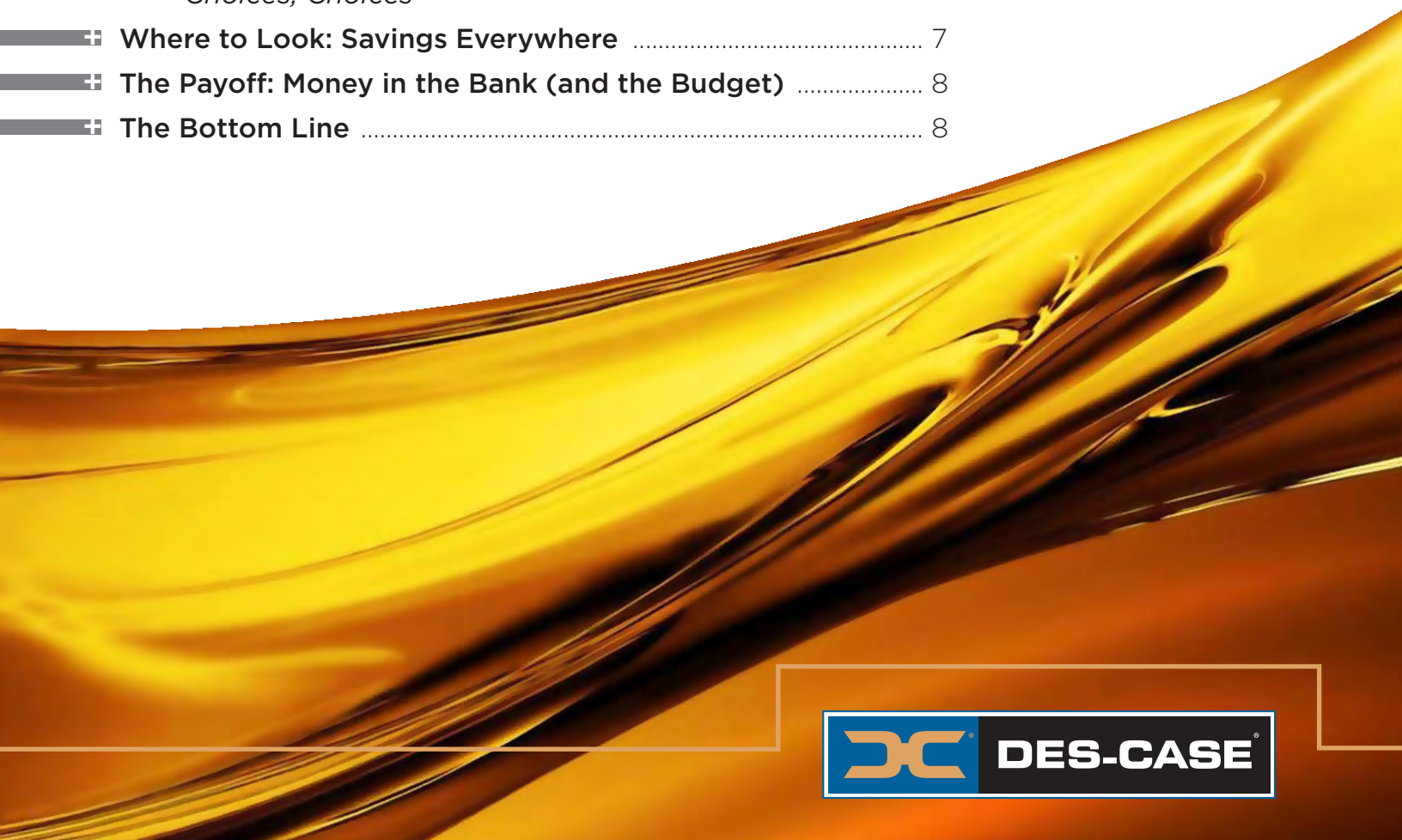

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THE PROBLEM: CONTAMINATION

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. Oftentimes, 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 lubes to contaminants.

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

THE GOAL: SETTING THE RIGHT TARGETS

Before a lubrication best practices program can be created it is important to consider the industry you're in and your applications.

