Become a Lube Hero

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LABORATORY TOUR
LUBE ASSESSMENT

Who is Lubrigard?

LUBRIGARD *is a division of* WEAR CHECK

***Lubrigard** has brought together a comprehensive suite of **products** and **services** aimed at elevating companies **lubrication** practices to **world-class**.*

Implementing World-Class Lubrication starts with a desire for maintenance improvement

Lubrigard Services

Benchmarking Services

Lubrication Management Benchmarking An audit of current lubrication practices and procedures. Deliverables include a comprehensive report, presentation and recommendations for improvement.

Lubrication Assessment An informal assessment of current lubrication practices and procedures. Deliverables include recommendations for improvement.

Lubrication Survey A survey of lubricated and greased equipment. Deliverables include a detailed equipment list including lubrication type and frequency provided in electronic format.

Implementation Services

Lube Room Design and Construction A complete lube room designed to accommodate your improved lubrication requirements and practices.

Oil Analysis Program Design Development of a comprehensive oil analysis program including scheduled sampling with pre-labeled sample kits, automatic test selection by individual component, and oil analysis management software.

Scheduled Oil Sampling Our trained technicians will come on-site and take your monthly scheduled oil samples.

Lubrigard Products

OVERVIEW

Lubrication Management Products
Lubrigard offers a variety of products to meet your lubrication management requirements.

The Right Tools
To do the job right your lubrication staff needs the right tools. Lubrigard offers you a convenient one stop shopping location for all your lubrica product needs.

FluidDefense systems
IFH GROUP
HARVARD FILTRATION
Oil Safe
DES-CASE
LUBRIGARD
Grease Safe

Lubricant Storage & Carts

Oil Dispensing Containers

Lubrication Ports

Oil Purification

Air Breathers

Permanently-Mounted Filtration

Filter Carts

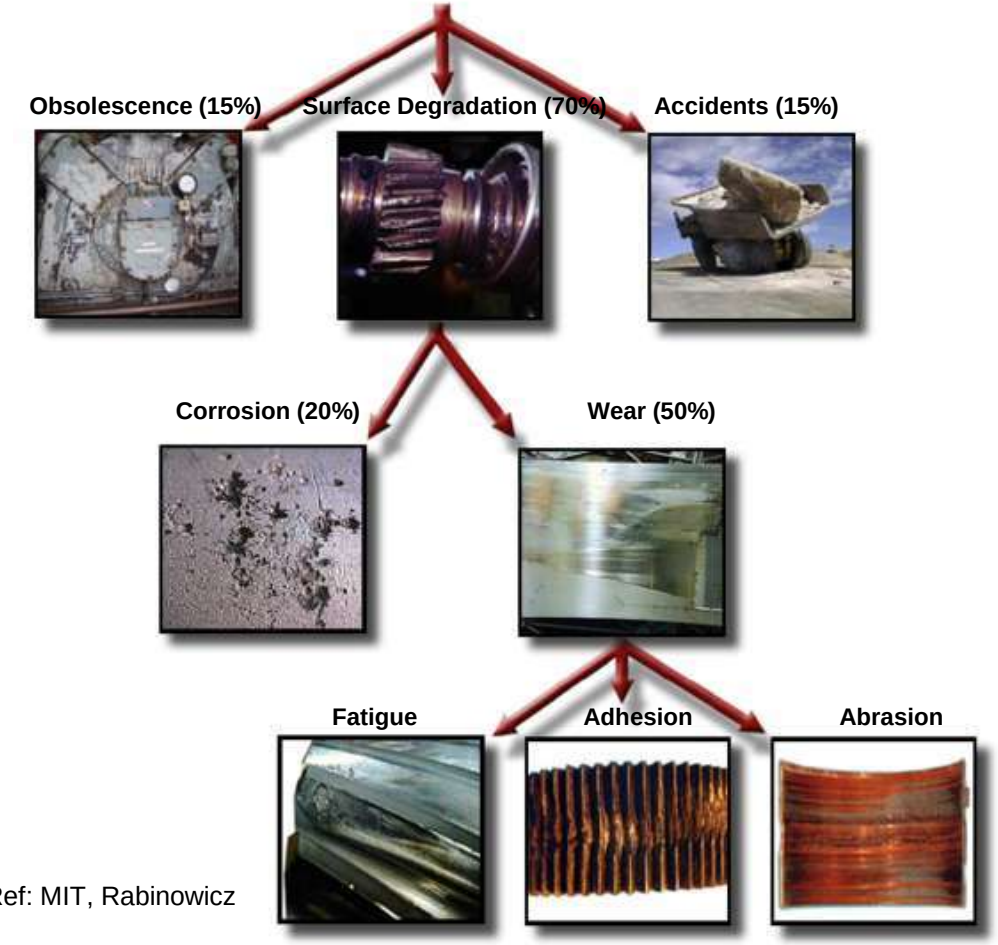
Oil Analysis Kits

Sampling Accessories

70%

Percentage of component replacements or "loss of usefulness" are due to surface degradation according to Dr. Rabinowicz of MIT.

Loss of Usefulness



Ref: MIT, Rabinowicz

NRC / ACOT Report of Frictional and Wear Losses

1986	Friction Losses $ Million / Year	Wear Losses $ Million / Year	Total Losses $ Million / Year
Agriculture	321	940	1,261
Electric Utilities	54	189	243
Forestry	111	158	269
Mining	211	728	940
Pulp & Paper	105	382	487
Rail Transportation	284	467	750
Trucks & Buses	126	860	986
Wood Industries	14	189	203
Total	**1,226**	**3,913**	**5,139**

Ref: NRC (National Research Council of Canada), ACOT (Associate Committee on Tribology)

$200B

Amount of money lost to friction and wear in the United States.

This does not take in account the environmental costs of spills and disposal.

Quiz Time

Q How important is precision lubrication to overall equipment reliability?

81%
CRITICAL

18%
IMPORTANT

1%
NOT IMPORTANT

Ref: Machinery Lubrication Reader Survey – March, 2011 (n: 347)

Quiz Time

Q

At your plant, have you achieved a level of lubrication that you would consider close to best practice?

68%
NO

32%
YES

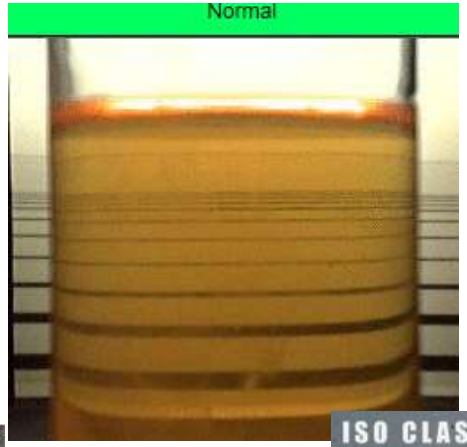
Ref: Machinery Lubrication Reader Survey – March, 2011 (n: 347)

Q

So why don't companies pursue World-Class Lubrication?

Problem	Solution
Lack of knowledge or understanding	Training and Education
Too busy putting out fires to develop an action plan	Project Management Support
Lack of management buy-in to provide funding	Develop a Business Case

Oil Cleanliness



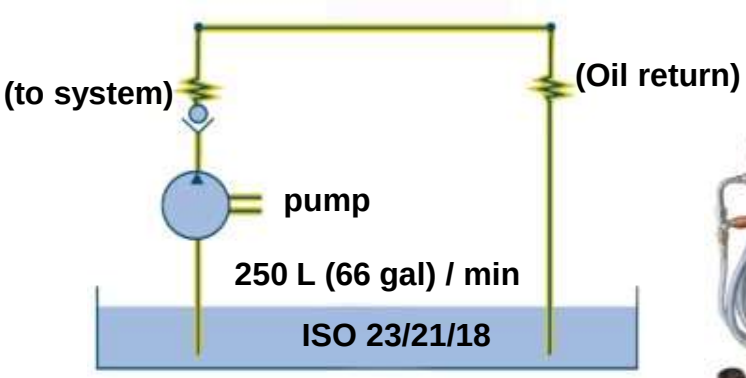
ISO 23/21/18

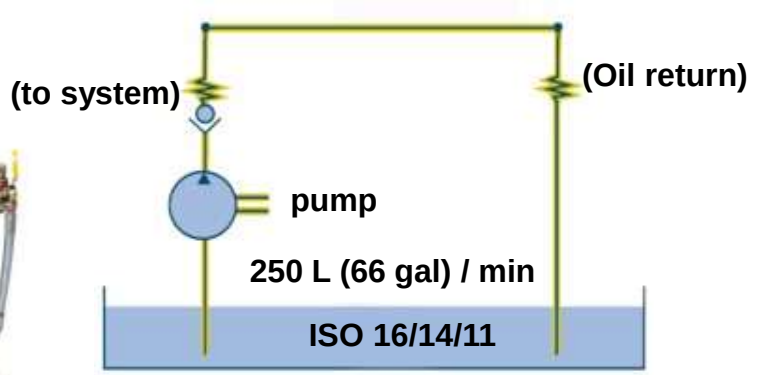
- 7 ISO codes higher than 16/14/11
- 2^7 X's dirtier *or* 128 X's dirtier

ISO 16/14/11

- 7 ISO codes lower than 23/21/18
- 2^7 X's cleaner or 128 X's cleaner

Cost of Poor Oil Cleanliness





ISO 23/21/18

- **4,375 kg (9,645 lbs) of dirt** pass through pump each year
- Equivalent to **175 x 25kg (55 lb) bags**
- Expected **pump life = 2 years**

ISO 16/14/11

- **25 kg (55 lbs) of dirt** pass through pump each year
- Equivalent to **1 x 25kg (55 lb) bags**
- Expected **pump life > 14 years**

