

Proper Oil Maintenance and The Price of Reliability vs The Cost of Reliability



By: Peter Smyth

Let me ask two simple questions:

- 1) If you're like most Americans, you have homeowner's insurance to replace or repair your house should disaster strike. You have auto insurance in case you have to repair your vehicle or someone else's, and to cover any liability that may result. If you could buy insurance to protect your plants' most vital assets in case of failure that results in lost revenue for your company and capital expenditures to repair or replace the equipment, would you buy it?
- 2) If you are fortunate enough to own a Porsche, would you take it to the drive through place and spend \$35 for an oil change or would you spend more and let a



Porsche trained and certified mechanic do it, using high quality oil and filter?

If you wouldn't buy that insurance you'll certainly save the price of the premium, but what will you be risking by not having that insurance? And if you pay \$35 for an oil change on your high performance sports car, what risk are you taking?

That brings us to our topic, the "price" of reliability vs the "cost" of reliability. Webster defines Price as "the amount of money for which something is obtained" and defines cost as "the price paid to acquire, accomplish, or maintain."

So for this discussion, price is the money you pay now for proper lubrication to keep your machinery in top form and running properly with the least chance of failure and longest possible life, while cost is the amount you may pay later in time and money if you don't invest in these things that may result in poor performance and machinery failure.

INCREASED RELIABILITY = DECREASED COSTS





Let's look at a few things that would fall under price and cost:

The Price of Reliability

Desiccant Breathers
Oil Coolers
Training staff in Best Practices
High quality in-Line Filtration
Off-line depth filtration
Sight Glasses
Proper seals
Quality Oil Handling Equipment
Proper Lubricants
Oil Sampling/Analysis Program

The Cost of Reliability

Unplanned Downtime
Expensive Repairs
Shortened Oil Life
Shortened Equipment Life
Loss of Production
Higher Operating Costs
Losing one's job
Avoiding reactive maintenance
Employee Turnover
Safety concerns

Keeping Contaminants Out

It is far less expensive to keep contaminants out than to have to remove them once they are already in your oil. A quality filtration plan can remove most hard and soft contaminants as well as moisture, but it's a much better strategy to keep them out in the first place. If you are not utilizing desiccant breathers on your oil reservoirs, especially in high humidity climates and on hydraulics, then you are cheating yourself of a very low cost insurance policy. Moisture can, and will, form inside the reservoir and varnish and wear debris can be generated from operation, but a desiccant breather is a simple first line of defense.

Cool Oil is Happy Oil

The Arrhenius rate rule for temperature states that for every 18 degrees F increase in temperature, your oil life is cut in half. Keeping your oil within its' recommended temperature range is vital. Heat will rapidly accelerate the oxidation of your lubricants, significantly shortening its usable life. The main cause of varnish is heat, the hotter your oil, the greater the chance of varnish build up. Your oil is designed to run within a certain temperature range, if you're not within this range your oil may not have the proper viscosity resulting in rapid wear and catastrophic failure. Cooler temperatures can be your enemy as well, resulting in thicker oil, which causes inefficiencies and damage, especially in outdoor applications, colder climates, and in machinery that is cycled on and off. If you want to buy an insurance policy for this, then look into an air



blast cooler which is simple and not too expensive. Liquid coolers are available as well, and most often require very little space, but need a water supply



Gas Turbine Oil with Varnish



Gas Turbine Oil without Varnish

Great Team Members aren't Hired – They're Trained

Show me a maintenance team that doesn't get regular training on their equipment, new technology, and best practices and I'll show you a facility that is asking for trouble. Keeping your team educated and sharp should be done on a regular basis and will not only increase their knowledge but increases moral and gives your company a great pool of talent when it comes time to fill higher positions. Much can be done on-line or in groups on site. Check with your most trusted suppliers, many offer lunch and learns at no cost. Not sure what to do? Ask your team what they need work on, I'll bet they have plenty of ideas and are willing to improve. Continual training is possibly the best investment in insurance you can buy.



