OEI MAGNETIC FILTRATION – CONTAMINATION ANALYSIS CASES

ONE EYE INDUSTRIES

SOLVING TOMORROW'S CHALLENGES, TODAY.

ONE EYE INDUSTRIES

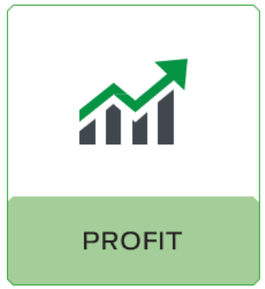
OUR MISSION

To be the trusted partner for
industrial machinery operators around the world.

WHY OUR CUSTOMERS CHOOSE US

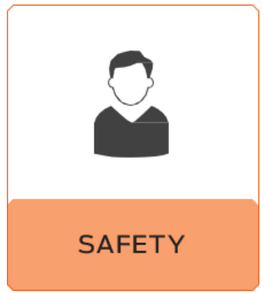
OEI Magnetic Filtration is the simplest way to achieve rapid payback with the lowest risk by extending the life of rotating equipment. As a result, safety is improved while substantially reducing costs and environmental impact of operations.

WHY OEI



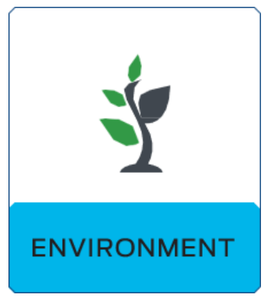
RELIABLE EQUIPMENT MEANS INCREASED PROFITABILITY

OEI designs and manufactures reusable magnetic filtration systems as the sustainable alternative to conventional filters, each filter is optimized for its application and exceeds fluid-cleanliness standards. This helps to prevent failure, reduce unplanned maintenance, and minimize downtime. The initial cost of an OEI product is quickly realized in the continued savings the product brings to any reliability program.



REDUCE UNPLANNED MAINTENANCE AND INCREASE THE SAFETY OF YOUR TEAM

Optimal fluid cleanliness extends life of critical systems preventing component, system and ultimately equipment failure and replacement. Preventing unplanned maintenance and extending service intervals results in reduced travel to and from sites, exposure to elements, treatment of toxic materials and the opportunity for injury. This allows for extended service intervals and a reduction in labour intensive maintenance.



CLEAN INSTEAD OF DISPOSE AND PROTECT OUR ENVIRONMENT

With a product life of 18+ years, OEI technology helps to reduce your environmental footprint. Each filter is cleanable, requires minimal consumables and operates without the use of utilities. Reusable components reduce the costs associated with the disposal and replacement of conventional filters, fluids and components.

SERVING INDUSTRIES AROUND THE WORLD

OIL & GAS
WELL STIMULATION

OIL & GAS
FACILITY

POWER
GENERATION

DEFENCE

MINING

TRANSPORTATION

PULP & PAPER

FOOD
PROCESSING

BUILDING
OPERATIONS

MANUFACTURING

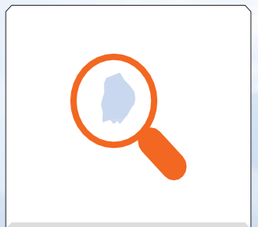
RENEWABLE ENERGY

MUNICIPALITY

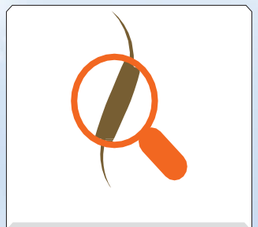
The most damaging contaminants in any system are wear particles under 4 microns.

The primary sources of fluid contamination:

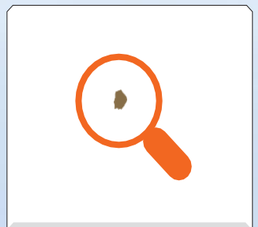
- The formations where the oil was produced
- The machining and manufacturing processes of system components
- Air intake and
- Initial break-in of equipment.



