CASE STUDY

CUSTOMER
WEST FRASER / JULY 2023

LOCATION
SMITHERS, BRITISH COLUMBIA, CANADA

EQUIPMENT
LETOURNEAU 65-TON STACKER

APPLICATION
ENGINE OIL AND DIESEL FUEL FILTRATION

ROI: IN 3 MONTHS

SAVINGS: $23,000 UNIT/PER YEAR

EMISSIONS: 8% reduction of fuel consumption results in 18,000L UNSPENT DIESEL = 48,258 kg of CO2

"I am amazed at how rapidly the efficiency gains were realized on our equipment. An 8% decrease in fuel consumption annually is a significant cost savings when applied to an entire fleet. Decreased fuel consumption results in reduced emissions". **Glen Cullen - Shop Manager, West Fraser**

CHALLENGE

Enhance the overall efficiency of their Letourneau 65 ton stacker. One eye Industries (OEI) was contacted to improve filtration efficiency by cleaning wear contamination down to and below 1 micron in size from the engine oil and fuel. The goal was to ensure the engine oil and diesel fuel achieved the highest cleanliness value possible to allow extended oil and engine component life and reduce emissions.

Picture 1: Letourneau 65 ton stacker

SOLUTION

Install OEI magnetic filters on the engine oil and the fuel system.
To further enhance the filtration process, an OEI ADD-Vantage 9000 was strategically positioned upstream of the OEM filter to assist and maintain the engine oil cleanliness by cleaning contamination down to and below 1 micron in size. Keeping in mind, wear contamination ranging from 4µm down to and below 1 micron is the most damaging to critical close tolerance components such as bearings, addressing this issue is crucial to improving the system's overall performance and reducing unplanned maintenance costs. An magnetic filter was installed as the final filter before the injectors to clean contamination down to and below 1 micron with the goal of increased injector service life, improved combustion, thus reducing emissions and blow-by opportunity into the engine oil.

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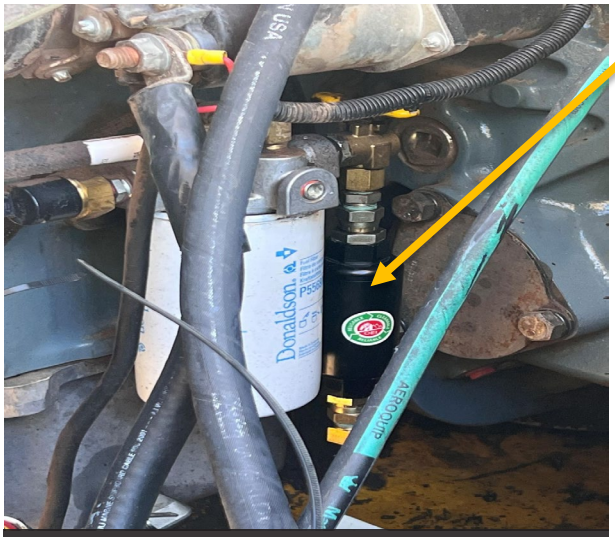
In addition to OEI upgrades other after market upgrades such as a viscous clutch fan to replace the discus clutch fan and an electrical air compressor replacing the previously installed mechanical air compressor.

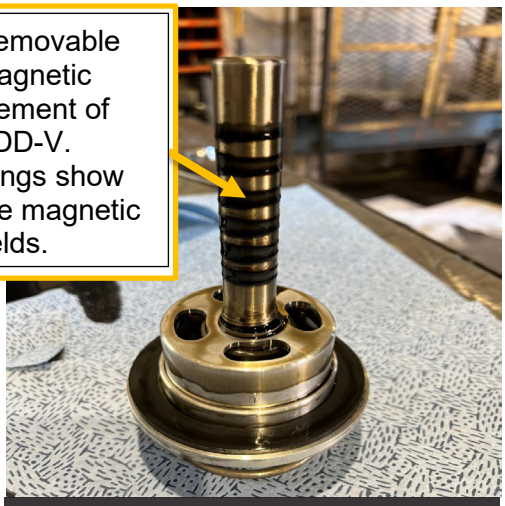


Picture 2: In line OEI Magnetic filter attached to fuel line between OEM filter and fuel injectors.