Every industry and application is unique – and what's right for someone in one environment isn't what's needed for someone else with finer tolerances, a more critical application or a different type of equipment.

Table 1 (next page) provides insight into a number of different industries.

INDUSTRY	COMMENTS
Aluminum Extrusion Forging & Rolling Mills	These operations are almost exclusively oriented to hydraulic equipment.
Appliance Manufacturers	Stampings—look for large hydraulic presses and some gearboxes.
Automotive Industries	This industry is intensively equipped with hydraulic machinery, gearboxes & robots.
Large Transformer & Switch Gear Mfg.	Use a large amount of insulating oil (transformer oil) which can easily get contaminated. Reclamation common.
Aerospace & High Tech Welding	Associated hydraulics are susceptible.
Day Tanks on Diesel Powered Generators	Found in almost every large building. Moisture contamination is a big problem because they are seldom used.
Paper & Pulp Mills: Particle Board & Sawmills (Forest Products)	Mill applications like gearboxes, hydraulic turbines, paper machines, calendars, & presses often are contaminated with water or airborne particles. Environments such as board mills, wood yards, & roll handling areas of paper mills are also good applications for desiccant breathers.
Oil Drill Industry	Hydraulics on the mobile equipment, gearboxes. Equipment in the field is subject to substantial dust contamination.
Acid & Chemical Storage	Moisture and dirt alters the fluid.
Food Processing Plants	Wash down of equipment makes moisture a real problem for hydraulic reservoirs & gearboxes. One of the best applications.
E.D.M. Die Making	Electro-discharge machining is a high metal removing process that produces contaminated oil.
Food Products; Oils, Grains, Syrups	Contamination prevention is particularly important during fill/empty operations.
Off Road Vehicles	Filtering moisture and dirt from air going to differentials, transmissions, loader cylinders, etc.
Automatic Screw Machine	These are basically high production lathes, which often use petroleum based cutting oils.
Chemical & Petro Chemical Plants	Micronic filtration of the process stream. Lube oil degassing and conditioning; turbine & seal oil.
Jet Fuel Storage at Large Airports	Water or dirt contamination results in loss of entire product.
Plastic Injection Molding	Big user of hydraulic equipment.
Power Plants & Utilities	Filtration application is on the main steam turbines, boilers, feed pumps and any peaking units. Transformer oil treatment is another obvious application.
Steam & Gas Turbine Manufacturers & Users	Paper mills, petrochemical plants, refineries, & even distilleries are turbine users. Off shore oil drilling platforms utilize gas turbines as main electrical generating power source.
Steel Rolling Mill & Forge Plants	A typical steel rolling mill has two stories of hydraulic equipment beneath the roll stands. They periodically contaminate this hydraulic oil with water based rolling fluids. A desiccant breather could prevent the contamination of moisture that gets in through the breather cap.
Mining Companies	Hydraulically powered equipment exposed in a very dirty environment.