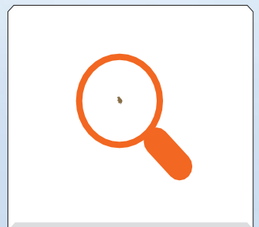
GRAIN OF SALT
~ 100 µ



HAIR FOLLICLE
~ 80 µ



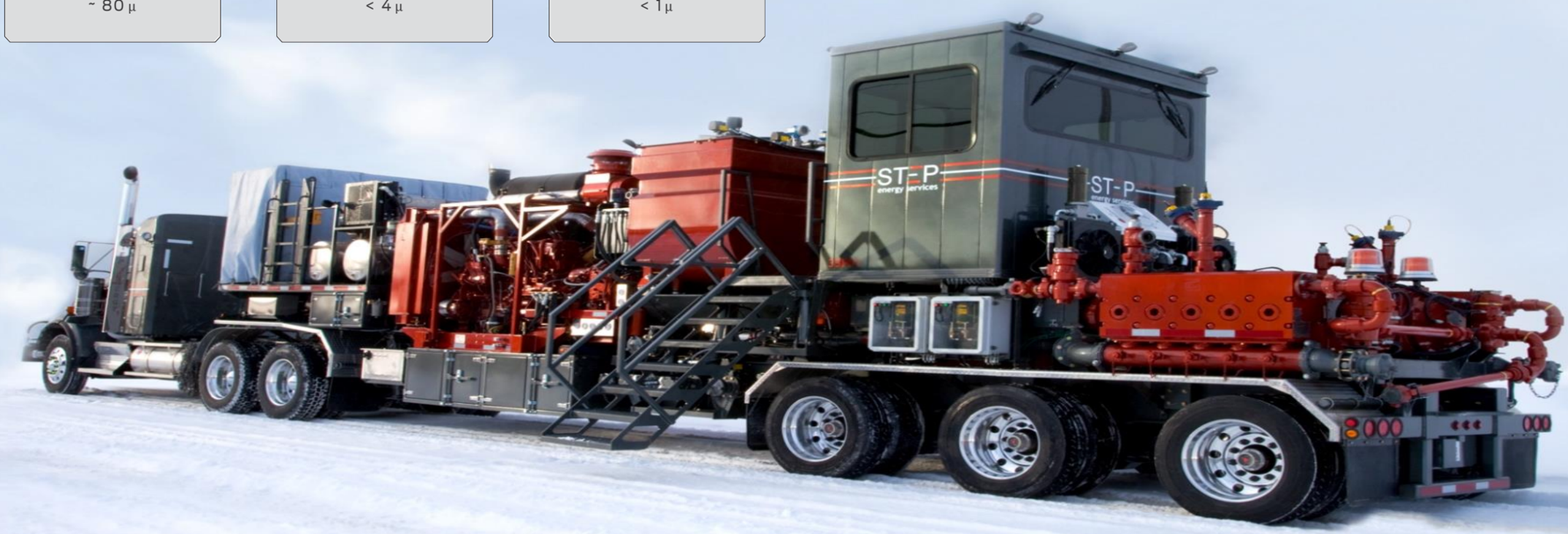
WEAR PARTICLE
< 4 µ



MOST HARMFUL
< 1 µ

Of mechanical wear
is due to wear contamination

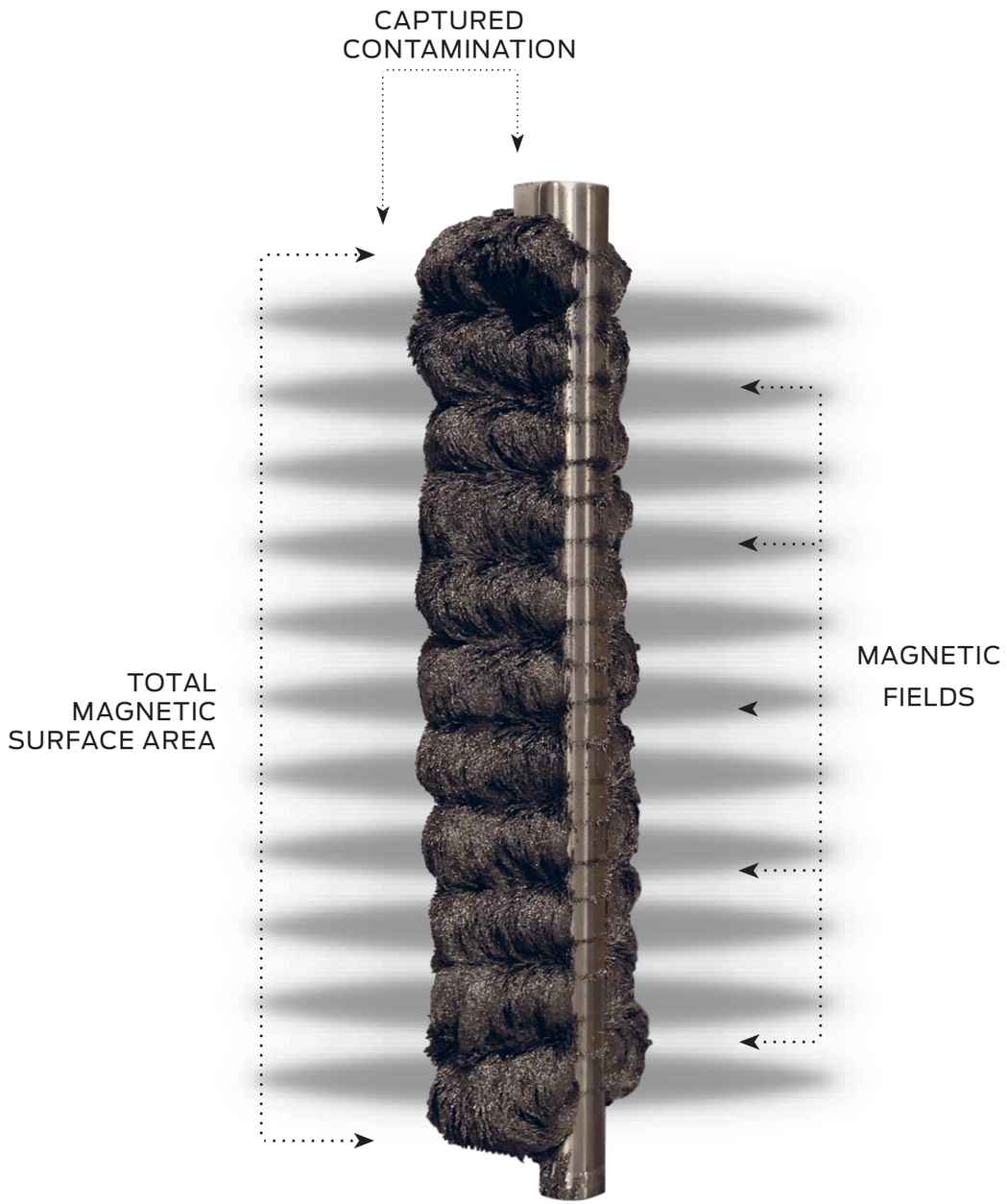
ISOCLEAN CERTIFIED LUBRICANTS



CORE TECHNOLOGY

The patented, magnetic filter element attract ferrous wear particles down to and below 4 microns (μ) with up to 95%+ efficiency. The magnetic filter element attracts both ferrous and non-ferrous particles. The radial magnetic field design offers incredible holding strength, and a high dirt holding capacity*.

- Clean And Reuse
- Minimal Flow Restriction
- Continuous Filtration in Bypass
- Predictive Maintenance
- No Installation Restrictions
- Captures Non-ferrous Contamination
- Prevents Oxidization & Varnish
- No Worm Holing & Channeling



OEI PRODUCTS

SCRUBBER SERIES

Magnetic Filter Scrubbers employ a magnetic filter element in a specialty housing that ensures maximum dwell time for high efficiency filtration.

ADD-VANTAGE 9000 SERIES

The ADD-Vantage 9000 magnetic filtration system employs a magnetic filter element and a stainless-steel cloth element in its design for high efficiency filtration and replaces conventional spin-on cartridge filters.

Y-STRAINER SERIES

Magnetic Y-Strainers employ a magnetic filter element as a replacement of conventional y-strainers. Designs with and without a screen are available.

KIDNEY LOOP SYSTEMS

OEI Kidney Loop Systems are self-contained filtration units with multiple magnetic filters for off-line filtration, fluid transfer of mobile or stationary equipment, and flushing of storage reservoirs..