Picture 3: OEI ADD-Vantage 9000 attached to engine oil filter assembly

RESULTS:

Engine oil filtration and fuel filter system was upgraded to enhance filtration and an ADD-Vantage 9000 was strategically positioned upstream of the 10µm Donaldson filter. This dual filtration setup significantly contributed to fuel reduction but also effectively curbed the chain reaction of wear within the engine. After 300 hours of operation samples were collected and sent to a 3rd party lab for analysis.



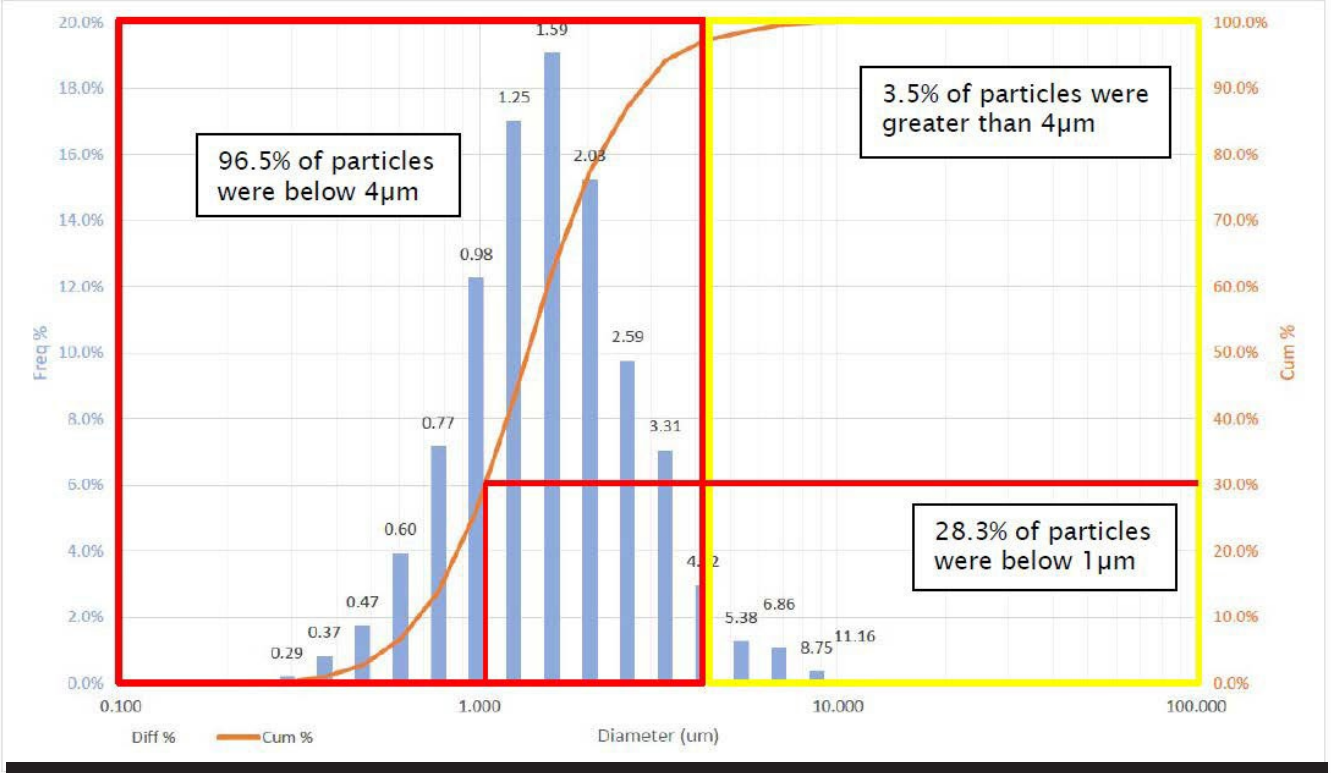
Picture 4: Contamination collected by ADD-Vantage 9000 after 300

	Size (um)								
Statistical Value	D10	D25	D50	D75	D90	Maximum	Minimum	Mean	Mode
Solids Contamination from Detroit 60 MF April 2023	0.70	0.96	1.35	1.94	2.82	9.4	0.26	1.4	1.25 – 1.594

Table 1: PSD analysis of oil filter contamination

The particle solids analysis of the engine oil determined that wear contaminants in the sample ranged between 0.26µm to 9.4 microns in size. Wear contamination below 4µm down to and below 1 micron is the most damaging to close tolerance engine components. The most frequently occurring particles captured by the ADD-Vantage 9000 range from µm 1.25 to 1.594

Of total particles captured by magnetic filtration 96.5% of the particles were below 4 microns in size while 28.3% of particles were below 1 micron in size. This analysis clearly demonstrates OEI technology's ability to clean liquids down to below 1 micron.