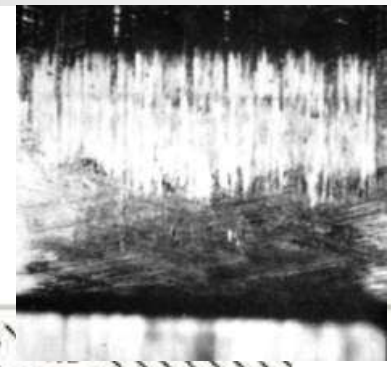
Number of Particles per 100 ml of Oil		
	ISO 23/21/18	ISO 16/14/11
Particles > 6µm	1,000,000 – 2,000,000	8,000 – 16,000
Particles > 14µm	130,000 – 250,000	1,000 – 2,000

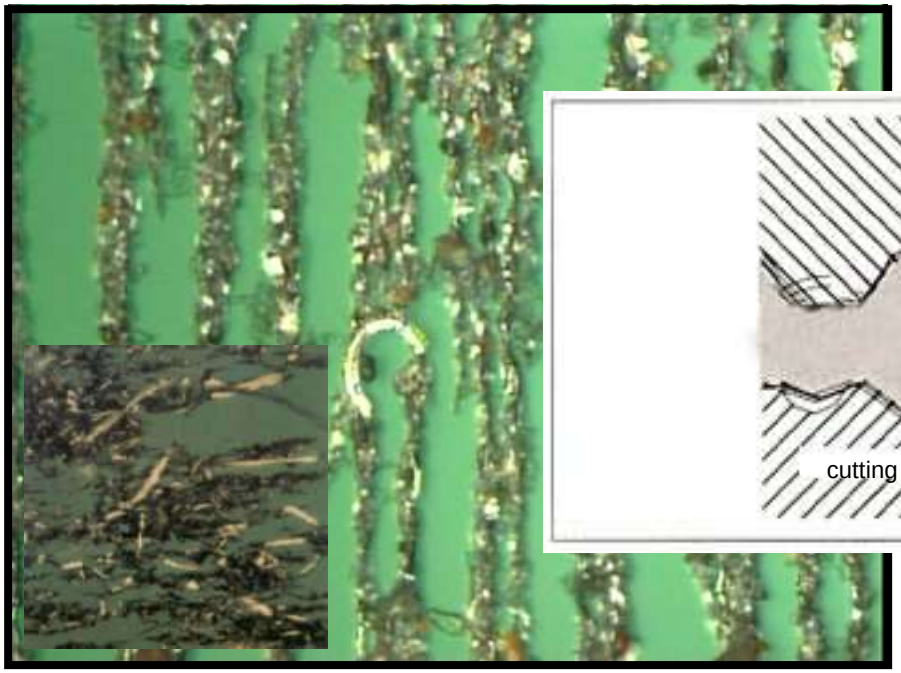
Ref.: E.C.Fitch, U of Pretoria

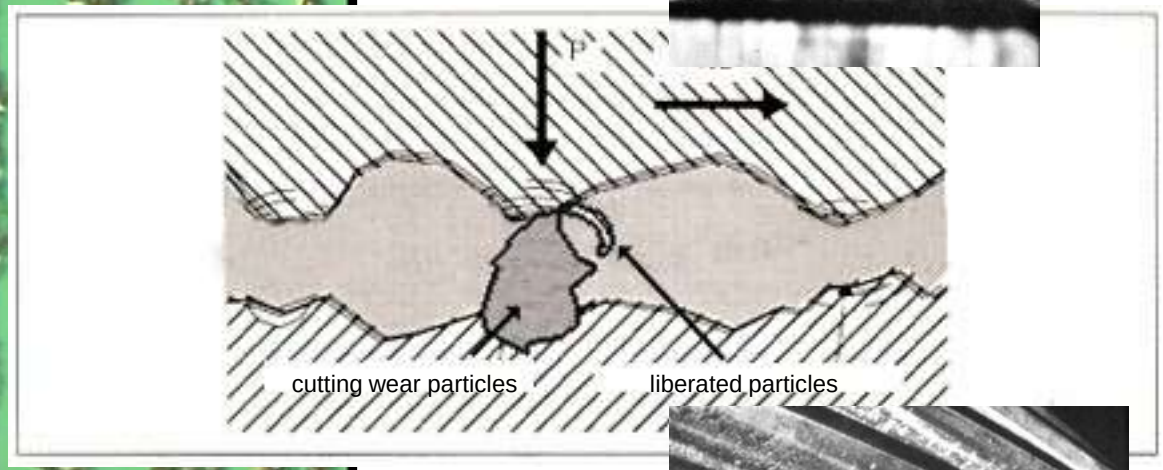
Effects of Particulate Contamination

Abrasion

cause abrasive particles present in oil
symptom grooves and pits in hard metal surface







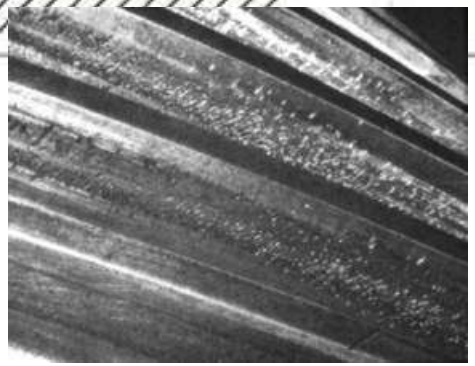


Photo: WearCheck

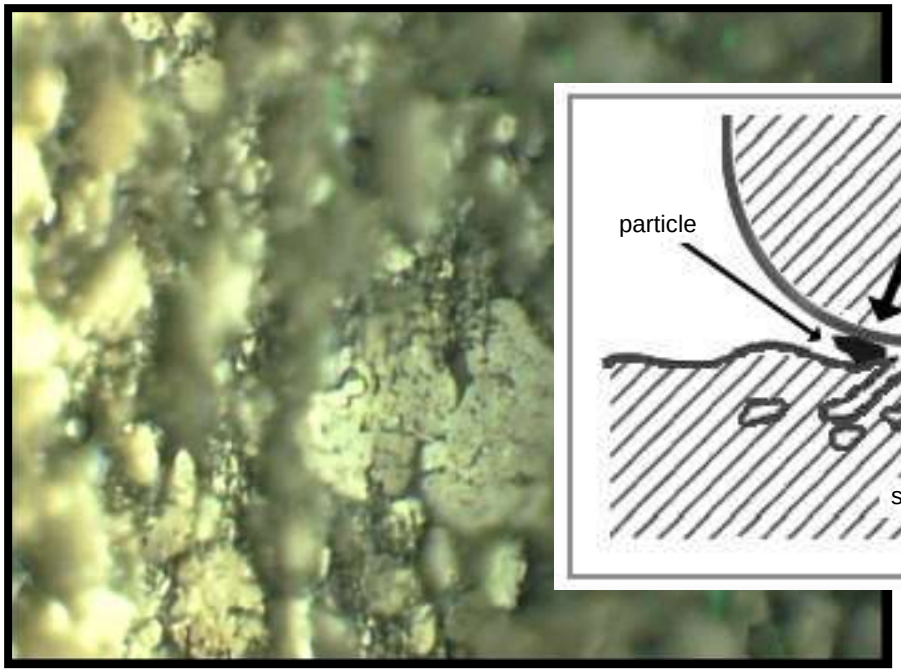
Cutting Wear Particle @ 200X magn. [Incident light]

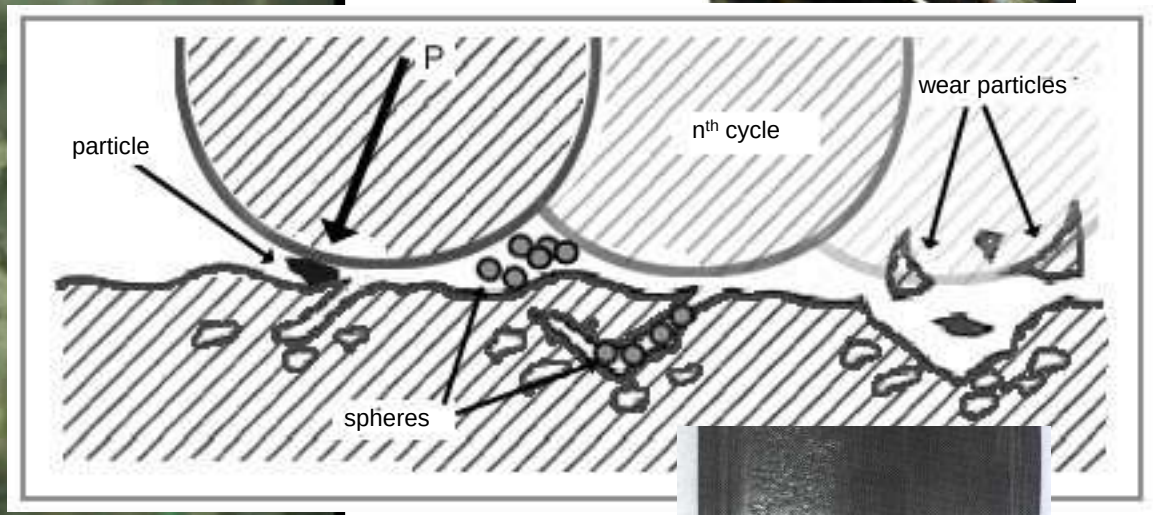
size 30 µm to several mm
shape curled
surface jagged

Effects of Particulate Contamination

Fatigue

cause n^{th} cycle fatigue / abrasive particle under EHL
symptom pitting on gear pitch line, and bearing race ways





Rolling Fatigue Particles @ 500X magn. [Incident light]