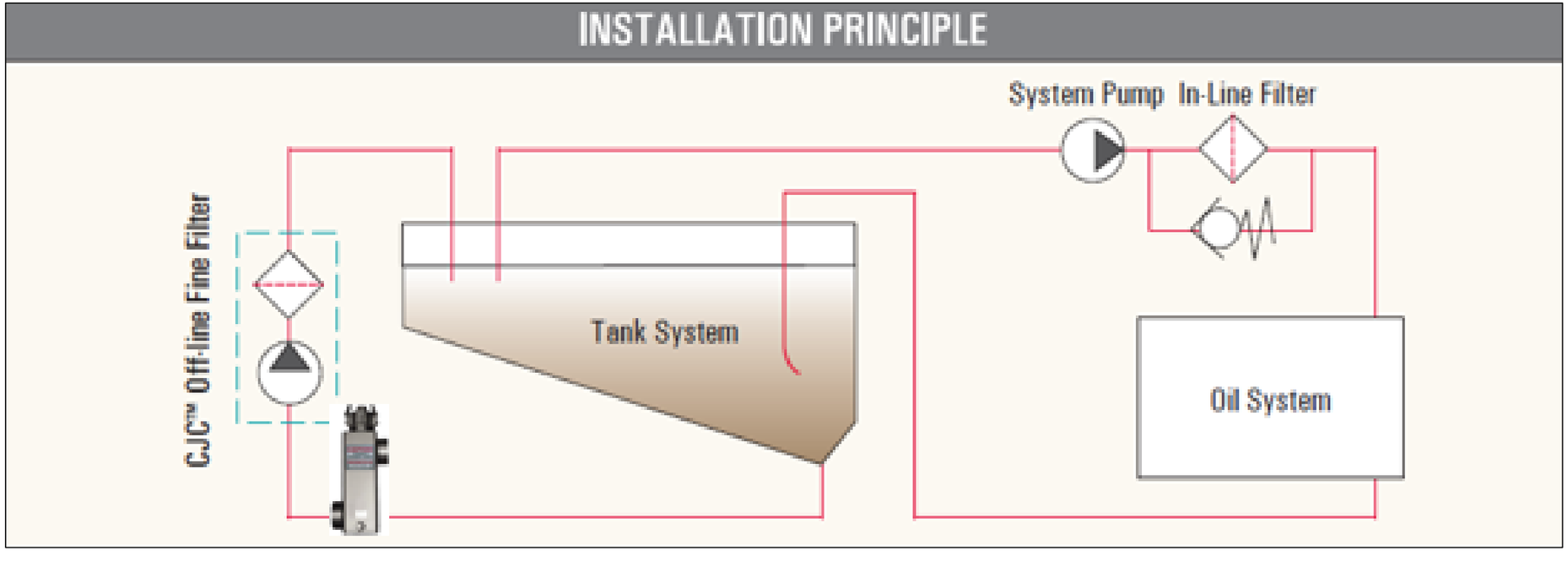
MILL LUBRICATION SYSTEM TEST

Base Case

- High failure rate of lube system components – very short MTBF
- Root Cause Analysis showed failure through abrasive wear caused by high levels of contamination.

Solution

- Offline filtration system designed and installed using depth filtration technology, complimented by a One Eye Industries magnetic scrubber



MILL LUBRICATION SYSTEM TEST

The ISO reading on the baseline sample was 23/22/19, taken on 24 January 2018.

After 7 days on 31 January, the third sample was taken, which produced an ISO reading of 19/18/14.

The following sample taken on 13 February produced an ISO reading of 20/17/14. This result was achieved in a 3 week timeframe.

Particle Count Cleanliness / ISO 4406:99

Sample Number	ISO4	ISO6	ISO14	>4µm	>5µm	>6µm	>14µm	>15µm	>25µm	>50µm	>75µm
483203	20	17	14	5474	2245	1185	118	105	59	29	15
481018	19	18	14	3245	1954	1320	120	95	38	23	20
480174	21	19	16	12107	6139	3684	519	454	170	61	35
480173	23	22	19	60368	41335	26633	4026	3600	1382	23	1

ISO4406(1999) Classification of number of particles >4µ / >6µ / <14µ in size/ml >4µ/>5µ/>6µ/>14µ/>15µ/>25µ/>50µ/>75µ - actual raw counts of particles greater than 4/5/6/14/15/25/50/75 micron in size per ml

This represents a ***minimum ISO code reduction of 5 codes***, which means *the oil is 32 times cleaner** than the baseline sample in the >6 and >14 micron size ranges.

This also represents the following;

- 91% reduction in particles over 4 micron
- 95% reduction in particles over 6 micron
- 97% reduction in particles over 14 micron

MILL LUBRICATION SYSTEM TEST

The purpose of the magnet is three-fold;

- to capture and trap the contaminants,
- to protect the offline filter pump and extend the life of the filter inserts,
- to act as a condition monitoring tool - The debris can be extracted from the magnetic rod and analysed in the lab.