Table 1: Industry Applications

OPTIONS

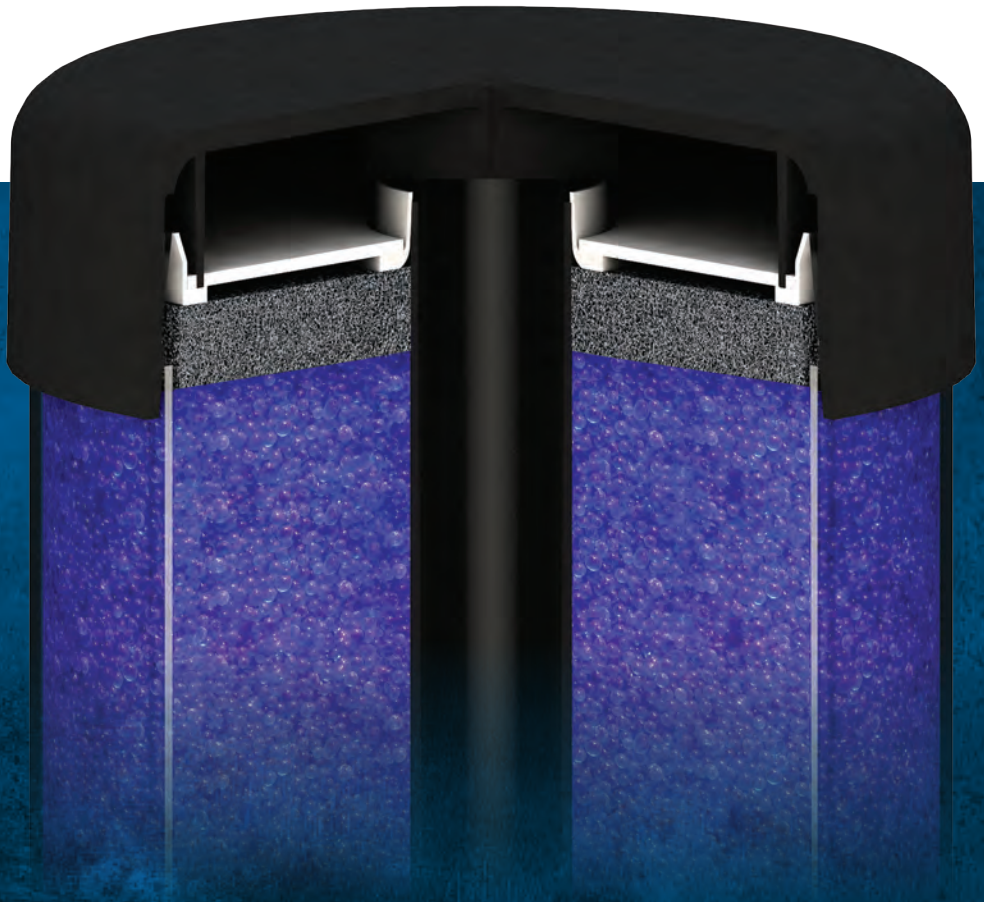
It has been said that the best cure is prevention. Ideally, all of us would have a brand new plant and machinery and begin with a solid program of preventative measures that would ensure the longest life for our equipment and oil. That, of course, never happens.

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 2, pg. 4). Proper installation and maintenance of desiccant breathers can significantly reduce ingression of airborne contaminants.

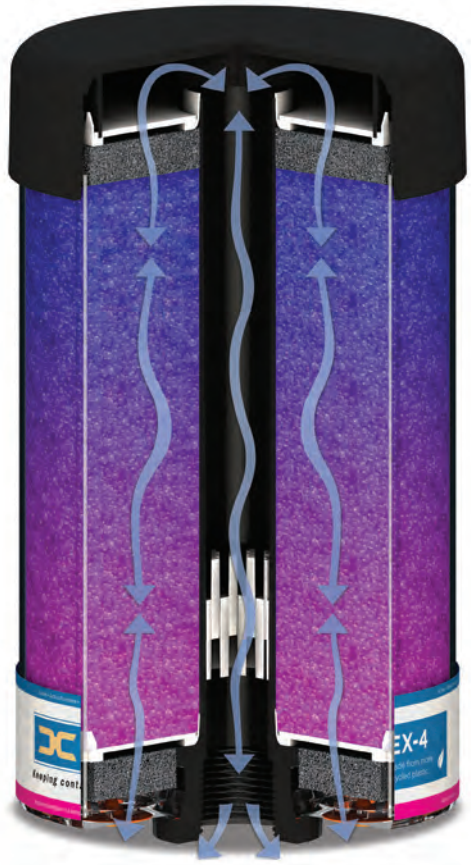
The desiccant breather continues to be at the top of the list for preventative maintenance and conquering contamination.



OPTION	DESCRIPTION/COMMENTS
Open Port	• Although uncommon 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 3µ • Higher airflow ratings • Not as effective if humidity is a concern • Hydrophobic membrane breathers are effective at stopping free water
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 indications 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 absorbing agent, changing color as it becomes saturated, indicated the need for a condition-based replacement • Some incorporate both hydrophobic and oleophboic media. This type of dual protection breather keeps free water out of the system, and oil mist contained within the headspace (where it belongs)

Table 2: Reservoir Filter Options

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 nonstop protection against uninvited contaminants, both dirt and water. 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.