Photo: WearCheck

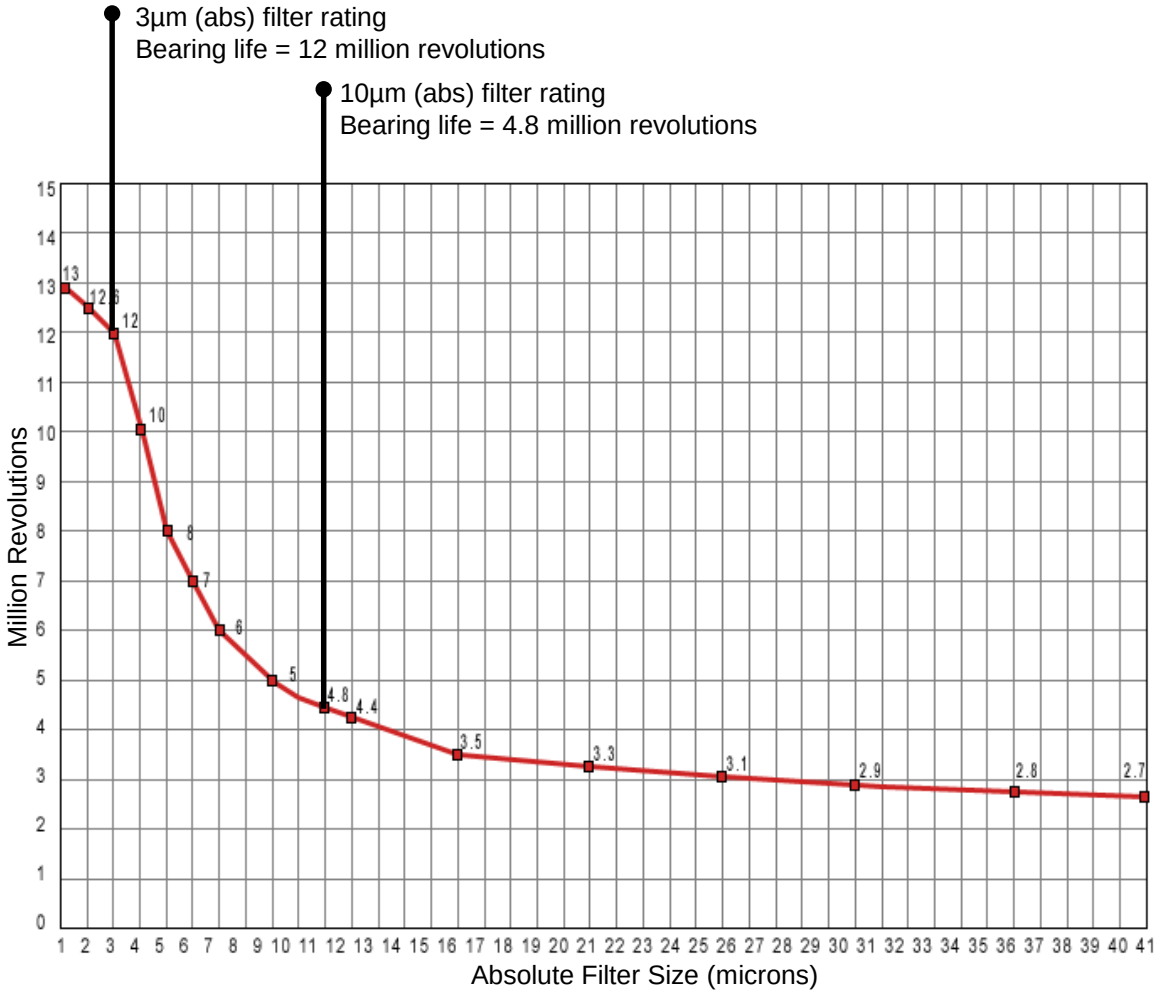
size 30 -100 µm
shape orange peel (curved)
surface pock marked

Particle Effects on Component Life

TIMKEN

Bearing Life vs. Filter Size

- Reducing the filter micron rating from 10µm to 3µm increases bearing life by a factor of 3X



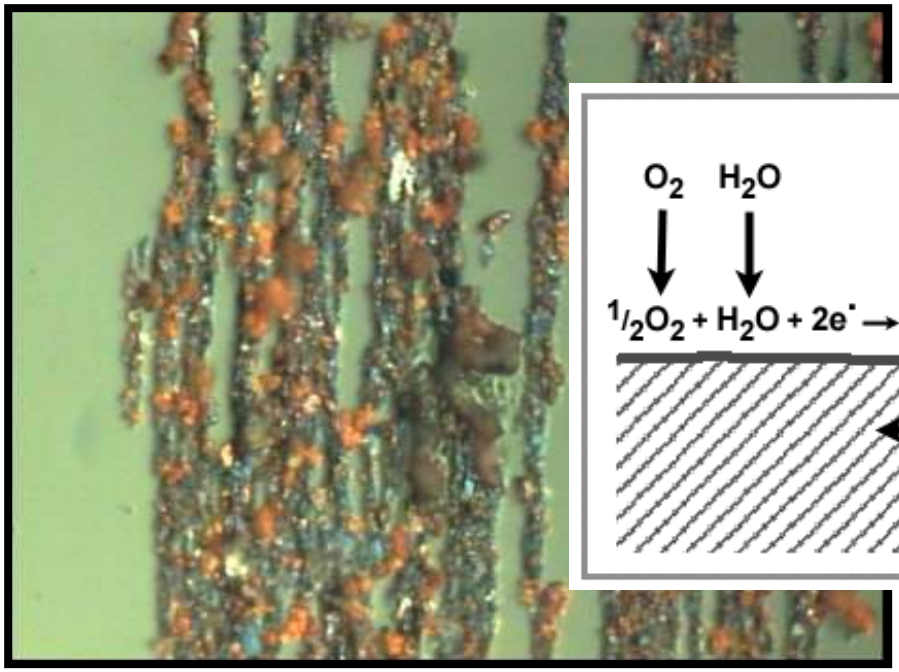
Ref: Timken

L_{50} Bearing Life vs. Filtration Mesh Size

Effects of Water Contamination

Rust and Corrosion

cause leaking seals, air breathers with no desiccator
symptom rusting and corrosive etching, sludge, oil line plugging, scale



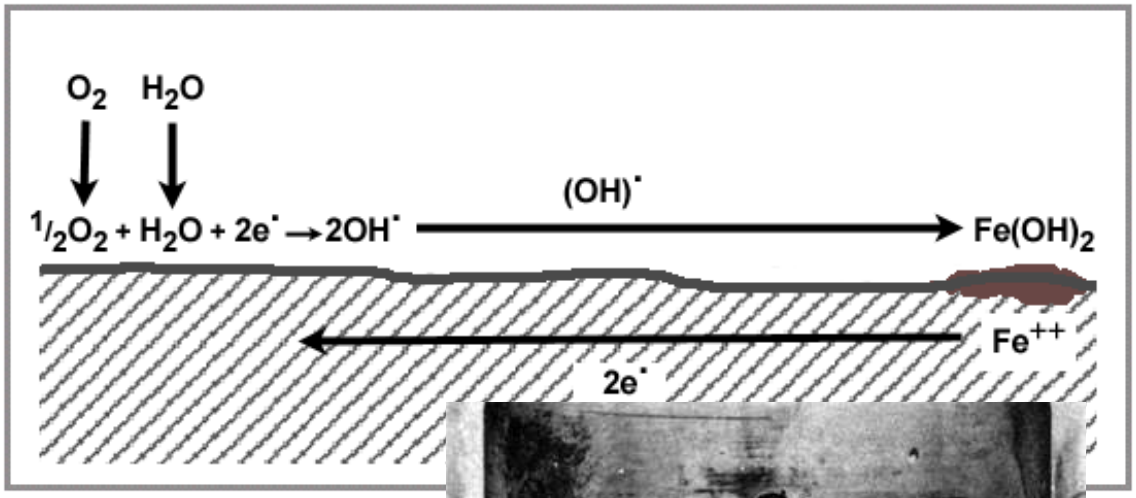


Photo: WearCheck

Red Oxides @ 500X magn. [Incident light]