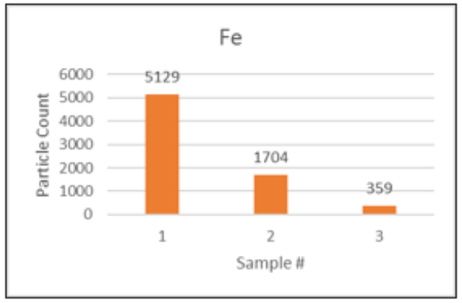
- Contamination captured after 24 hours on the OEI magnetic filter elements

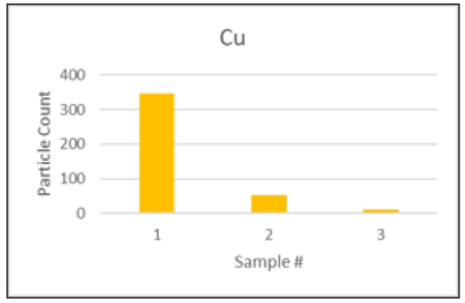
- Photos taken after 5 days on the same rods showing contamination that was trapped, indicating that a significant amount of contamination has been removed from the lubrication system.

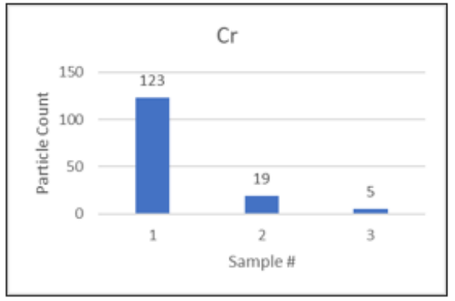
MILL LUBRICATION SYSTEM TEST

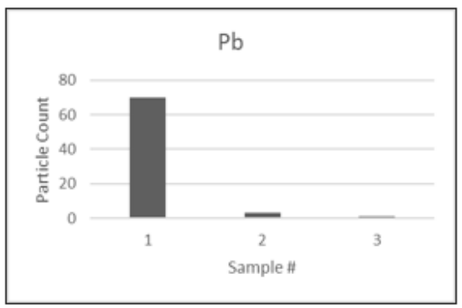
The table indicates PQ Index and spectrographic elemental analysis of the wear metals and contaminants (in parts per million) that were taken from the OEI magnetic rod and analysed in the laboratory.

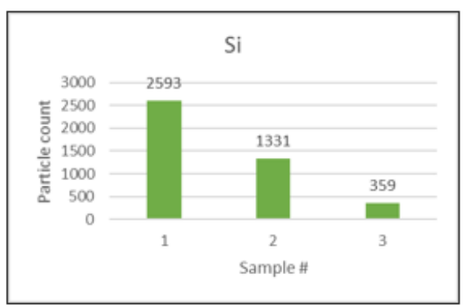
PQ / Spectrometer / Wear Metals and Additives										
Sample Number	PQ	Fe	Al	Cr	Pb	Cu	Sn	Ni	Ag	Si
483204	1086	359	54	5	1	11	0	10	0	359
481019	1000	1704	168	19	3	52	0	37	0	1331
480175	1000	5129	750	123	70	347	0	258	0	2593

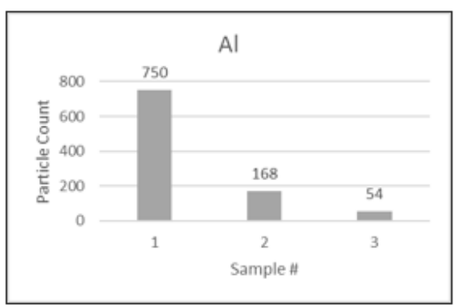












MILL LUBRICATION SYSTEM TEST

- Improved reliability - MTBF doubled from 2,3 to 4,6 months
- Cash savings of US$200k pa (one mill)
- Reduction in consumables of US$10k pa
- 75% reduction in oil costs
- And most importantly – lower residual safety risk due to less maintenance

DIESEL FUEL CONTAMINATION ANALYSIS

- 15 day trial of a duplex magnetic scrubber on a new ULSD 2 diesel fuel pumping station.