Topic Area	Industrial Lubrication Fundamentals	Machinery Lubrication I	Machinery Lubrication II	Oil Analysis II	Oil Analysis III
Maintenance Strategies	◆	◆◆◆◆	◆	◆	◆
Lubrication Concepts	◆◆	◆◆◆◆	◆	◆	◆◆◆◆
Fundamentals of Machine Wear	◆	◆◆	◆◆	◆	◆◆◆◆
Lubricant Selection	◆	◆◆	◆◆◆◆	◆	◆
Reception and Storage	◆◆◆	◆◆	◆◆◆◆	N/A	N/A
Handling and Application	◆◆◆◆	◆◆◆	◆◆◆	◆	◆
Contamination Control	◆◆	◆◆	◆◆◆◆	◆◆◆◆	◆
Lubricant Analysis	◆	◆	◆◆	◆◆◆◆	◆◆◆◆
Wear Debris Analysis	N/A	N/A	N/A	◆◆◆◆	◆◆◆◆
Oil Analysis Program	N/A	N/A	N/A	◆◆	◆◆◆◆
Environmental Disposal	◆◆◆◆	◆◆	◆	N/A	N/A
Certification Preparation	N/A	MLT I and MLA I	MLT II	MLA II	MLA III
Availability	Private Classroom	Public, Private Classroom & Online	Public, Private Classroom	Public, Private Classroom	Public, Private Classroom

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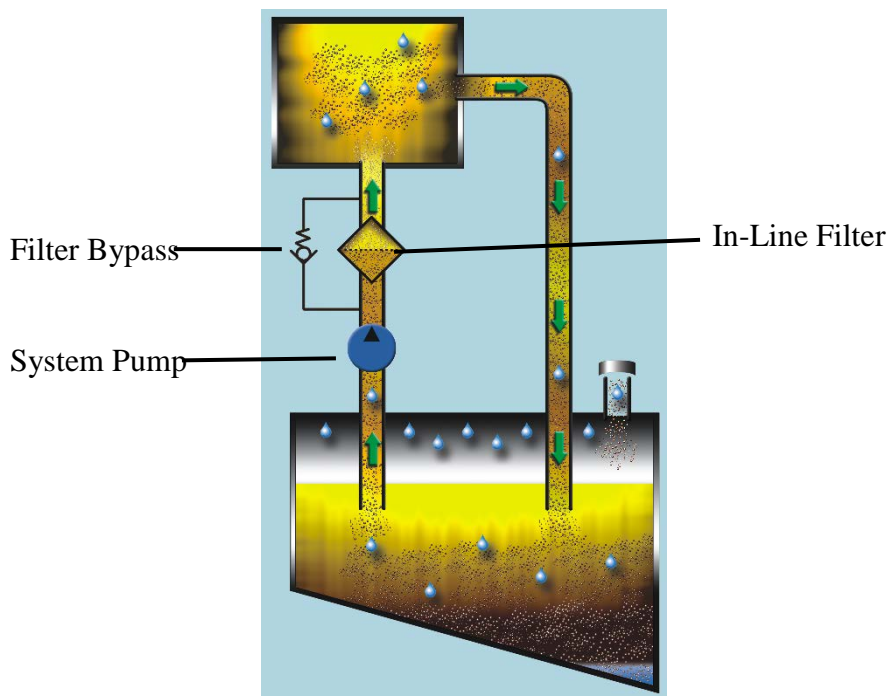
Topic Area Scale From 1-4 ◆

Filtration is a PLAN not a piece of equipment

Possibly the most important aspect of a quality lubrication plan and your reliability insurance is quality filtration. Almost every piece of equipment in your facility that has hydraulic or lubricating oil needs both in-line and off-line filtration. An in-line filter (usually from the OEM) is designed to prevent against sudden catastrophic failure and should in most cases be paired with an ultra-low micron off-line filter. A quality in-line filter is great at blocking hard contaminants, but has limitations that stop it from truly cleaning the oil.



- The pickup point for the oiling system is typically half way down in the tank to ensure that it does not pull in the heavy debris. This means that contaminants are allowed to collect in the bottom half of the tank, breaking down the oil, consuming the oil's additives, resulting in dirty oil, acidity, sludge & varnish formation and eventually making their way into the critical parts on the machine. It does not matter what the beta ratio is on the in-line filter, every change in pressure across the filter and every start and stop of the machine will blast contaminants through the filter and into the critical pumps, bearings and valves of the machine.
- The in-line filter can typically not remove water, which will allow water to build-up in the tank causing the formation of rust and bacteria growth
- Furthermore, the inline filter has to accommodate the high flow of the system, so going too fine, and you'll risk filters blocking and going into bypass mode.
- Most in-line type filters can typically not remove soft contaminants like varnish





By combining both types of filters to each system you can meet, and in many cases exceed, your goals for moisture and particle counts (ISO codes) in the oil.