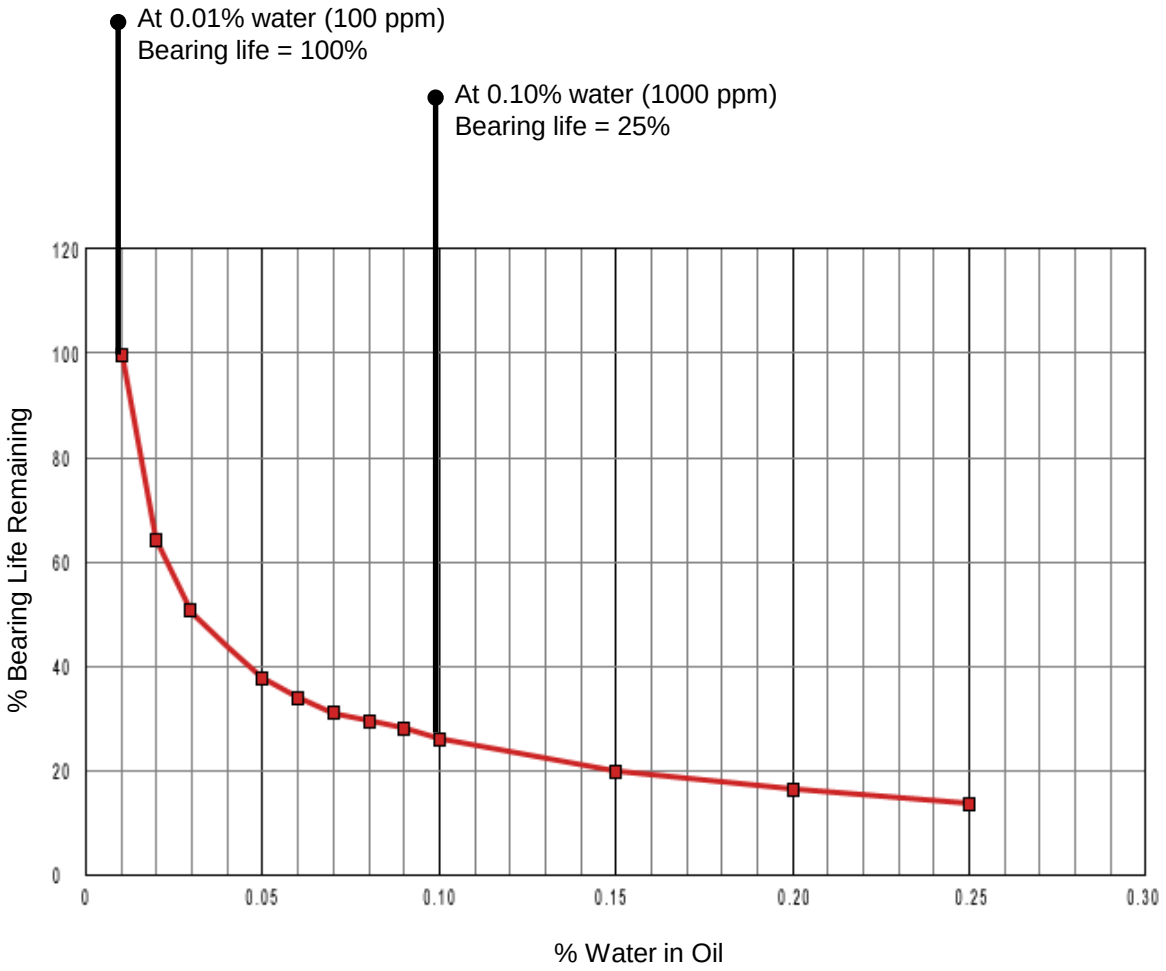
size 20 -80 µm
shape chunky
color reddish orange

Water Effects on Component Life

TIMKEN

Bearing Life vs. Water %

- Reducing the water ingression level from 0.10% down to 0.01% increases bearing life by a factor of 4X.Test ABN >.05%



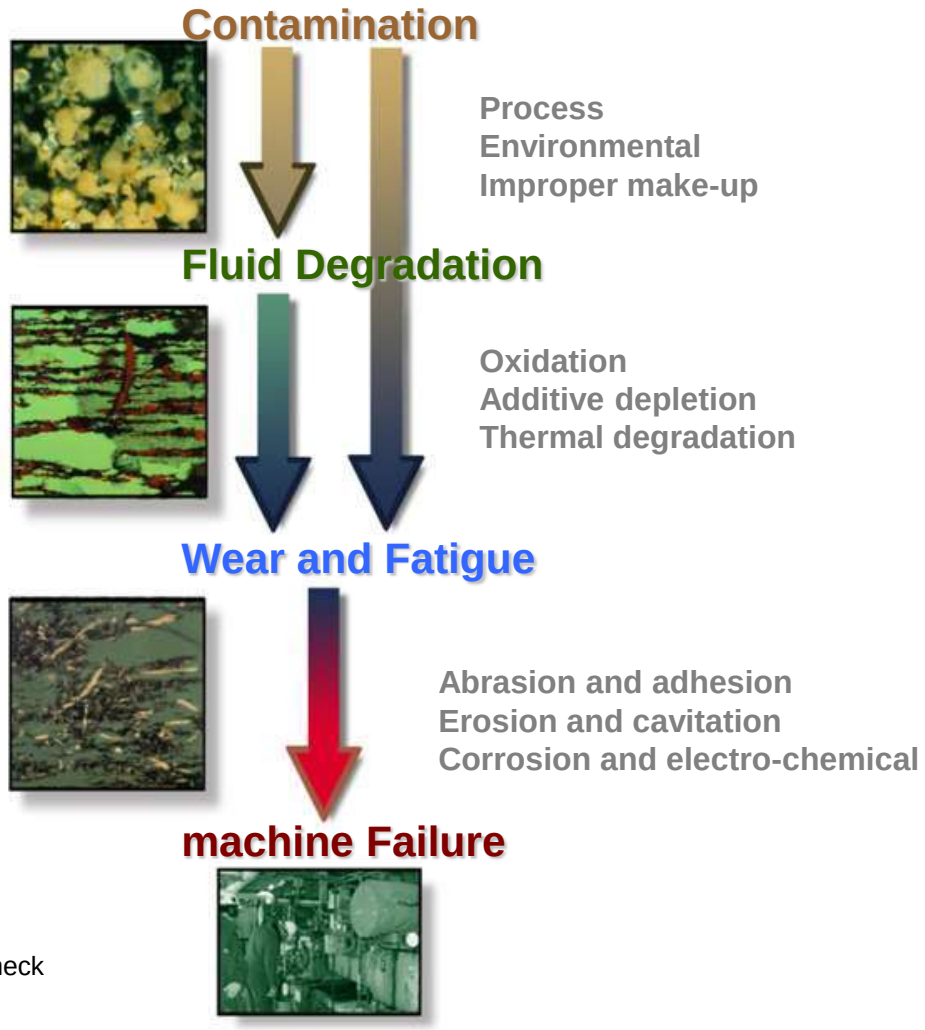
Ref: Timken

Water Contamination vs. Bearing Life

Machine Failure Cycle

Ingress of contaminants and other oil contamination increases rate of fluid degradation. Contamination and poor fluid quality cause increased wear. Eventual machine failure is inevitable.

Create a maintenance environment that prevents contamination ingress and improve machine reliability.



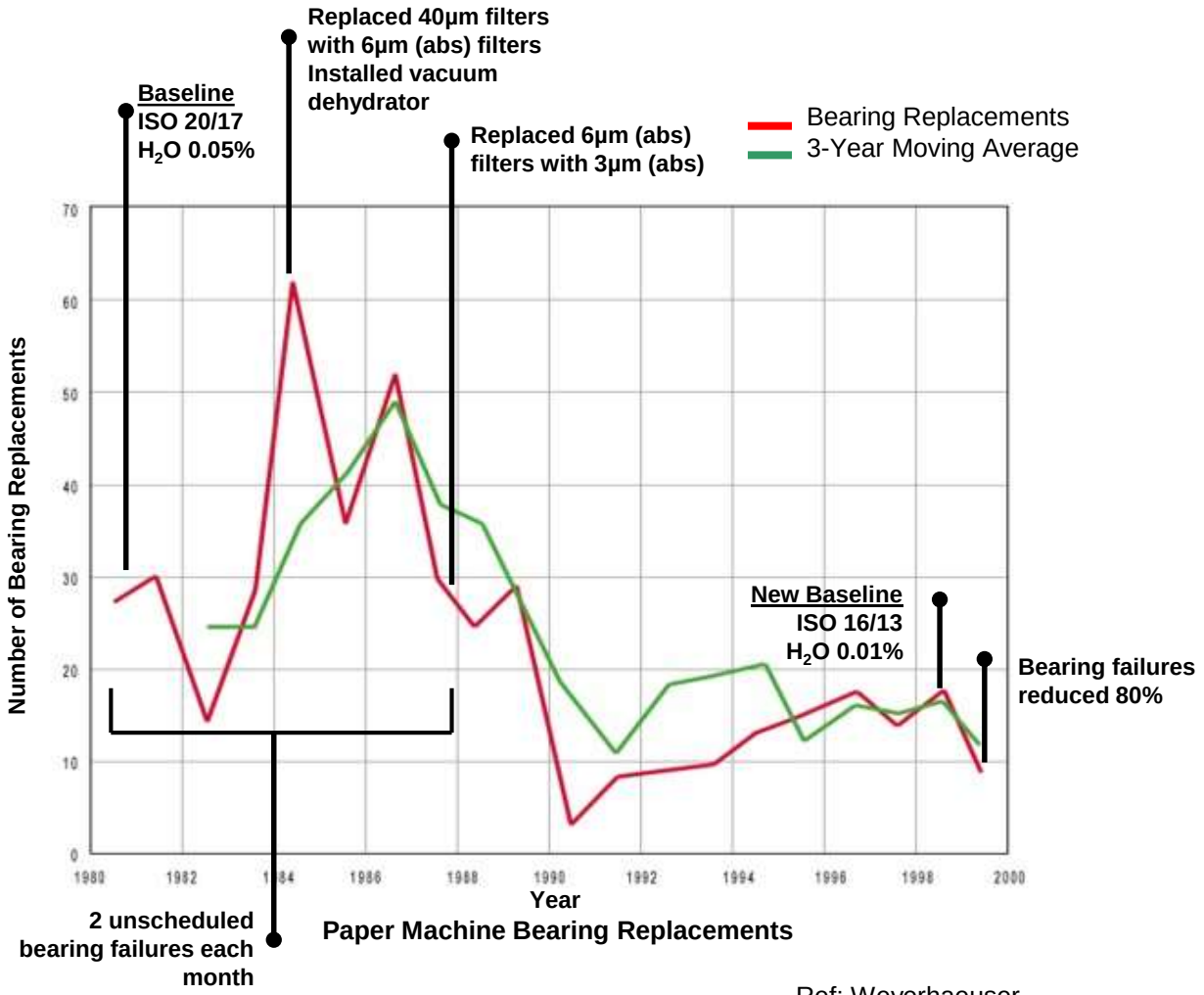
Ref: WearCheck

Contamination Control Case Study

Weyerhaeuser

Bearing Failure Study

- Acted upon SKF recommendations to reduce particle and water ingress
- Improved filtration and water removal systems reduced bearing failures by 80%



Ref: Weyerhaeuser

Path to World-Class Lubrication

How do we achieve
World-Class Lubrication?