- 24” Duplex Magnetic Filter Scrubber
- 2, 1” OD Magnetic Filter Elements
- 360,000 L of diesel fuel pumped over 15 days
- Flow rate of 80 L/min
- Multiple patch tests ran to determine efficiency of OEI magnetic technology

DIESEL FUEL CONTAMINATION ANALYSIS

- Millipore test results:
  - 12.5-micron particles to 0.1-micron particles

EXTENDING MAINTENANCE INTERVALS

EQUIPMENT

New-Build Well Stimulation Pumper (A)

APPLICATIONS

- 3152C CAT Engine
- TH55-E70 CAT Transmission
- FMC WQ2700 Quintuplex Pump

CHALLENGE

Prevent the wear contamination that is inherent in new fluids, and produced during parts manufacturing and break-in operation from causing premature component failure and unscheduled downtime.

SOLUTIONS

Outfit all fluid applications with OEI Magnetic Filtration.

RESULTS

The photos show the contamination collected from multiple applications after 300 hours of operation.

Planned maintenance intervals were extended from 250 hours to 600 hours.

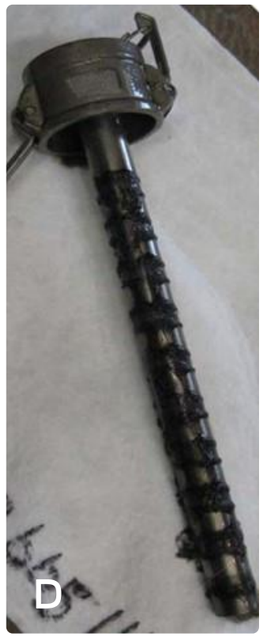
	MAGNETIC FILTER	PHOTO RESULT
ENGINE OIL	ADD-Vantage 9000	B
SUMP PUMP LUBE OIL	Mounted Magnetic Element	C
QUINTUPLEX PUMP LUBE OIL	Magnetic Scrubber	D
COOLANT	Magnetic Y-Strainer	E
FUEL	ADD-Vantage 9000	F

ROI

PROFIT

PM Periods Extended

300 Hours To 600 Hours



Case Study

EQUIPMENT

Twin Pumper

APPLICATIONS

Gearbox

CHALLENGE

Determine the value of gearbox preventative maintenance.

SOLUTIONS

Operate 2 Twin Pumpers for 6 years,

one with a gearbox reliability package employing OEI technology capable of filtering wear contamination < 1 μ,

and one without; compare the operating costs.

RESULTS

GEARBOX OPERATING COSTS OVER 6 YEARS			
	COST/HOUR	COST/YEAR	TOTAL COST
STAND-ALONE	$5.87	$8,722.25	$52,333.53
RELIABILITY PACKAGE	$2.03	$3,125.00	**$18,750.00**
RELIABILITY PACKAGE SAVINGS: $33,583.53			

ROI

PROFIT

GEARBOX

PREVENTATIVE MAINTENANCE

6 YEARS: $33,583.53

EXTENDING HYDRAULIC PUMP OPERATING LIFE

EQUIPMENT

Drill Rig

APPLICATIONS

Closed Loop Hydraulic System on 35 Top Drives

CHALLENGE

Design a bi-directional, high-pressure filtration system capable of handling
300 gpm to prevent pump damage from wear contamination produced by the motor.

The Parker P14/P16 pumps were failing due to wear contamination every 2-3 months at a cost of $35,000/set ($168,000 annually).

SOLUTIONS

Deploy 2 OEI High-Pressure Magnetic Scrubbers on each Drill Rig.

RESULTS

After installing OEI filtration, the Parker pump change-out intervals extended from every 2-3 months to every 3 years equating to $504,000 in savings.

These savings do not account for reduced downtime, production and labour requirements.

ROI

PROFIT

HIGH-PRESSURE PUMP PROTECTION

$504,000 in 2.5 Months

DESIGN PARAMETERS	
• >1 µ FILTRATION	• SUCTION FILTRATION
• BI-DIRECTIONAL FLOW	• CLOSED-LOOP SYSTEM
• HIGH PRESSURE	• NO HORSEPOWER REQUIREMENTS

CAPTURING NON-FERROUS CONTAMINATION

EQUIPMENT

Frac Truck

APPLICATIONS

Turbo Coolant System

CHALLENGE

Improve the quality of coolant oil in order to prevent premature wear of seals and pumps, and improve its ability to cool and lubricate the turbo charger.

SOLUTIONS

Install a magnetic y-strainer in the coolant circuit.

RESULTS

The top photo shows contamination captured after 11 hours of operation.