A high quality off-line filter (kidney loop) that offers depth filtration is key. Depth filtration meaning that a much larger (and typically much more effective) filter media is used and the entire volume of the filter is actively removing contaminants. Off-line systems can circulate the oil much slower and at lower pressure, while having a much larger filter media area, which allows for much more “dwell time” (time that the oil spends passing through the filter media where contaminants are captured). Off-line depth filters also hold far more contaminants before needing an element replacement. Imagine a drip coffee maker that slowly drips hot water over coffee grinds that are kept out of your cup by the coffee filter vs an espresso machine that forces steam through the grounds under pressure. The cup of coffee will be void of any grinds, while the high pressure process of espresso making forces small remnants of the coffee to be forced through into your cup. The same thing is happening in your in-line filter - when it comes to contaminant removal a slow and low pressure circulation is always superior. It is vitally important that you remove all 3 types of contaminants: particulates, water, and oxidation products/varnish. By keeping contamination levels as low as possible also positively effects other oil issues – it keeps viscosity at the proper level, slows down the oil aging process, keeps acid levels from building too fast, and lets additives do their job and last longer.

The life expectancy of your equipment that can be offered by maintaining clean, dry oil is shocking. Take a look at Noria’s Life Extension Table below for particles and moisture and see how much longer your equipment will last if you use proper filtration to keep your oil clean.

Two important things to keep in mind with lubricant filtration:

- All filtration is not the same, there are vast differences in the size, type, and amount of contaminants that filters can hold.
- Waiting till your oil is highly contaminated is not the time to install a world class filter. You don’t wait till a swimming pool is green and fouled with algae and then add a large amount of chlorine, you add a little bit on a frequent basis to keep the water clean and avoid algae build up.

The same is true for filtration, keeping it clean is more effective and less expensive than addressing a very contaminated system. World class filtration is probably the most important insurance you will buy and most likely has the quickest ROI - often less than one year return on investment.



LET – Cleanliness Level ISO Codes, Complete										
	<small>Source: Noria Corp.</small>									
Current Machine Cleanliness (ISO Code)	Expected Cleanliness level (ISO Code)									
	21/19/16	20/18/15	19/17/14	18/16/13	17/15/12	16/14/11	15/13/10	14/12/9	13/11/8	12/10/7
24/22/19	2 1.6 1.8 1.3	3 2 2.3 1.7	4 2.5 3 2	6 3 3.5 2.5	7 3.5 4.5 3	8 4 5.5 3.5	>10 5 7 4	>10 6 8 5	>10 7 10 5.5	>10 >10 >10 8.5
23/21/18	1.5 1.5 1.5 1.3	2 1.7 1.8 1.4	3 2 2.2 1.6	4 2.5 3 2	5 3 3.5 2.5	7 3.5 4.5 3	9 4 5 3.5	>10 5 7 4	>10 7 9 5.5	>10 10 10 8
22/20/17	1.3 1.2 1.2 1.05	1.6 1.5 1.5 1.3	2 1.7 1.8 1.4	3 2 2.3 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4 5 3	9 5 6 4	>10 7 8 5.5	>10 9 10 7
21/19/16		1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.2 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4 5 3.5	9 6 7 4.5	>10 8 8 6
20/18/15			1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4.6 5.5 3.7	>10 6 8 5
19/17/14				1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.7	4 2.5 3 2	6 3 4 2.5	8 5 6 3.5
18/16/13					1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.8	4 3.5 3.7 3	6 4 4.5 3.5
17/15/12						1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.4	2 1.7 1.8 1.5	3 2 2.3 1.8	4 2.5 3 2.2
16/14/11							1.3 1.3 1.3 1.2	1.6 1.6 1.6 1.4	2 1.8 1.9 1.5	3 2 2.3 1.8
15/13/10								1.4 1.2 1.2 1.1	1.8 1.5 1.6 1.3	2.5 1.8 2 1.6

LEM - MOISTURE Level									
	<small>Source: Noria Corp.</small>								
Current Moisture Level, ppm	Life Extension Factor								
	2	3	4	5	6	7	8	9	10
50,000	12,500	6,500	4,500	3,125	2,500	2,000	1,500	1,000	782
25,000	6,250	3,250	2,250	1,563	1,250	1,000	750	500	391
10,000	2,500	1,300	900	625	500	400	300	200	156
5,000	1,250	650	450	313	250	200	150	100	78
2,500	625	325	225	156	125	100	75	50	39
1,000	250	130	90	63	50	40	30	20	16
500	125	65	45	31	25	20	15	10	8
260	63	33	23	16	13	10	8	5	4
100	25	13	9	6	5	4	3	2	2

1% water = 10,000 ppm. • Estimated life extension for mechanical systems utilizing mineral-based fluids.