Generate Awareness through
Training & Education

Build the Business Case for
World-Class Lubrication

Improve Lubricant
Storage, Handling & Dispensing

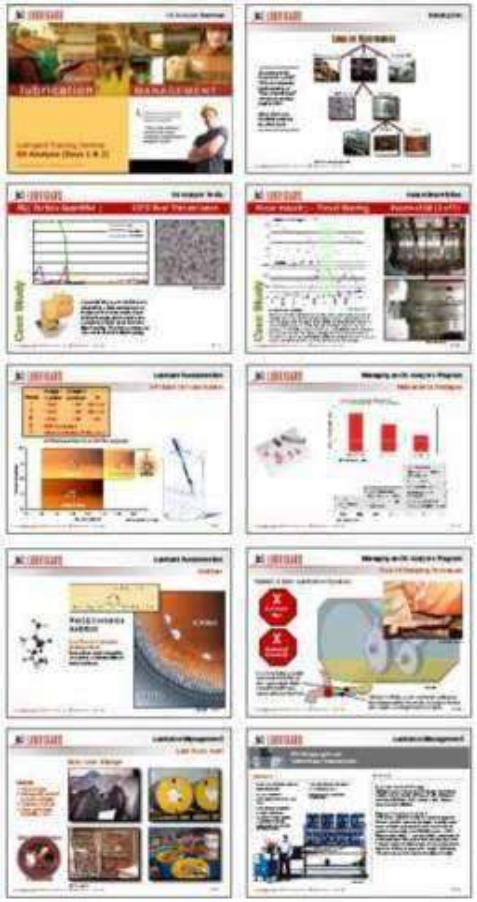
Start an
Oil Analysis Program

Plan & Implement
Machine Contamination Control

Move to
Condition-Based Maintenance

Training & **Education**

Education the Essential Component



If you are asking yourself these questions these seminars are for you

- ***I'm faced with limited resources and a reduced budget so how can I manage my maintenance program more efficiently?***
- ***Where does oil analysis fit into my maintenance program and how do I make the most from what oil analysis is telling me?***
- ***Our oil analysis program is uncovering problems, but what are the next steps that we need to take to correct them?***

OVERVIEW

Lubrigard offers a range of training seminars
from courses on Lubrication Management to Oil Analysis.

Training is key to change
When implementing changes to maintenance procedures and protocols it is important to shape a clear vision, and provide training to ensure that co-workers understand the reason for the change, and why change is important. Training will help co-workers understand how they will benefit from the changes in both the short and long term.

Training helps shape a clear vision
by showing what it will look like when it is done, how job functions and routines will be affected. Most importantly training can highlight what is exciting about accomplishing this change.

STLE Certifications

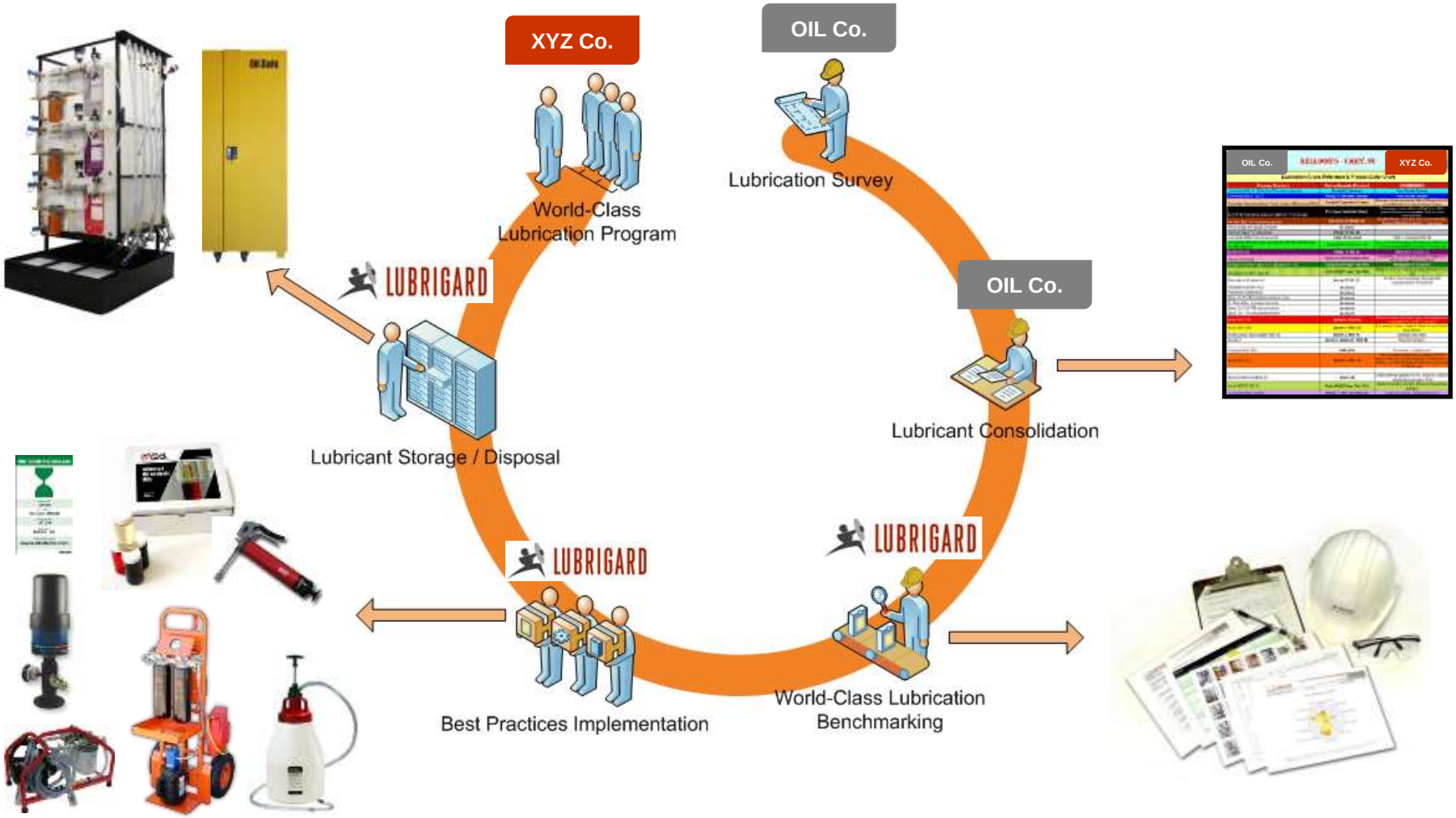
The value of STLE certification has been proven in the market place with increased income and immediate respect and credibility with buyers and peers. STLE offers three certifications, which are valid for three years and then must be renewed. These certifications are designed to be consistent with the standards of **The Institute for Credentialing Excellence**, ISO 17024, and also distinguish between a credible real professional and a “self-proclaimed” expert.

Certified Lubrication Specialist (CLS) is the only independent certification for the lubrication professional that verifies your broad lubrication engineering knowledge. Certification recognizes those individuals who possess current knowledge of lubrication fundamentals and best practices in lubrication maintenance in industrial settings. Certified individuals must have at least three years of experience in the field of lubrication.

Oil Monitoring Analyst (OMA) is the certification for the Predictive Maintenance Professional that demonstrates competence in the field of machinery oil monitoring. Oil monitoring in this context consists of sampling and analyzing the oil properties to assess whether the oil needs service and/or to assess the mechanical health of the equipment being monitored. There are two types of OMA certifications. OMA I is for the oil sampler, the individual on the shop floor with responsibility for sampling the oil and the overall care of the equipment. OMA II is for the oil analyzer, the individual in the laboratory responsible for properly running the appropriate tests, data interpretation, program management, and related activities.

Building the Business Case for
World-Class Lubrication

World-Class Lubrication – Overall Plan



Business Case Analysis

	Response	Calculated Value
Annual maintenance costs	**$17,500,000**	**$17,500,000**
Downtime Losses	**$600,000**	**$600,000**
Scheduled PM and Repair Costs	**60%**	**$10,860,000**
Amount spent on rotating/reciprocating equipment	**65%**	**$7,059,000**
Percentage of lubrication related problems	**30%**	**$2,117,700**
Percentage of lubrication problems that can be eliminated	**25%**	**$529,425**
Estimated Annual Losses Due to Poor Lubrication	**Estimate**	**$529,425**

Business Case Analysis

Financial Evaluation Case	Likely Case
Estimated Annual Losses due to Lubrication	$529,425
Lubrigard Purchases to improve lubrication	$94,900
Annual expenses (oil analysis, breathers, etc.)	$36,850

50% implemented | 75% implemented | 100% implemented

Year	0	1	2	3	4	5	
Program Benefits	$0	$264,713	$397,069	$529,425	$529,425	$529,425	
Program Costs – Upfront	$94,900	$0	$0	$0	$0	$0	
Program Costs - Ongoing	$0	$18,425	$27,638	$36,850	$36,850	$36,850	
Total Costs	$94,900	$18,425	$27,638	$36,850	$36,850	$36,850	
Net Cash Flow	-$94,900	$246,288	$369,431	$492,575	$492,575	$492,575	5 Yr NPV
Discounted Net Cash Flow (10% discount)	$-94,900	$223,898	$305,315	$370,079	$336,435	$305,850	$1,446,677
Internal Rate of Return (IRR)							263%