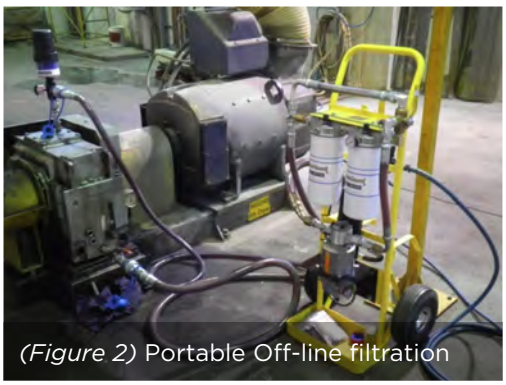
Breathing starts the same day the machine is put into operation or a static tank is filled. The correct approach to preventing dirt and moisture damage is to proactively control ingression points. Since the most common point of entry is the conventional vent port, installation of desiccant breathers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

There are two basic forms of oil filtration: in-line or off-line. Any circulating system should have in-line filters on the pressurized supply line so that the oil that is fed to the moving components is clean and dry. However, oftentimes in-line filters cannot adequately control contaminants at low enough levels without significant and costly upgrades. Under these circumstances off-line filtration is an excellent, cost effective solution. Off-line filtration, sometimes called by-pass or kidney loop filtration uses an external motor, pump and filter to remove oil from the oil sump or reservoir, returning filtered oil back to the sump. Off-line filtration can be either permanently installed on the system *(Figure 1)* or portable *(Figure 2)*. While permanent off-line filtration will usually offer better overall contamination control, portable filtration, which can be connected and disconnected to the machine by way of quick connects, offers the advantage that the same filtration system can be used for multiple machines; provided each machine uses the same oil type.

(Figure 1) Permanent Off-line filtration



(Figure 2) Portable Off-line filtration

Filter Carts Capture Contaminants

A hand cart is a portable, off-line filtration system when 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. They should be part of a routine that includes new oil filtering, transferring and dispensing oils.

You may ask, "Should I filter new oil?", since 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 since 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 cart. They are the ideal way to pre-filter and transfer fluids into reservoirs.

CHOICES, CHOICES

There are a number of variations to filter units – and units vary greatly in their options. There are a number of manufacturer's guides to selection as well as some online, customizable alternatives that can help you with getting what's right for you. Consider some of the following basic questions as you look for the right choices for your plant or application:

- **Where do I need the filtration?**
  — This will influence whether you want to look at a fixed unit, a traditional cart on wheels, or some of the newer, more compact units.
- **What do I need to filter?**
  — This will influence the number of units you need (to reduce cross contamination), the type of filters you want to use (filter media, micron rating, water removal, etc.), and the materials you need in the construction of the filtering apparatus (material compatibility, electrical or air connections).
- **How often do I need to filter?**
  — If you have an application that is in need of filtration for the first time, a general rule is to filter the oil through seven passes to ensure that nearly all of the oil in the reservoir has been adequately cleaned. However, if the oil is able to be completely removed from the system, one or two passes should suffice, depending on the speed with which you filter the oil. After the initial cleaning, consider the criticality of the application, the sensitivity it has to contaminants and the ingression rate of contaminants (through seals, from the environment and internal abrasiveness) in setting the schedule for filtration.

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 2, 3, or 4 times what a non-systematic approach would yield, saving tens if not hundreds of thousands of dollars.

THE PAYOFF: MONEY IN THE BANK (AND THE 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/machine or part produced)

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 a 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% reduction in moisture by using these methods, or the mobile equipment that went over 30,000 hours without needing an oil change...and many others.

THE BOTTOM LINE

Equipment life can be greatly extended through proper lubrication maintenance which effectively starts with breather protection, off-line filtration and oil sampling. In today's competitive market, most companies are now realizing that maintaining clean oil is one of the best investments it can make, with contamination at the core of premature machinery failure and diminished lubricant life.

By utilizing options outlined above and implementing several contamination control techniques as a 'best practice', maintaining clean, dry lubricants—and gaining the profitability that goes along with it—is easier than ever.