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If You Can't Measure It, You Can't Manage It

Not sampling and analyzing your oil on a consistent basis is akin to driving blindfolded – you have no idea where you're going and what you are doing - and the same result will happen. The simplest lubrication insurance policy you can buy is consistent oil analysis. It identifies small issues before they become big problems and gives you time to correct. Communicate with your testing lab so that you are getting all the info you need, and not paying for testing you don't need. Create a log for each piece of



equipment, set goals for all the important parameters, and then work diligently at staying below those goals.

Sample Trend - All Data

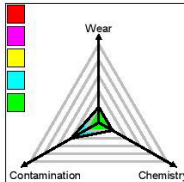
Database: OilLab2008.rbm	Equipment: 67130 - D KILN DRIVE
Area: MO - MONTHLY SAMPLES	Point: RED - Reducer

Ref Oil	Shell - Omala - S2 G 320				
Sample Date	9/6/2016	8/19/2016	8/12/2016	8/1/2016	7/29/2016
Sample #	33130	32938	32842	32645	32641
Unit Usage - day	107	106	106		
Oil Usage - day					
Oil Added - gus					

Wear	0	0	0	0	0
Ferrous Idx - Idx	0.0	0.0	0.0	0.0	0.0
LCont Ferrous - Idx	0	0	0	0	0
LCont NonFe - Idx	0	0	0	0	0

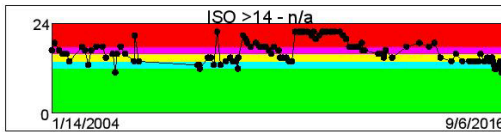
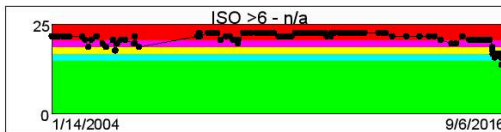
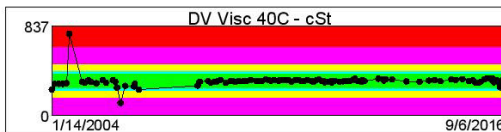
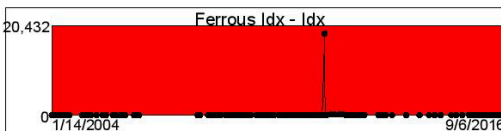
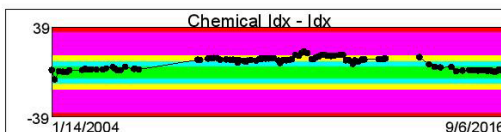
Contamination	10	0	0	21	21
Contam Idx - Idx	0.0	0.0	0.0	0.0	0.0
% Water - %	0.0000	0.0000	0.0000	0.0000	0.0000
LCont Droplet - Idx	0	0	0	0	0
Non-Ferrous Id - Idx					
Cnts >4 - pml	1,287	469	373	3,086	3,685
Cnts >6 - pml	422	128	150	589	674
Cnts >14 - pml	51	19	15	60	52
Cnts >22 - pml	20	7	4	17	18
Cnts >38 - pml	8	2	0	3	8
Cnts >70 - pml	6	0.0	0.0	1	2.4
ISO >4 - n/a	17	16	16	19	19
ISO >6 - n/a	16	14	14	16	17
ISO >14 - n/a	13	11	11	13	13

Chemistry	0	0	0	0	0
Chemical Idx - Idx	.6	1.9	1.6	2.0	2.0
DV Visc 40C - cSt		326.6	270.3	261.6	259.3
DV Visc %Chng - %		2.1	-15.5	-18.3	-19.0



EMERSON
Process Management

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Rayonier Corporation

After installation of quality off-line filtration on August 1st, this paper mill can now expect longer oil life, almost double the life of the gearbox, and far fewer chances of unexpected downtime and repairs. ROI on this system was short and very measurable.