Because of static adhesion and entrapped ferrous material, high quantities of non-ferrous and water particles were captured on the magnetic element.

Analysis

- 32% Silica
- 59% Ferrous Material

Contamination Particle Sizes

< 1 - 40 µ

ROI

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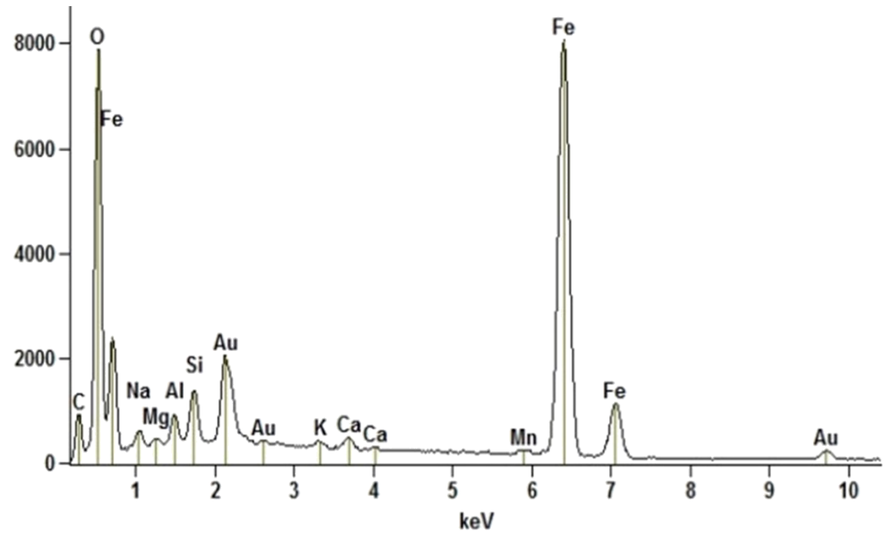
TURBO-CHARGER
OPERATING LIFE EXTENDED

2 - 3 x



PREVENTING COMPONENT FAILURE

EQUIPMENT

930E HAUL TRUCK

APPLICATIONS

Wheel Motor

CHALLENGE

Find a more effective predictive maintenance tool than OEM ceramic-magnetic plugs to monitor and identify premature wear of the haul truck wheel motors.

SOLUTIONS

Test the efficiency of OEI magnetic technology against OEM magnetic technology.

On one of the wheel motors, install 1 OEI Magnetic Filter Plug alongside 7 OEM plugs to evaluate and compare their capability of capturing wear contamination.

RESULTS

Before the test was completed, the wheel motor had a catastrophic failure.

When the magnetic plugs were removed at the rebuild shop, only the OEI Magnetic Filter Plug showed signs that a bolt had broken off causing severe damage and catastrophic failure.

If OEI Magnetic Filter Plugs had been in service and monitored as part of a predictive maintenance plan, this failure could have been prevented.

ROI

PROFIT

PM Periods Extended

300 Hours To 600 Hours

OEM MAGNETIC PLUG

OEI MAGNETIC FILTER PLUG

CHALLENGING ISO FLUID STANDARDS

EQUIPMENT

550 Komatsu Shovel

APPLICATIONS

Hydraulics operating at 4500 PSI with 6000 L of hydraulic fluid at an ISO rating of 25/24/16

CHALLENGE

In a limited kidney-loop interval of 3 hours, improve the Komatsu Shovel's hydraulic fluid ISO rating 25/24/16 to the standard 18/16/13.

SOLUTIONS

Run an OEI Kidney Loop System on a 3 hour trial.

RESULTS

Fluid samples were taken before and after the trial then sent to 3 independent labs.

Common results showed that OEI exceeded ISO standards and cleaned the hydraulic fluid to 17/14/10.

Contamination Analysis

88% ferrous contamination

12% non-ferrous (carbon and calcium)

ROI

PROFIT

EQUIPMENT FAILURE PREVENTED

ISO LOWERED FROM:

25/24/16 TO 17/14/10 IN 3 HOURS.

EXTENDING ENGINE OPERATING LIFE

EQUIPMENT

Kress Coal Haul Truck

APPLICATIONS

CAT 3508 Engine

CHALLENGE

Extend the life of a Kress Coal Haul Truck's 3508 CAT Engine that was diagnosed for rebuild at 13,000 hours because an oil analysis showed high levels of contamination: particle quantifier (PQ) 12.