Lubricant
Storage

Bad Lubrication Bulk Storage Practices

- UNSAFE
- Filthy
- Disorganized
- Wasteful
- Destructive

Ref: Lubrigard

Bad Lubrication Carts

Issues

- Dirty carts
- Cluttered and unorganized

BAD LUBRICATION

PRACTICES

Ref: Lubrigard

Bad Bulk Oil Transfer Practices

Issues

- No oil filtration
- No air filtration

Ref: Lubrigard

Bad Lubrication Dispensing Practices

Issues

- Unsealed lube transfer containers
- Poorly identified
- Open and contaminated pails

Ref: Lubrigard

SORT 1

Throw away all rubbish and unrelated materials/documents in the workplace

SET IN ORDER 2

Set everything in proper place for quick retrieval and storage

SHINE 3

Clean the workplace; everyone should be a janitor

STANDARDIZE 4

Standardize the way of maintaining cleanliness

SUSTAIN 5

Practice '5S' daily - make it a way of life; this also mean commitment

World-Class Lubrication Storage

- Separate fluid handling for each product
- Filtration during filling and dispensing
- Ability to filter product while in storage
- Rated air breather to prevent re-contamination
- Color-coded / labelled to prevent cross-contamination

World-Class Lubrication Storage

- **Bulk tanks should be fitted with one filter that can serve for filling, recirculation and dispensing.**

World Class Lubrication Low Volume Lube Storage

- Sealed cabinets
- Rolling carts with drawers and utility cabinet
- Ample space for grease guns, containers, fittings, etc.

Carts & Cabinets

Essential Components for World-Class Lubrication Storage

Lubrication Carts

Lubrication carts are ideal for multiple top-up tasks and/or oil changes for small to medium reservoirs.

World-Class Bulk Transfer Practices

For large sumps the most efficient transfer method is directly from the tote using a suitable mobile filtration cart.

Oil Transfer From Bulk

World Class Oil Drum Transfer Practices

Essential Components for World-Class Lubrication Storage

Dispensing Containers

- Made of anti-static treated plastic
- Color-coded and/or marked for product type
- Sealable
- Variety of dispensing nozzle sizes, options (quick-connect, etc.)

Greasing

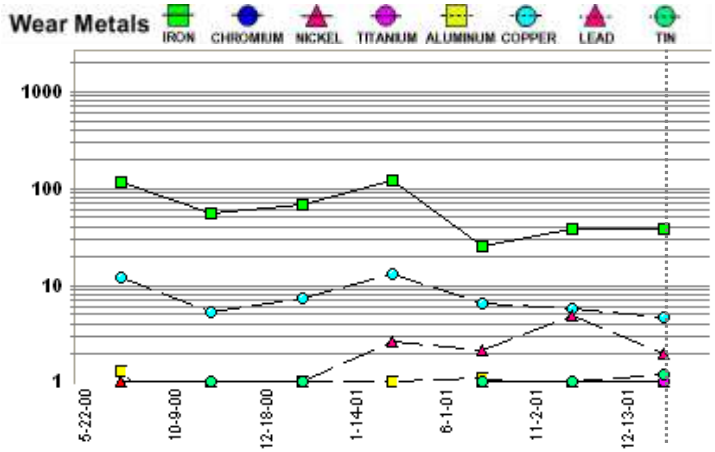
- Color-coded grease guns
- Color-coded grease caps
- Flow meters
- Acoustic greasing monitor

"Oil analysis has proven itself time and again to be an invaluable technology in industry's quest to bring longer and longer service life out of equipment"

Ray Thibault

Oil Analysis

Analytical Ferrography Case Study – Automotive Industry Gearbox



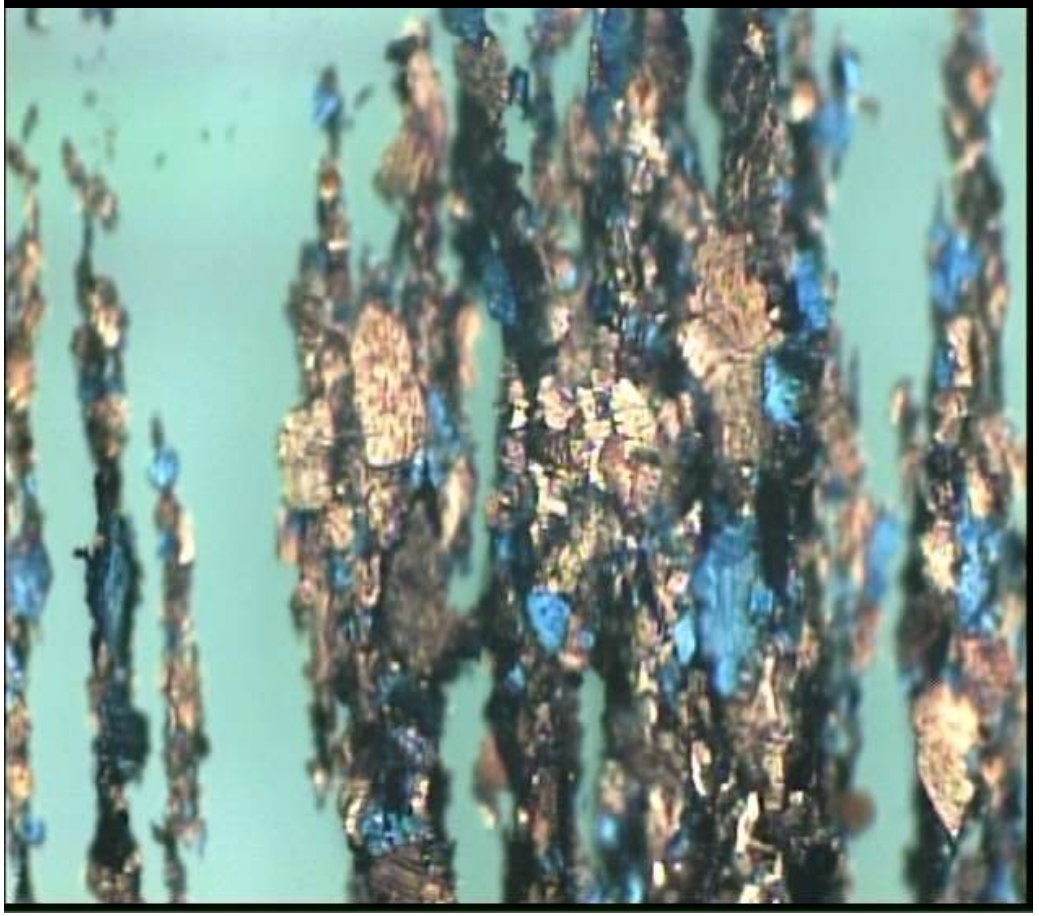
Cymonic Transfer Drive Gearbox #1

30 Ltr of Esso Spartan EP 220

Oil Analysis Findings & Recommendations

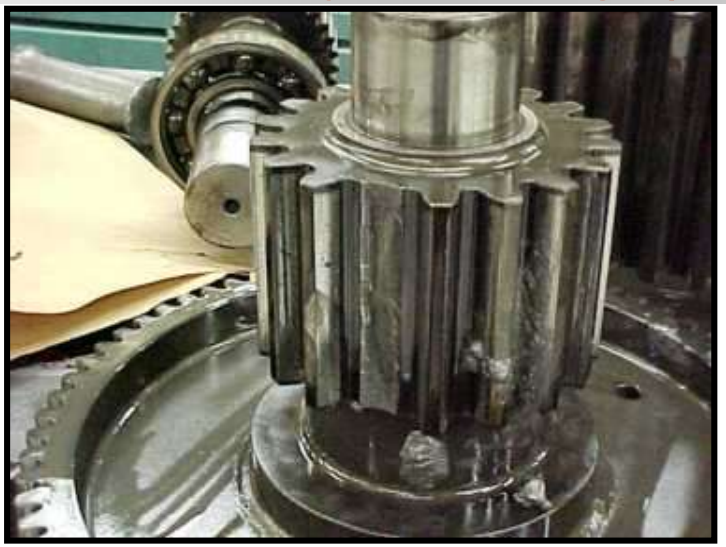
Abnormal gear wear particles continue to be observed. If, filtration has occurred since the previous sample suspect an abnormal wear mode is persistent. Otherwise consider filtration as soon as possible as ***a minimum of two gear sets are generating abnormal wear***. Analytical ferrography shows moderate amounts of ferrous rubbing wear with low and medium alloy steel gear wear particles. ***Several particles show signs of wear from gear pitch lines while other shows signs of gear tip damage*** (striations from damaged/broken tips). Confirming if filtration has occurred since last sample is essential in determining the options available. Either filtrations needs to be done soon or ***maintenance activities may be required in the near future to prevent significant equipment damage***.