Seeing is believing

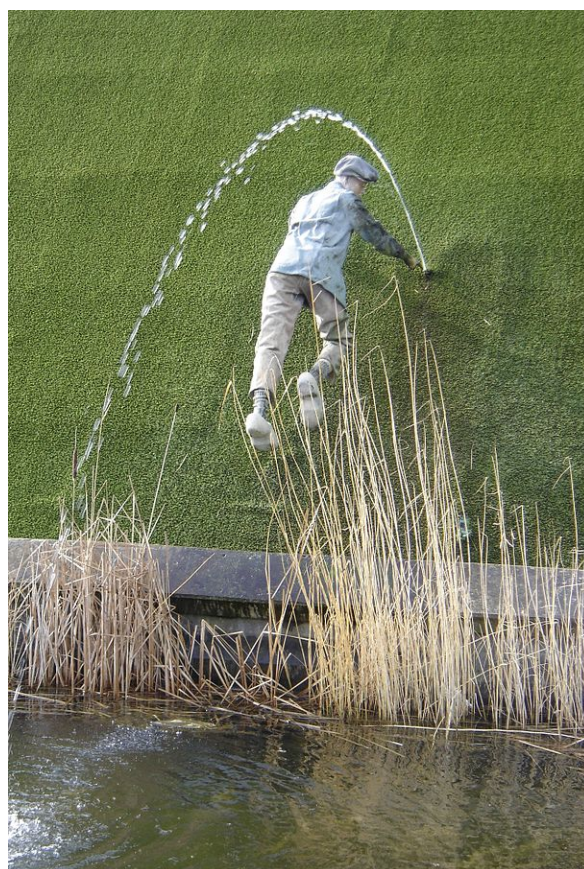
Having site glasses on major equipment is not the most technically advanced tool in your kit, but many a dollar has been saved and many a breakdown has been avoided by the human eye. If your oil “looks” dirty you better believe it is dirty. It doesn’t take much water leaking into your system to show up as cloudy. If you don’t spend a little on visual insurance, you may never know your oil is heavily contaminated until it’s too late. Why take that chance?



Luneta LLC

The Little Dutch Boy

You probably remember the story of the little boy in Holland who saved his town by plugging a hole in the dike with his finger. Well he’s now a reliability manager at a giant petrochemical plant (just kidding, but the story was a work of fiction). The point is, much like a desiccant breather, spend a little of your insurance budget on quality seals that are designed for your application so contaminants stay on the other side and



Follow the Path of Clean Oil

Lubricants are never cleaner than the moment after they are manufactured. Think about the path a lubricant takes on its’ way from the refinery to you. Maybe it gets put in a tanker truck (or two), then a storage tank (or two), then it sits for a month (or two), and then it gets pumped through a dirty hose (or two), then it gets put in a not so clean container – you get

*By user:Pieter1 - Own work, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=587010>*



the picture – new oil as you receive it is not clean oil. And once you have it, how often is it exposed to contaminants and moved from one container to another? Proper oil storage and handling is an insurance policy nobody should be without.

The Lubricant Super Store

There are hundreds, probably thousands of oils that you can put into your reservoir that will “do the job”, but there are probably only 1 or 2 that were designed to maintain your system at peak operating condition and efficiency and prolong life. Don’t take chances with your Porsche at the express lube.



Noria Corporation

When reflecting back upon their lives, many a wise man has said it wasn’t the things he did that he regretted, but the things he didn’t do that burdened him the most. The same can be said of lubrication – spending a few thousand dollars now may be tough, but it will be much easier than spending many more times that and losing much, much more, if failure results.

So when it comes to designing and maintaining a proper lubrication program in your facility, you’ll be much better off if you don’t focus on the PRICE now of doing it, but take a hard look at the COST later of not doing it. Insurance for your equipment is available by paying a much lower price on a regular basis to avoid huge costs that may



result in the future. There are no insurance agents with catchy TV ads to sell it to you, you can reach out to get help or implement it yourself.

More Information

For more information about Off-line Filter Systems for gearboxes or any other lubricated machinery, please contact C.C. Jensen at ccjensen@ccjensen.com, or call (770) 692-6001, or visit www.ccjensen.com