SOLUTIONS

Install an OEI ADD-Vantage 9000 magnetic filter (200 Beta efficiency rating) alongside two conventional CAT filters.

RESULTS

The oil analysis on the next planned maintenance (PM) interval identified the PQ of < 1.

With OEI filtration, the haul truck remained in service, and the CAT 3508 engine lasted an additional 17,200 hours before a glycol leak contaminated the oil and seized the engine.

The maintenance intervals extended first to 350 hours, then to 500 hours.

The extended maintenance intervals recovered the cost of the ADD-Vantage 9000 filter within 250 hours of operation.

ROI

PROFIT

ENGINE REBUILD PREVENTION

$251,760 USD

Unit Number	TKD6498
Location	BLACKWATER MINE
Make	KRESS
Model	CH200C
Serial Number	HBB-M079
Compartment	engine-primary
Oil Brand/Type	BP MINE MULTI 15W40
Oil Changed	Y

Lab Control Number 02925708
Current Evaluation A

CURRENT EVAL: A
DAYS TAKEN TO REACH LABORATORY: 3

DATE TAKEN	DATE REC'D	OIL ADDED	METER HRS/KM	HRS/KM ON OIL
21-01-08	23-01-08		13980	534

Wear Levels in the 5 Micron Range appear OK. Viscosity Normal for Oil Type Indicated. Infra-red analysis INVALID with oil on record at laboratory. Please supply sample of new oil to update our records. Continue Sampling at the Recommended Interval.

PREVIOUS #1 EVAL: A

DATE TAKEN	DATE REC'D	OIL ADDED	METER HRS/KM	HRS/KM ON OIL
10-12-07	12-12-07		13446	508

Wear Levels in the 5 Micron Range appear OK. InfraRed Analysis appears acceptable for Hrs/Kms. Viscosity Normal for Oil Type Indicated. All other Test Results appear Acceptable. Continue Samplingat the Recommended Interval.

PREVIOUS #2 EVAL: B

DATE TAKEN	DATE REC'D	OIL ADDED	METER HRS/KM	HRS/KM ON OIL
27-11-07	29-11-07			350

Iron is HIGH for the Hrs/Kms on the Oil, Lead isIncreasing, Oxidation is HIGH, Oxidation resultcan be from Overheating/Blow By. Viscosity Normal for Oil Type Indicated. Investigate and Evaluate Compartment Condition. These results may be dueto an Extended Oil Change period. REDUCE the OilChange Interval. Resample at 250 hours.

PREVIOUS #3 EVAL: A

DATE TAKEN	DATE REC'D	OIL ADDED	METER HRS/KM	HRS/KM ON OIL
23-11-07	26-11-07		13186	248

Wear Levels in the 5 Micron Range appear OK. InfraRed Analysis appears acceptable for Hrs/Kms. Viscosity Normal for Oil Type Indicated. All other Test Results appear Acceptable. Continue Samplingat the Recommended Interval.

ELEMENTS:- Concentration in ppm (weight/weight) — Wear metals | Additives | FLUID CONDITION/CONTAMINANTS

DATE TAKEN	Cu	Fe	Cr	Pb	Al	Si	Sn	Ni	Na	K	Ca	Mg	Zn	P	W	F	ST	OXI	SUL	PQ	VSC	DEP	V100	Mo
210108	2	19	<1	2	1	3	<1	<1	3	3	2486	8	1188	1076	0.1	<3.0	41			<1	111	OK	14	<1
101207	2	19	<1	2	2	4	<1	<1	3	4	2214	7	1077	933	0.1	<3.0	35	27	34	1	110	OK	13	1
271107	9	46	<1	5	7	15	<1	<1	4	2	2611	9	1233	1091	0.1	<3.0	59	41	49	2	110	OK	15	2
231107	6	32	<1	3	6	12	<1	<1	3	2	2330	8	1116	958	<0.1	<3.0	40	23	37	<1	111	OK	15	2
081107	3	21	<1	<1	3	7	<1	<1	3	1	2333	8	1088	988	0.1	<3.0	20	17	26	<1	106	OK	14	1
031107	12	90	2	4	8	19	<1	<1	5	2	2650	9	1155	1000	0.1	<3.0	64			12	106	OK	14	3

ONE EYE INDUSTRIES

SOLVING TOMORROW'S CHALLENGES, TODAY.