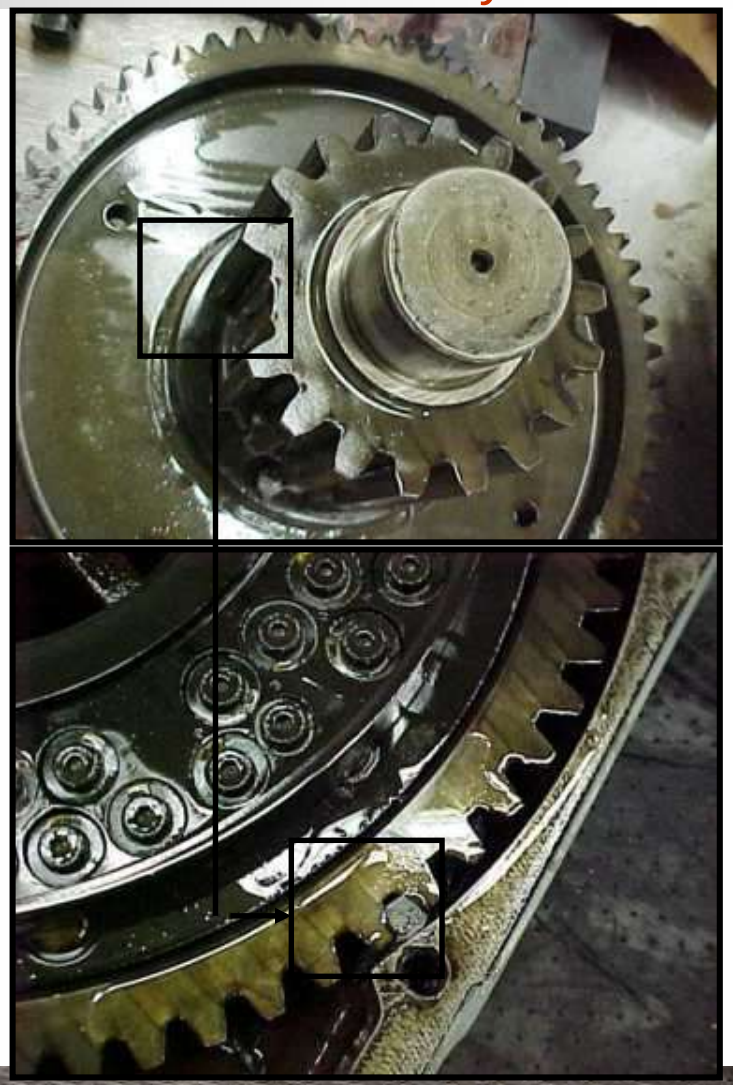
Analytical Ferrogram @ 500X magn. **Dec 13, 2001**



00917370

Analytical Ferrography Case Study – Automotive Industry Gearbox





Cymonic Transfer Drive Gearbox

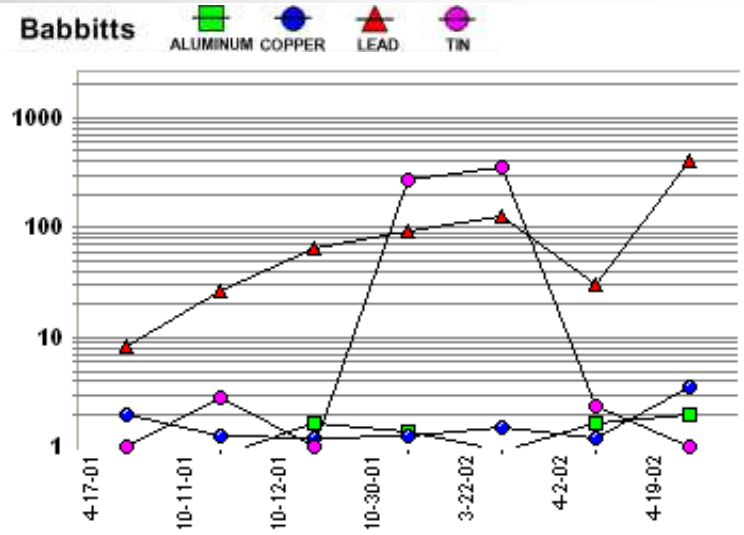
30 Ltr of Esso Spartan EP 220

Maintenance Findings

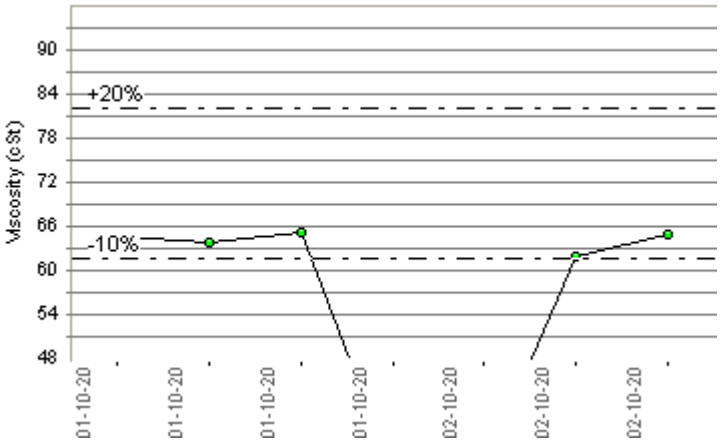
A planned replacement was scheduled for another gearbox in the plant based on service life. The oil analysis results were relayed by the oiler to the maintenance manager, however ***the recommendation was overlooked. Six months later the gearbox suffered a catastrophic failure. The plant was shut-down for 12 hours at a cost of $15 million***. Inspection of the failed unit by the OEM revealed that a gear tooth had broken off at the root and jammed into the opposing gear set.

Cost: $15,000,000

ICP/Viscosity Case Study – Hydroelectric Power Plant Thrust Bearing



Viscosity @ 40°C



Turbine Main Shaft Thrust Bearing

25 Ltr of Hydrosafe ISO 68

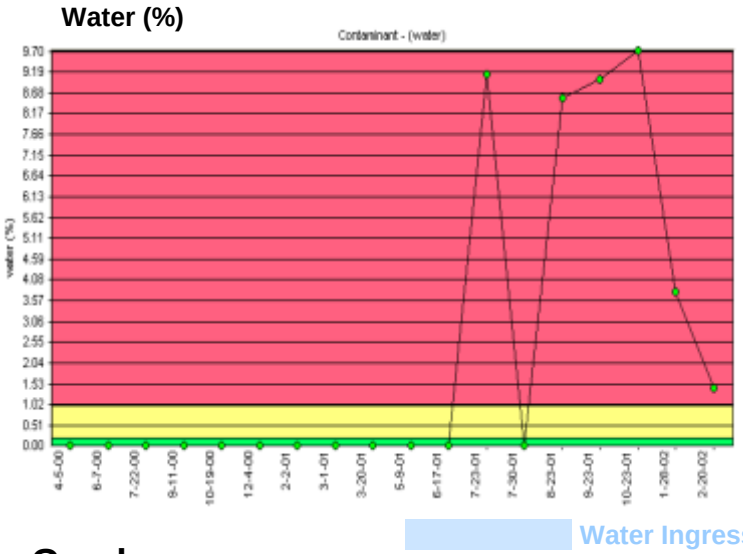
Oil Analysis Findings & Recommendations

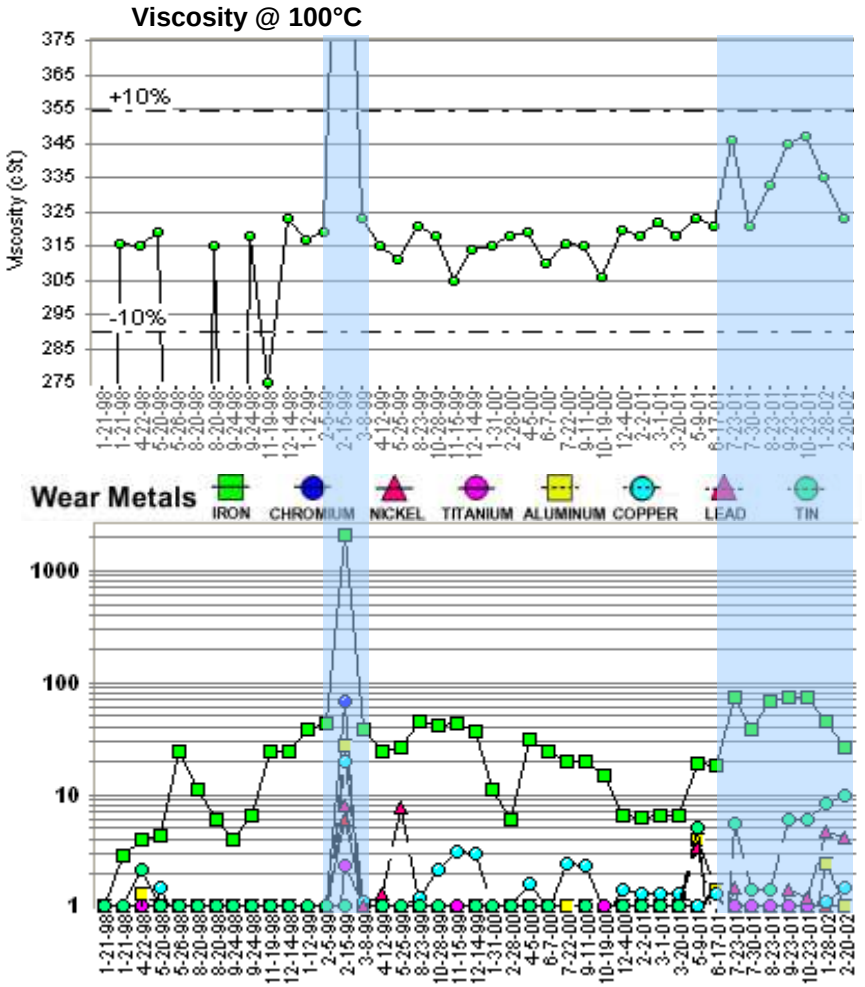
ICP and physical tests showed that although the ***additive, TAN and viscosity levels remained normal***, the lead level jumped to over 400 ppm and the tin level dropped to 0 ppm. Indications are that ***severe babbitt flaking is occurring*** .

The lead level is abnormal. Analytical ferrography indicates minimal solid particles. ***Lead is suspected of being leached from lead contact surfaces***. This type of erosion over a long period of time can totally remove the bearing surface. ***We recommend that you change the oil. We advise that you inspect for the source(s) of wear***.

00963394

Karl Fischer Case Study – Polyolefins Plant Gearbox





Gearbox

3476 Liters of Shell Omala 320

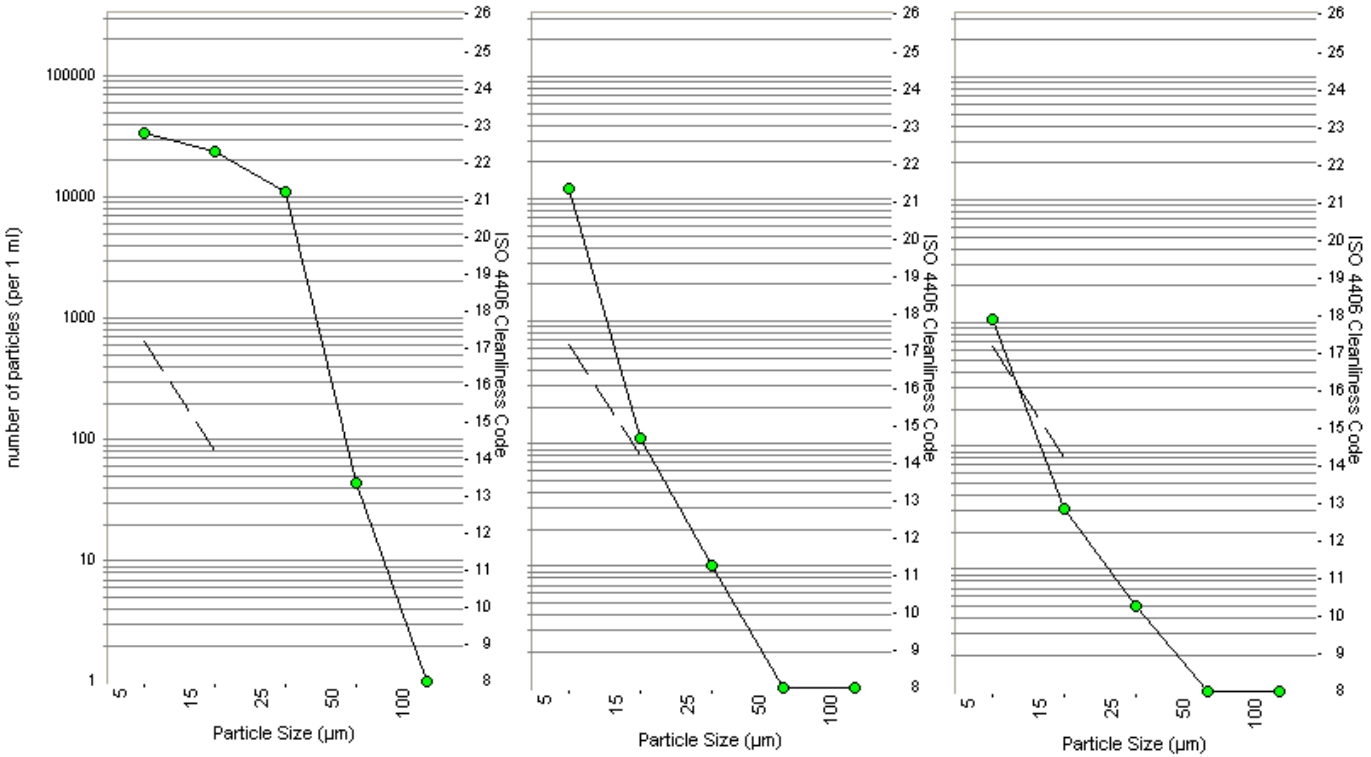
Oil Analysis Findings & Recommendations

We advise that you ***check for the source of water entry***. NOTE: Test values may be askew due high concentration of free water present in sample. We advise that you ***follow the water drain-off procedure for this component***, and use off-line filtration to improve the cleanliness of the system fluid.

Findings: A steam leak by gearbox allowed water to condense and contaminate the oil. The oil was changed as this oil is not conducive to draining off water.

00930470

Particle Count Case Study – Pulp Mill Hydraulic System



Maintenance Findings

This hydraulic unit has 2 Vickers PNB-20-rsfw-20-c-11 pumps that operate 4 cylinders, one pump is always running and the other is a spare.

The sample reports indicated a steady raise in particle counts. A work order was put in to change the oil filters, ***while changing the filters it was discovered that the filters were clogged*** and debris present in the filter housings.

Another work order was put check out the ***indicator lights*** on the panel for the filters. It was found that these ***were not working properly*** and the indicators were repaired. As a result of this, ***additional PM's have been implemented*** to do the following

1. A timed change out of the oil filters (Pall HC 9650FU8H elements) every 2 months
2. A 12 month inspection and clean of the reservoir on the annual shutdown.

00996245

It's a 'proven fact' that

75% to 80%

of all hydraulic machinery failures can be traced to contamination in hydraulic fluids

Thelma Marougy- Eaton Corp.

Machine
Contamination Control

Low Quality Breathers

Issues

- Unsealed breathers
- No filter rating
- No desiccant
- Missing altogether

BAD LUBRICATION

PRACTICES

High Quality Breathers

- Low-cost Replaceable
- Rated air filtration
- Desiccant water removal
- Integrates with lubrication ports
- Color-indicator

World-Class Drain Ports

- Quick-connect filter cart return connection
- Oil level guage
- Integrated oil sampling hardware

Lubricant Identification Tags

- Durable, color-coded ID tags
- Applied to all fill-ports, storage tanks, dispensing containers, and grease guns.

Portable Filtration Systems

1 Drum Filterpak

Compact, portable and customized, for your application, the Lubrigard Drum Filterpak is an option you can carry wherever you need to go.

2 Filter Cart

Off-line filtration units effectively filter fluids used in hydraulic and lube oil systems. Filter Carts provide large filtration surface area for maximum efficiency. By removing dirt and moisture, your equipment and lubricants can run longer and harder.

3 Top Off Tank Kit

Converts a standard filter cart to an all-in-one tank top-off unit.

4 Drum Filter Cart

The drum filter cart is a customizable, all-in-one cart that filters and transfers oil from a conveniently attachable, secured drum.

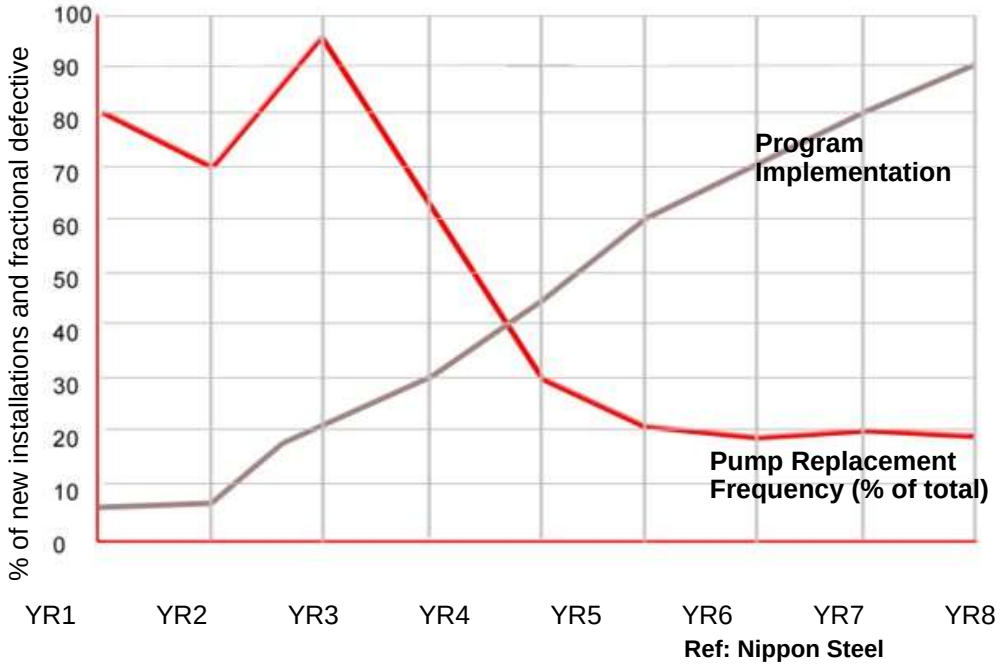
5 Heavy Duty Filter Cart

Heavy-duty, industrial style with bolt-down lids and heavy gauge cylinder walls. These canisters can accept various size high-capacity micro-glass, depth, water removal and molecular sieve elements and can be changed very easily.

6 Vacuum De-Hydration Cart

The Lubrigard Vacuum Dehydrator is a single utility system requiring electric service only, no a chilled water supply. The system view windows enables an operator to observe system operation and performance during operation. conventional vacuum pumps.

Case Study – Steel Mill Hydraulics



Ref: Nippon Steel

Action Plan

- Cleanliness Targets
- Sampling ports
- Improved filters & breathers
- Onsite particle counts

Achievements

- 75% reductions in oil consumption
- 80% reduction in hydraulic repairs

ROI on a Gearbox Program

GEARBOX PROGRAM	Gearbox Facts	50 Gearboxes
Gearbox Capacity	50 Litres	2,500 Litres
Price of Gear Oil	$5 / Litre = $250 per Gearbox	$12,500
Cost of Replacement	$80,000 per Gearbox	$4,000,000
Cost of Down-time	$800 / hr = (typical 30 hrs) $24,000	
Cost of Hardware	$285 (one time)	$14,250
Cost of Oil Sampling	$180/year	$9,000/year
Current Oil Drain Interval	1 year	1 year
Proposed Drain Interval	5 years ($1000) savings	$50,000
Failure Rate Reduction	10% failure reduction rate	($220,000 / 10) = $22,000 / yr
	Cost of Program over 20 years	**$194,250**
	Cost Savings over 20 years	**$640,000**
	Program Payback (ROI)	**7 months**

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