Picture 5: Particle size distribution of captured contamination from ADD-Vantage 9000

RESULTS

Diesel Fuel Filtration - An in-line OEI magnetic filter was installed after traditional filtration, before the injectors. The OEI filter captured the remaining wear contamination the OEM filter missed, resulting in increased injector life while reducing blow-by. (picture 6.)

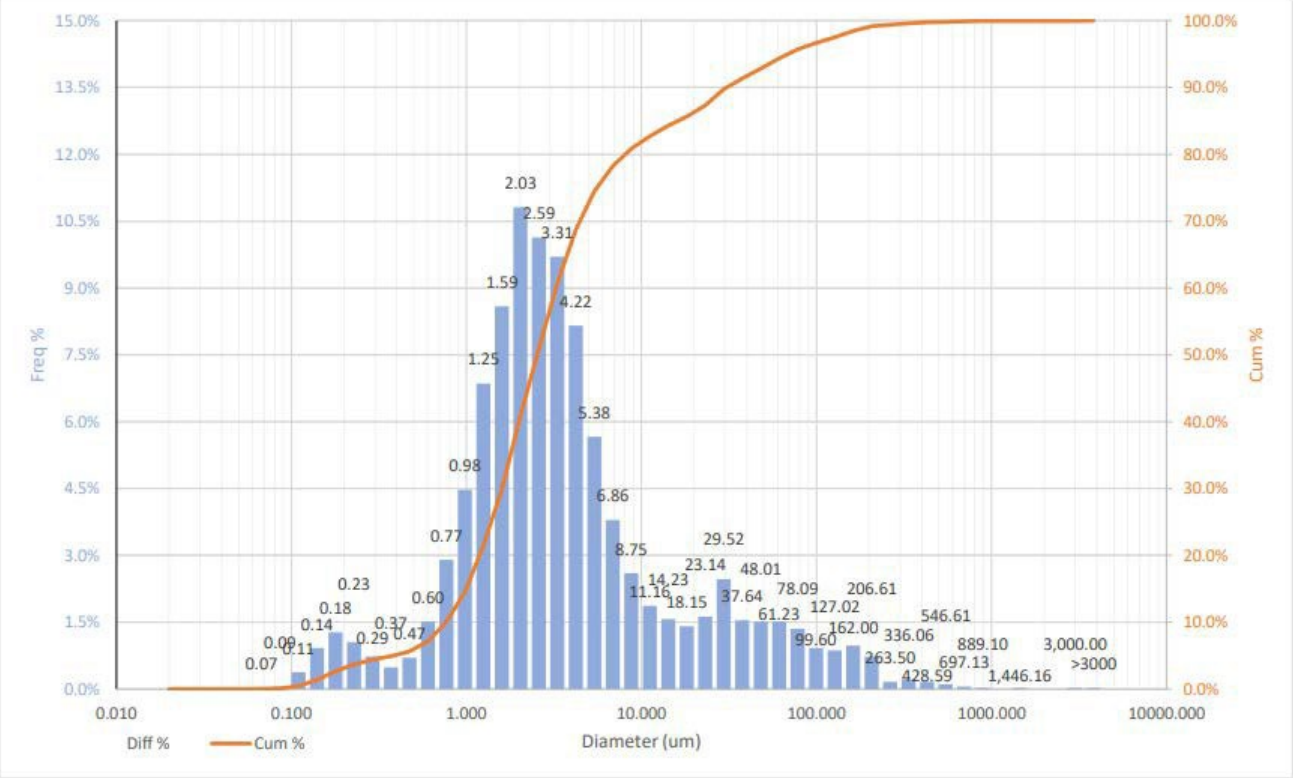
Picture 6: Contamination collected after OEM filter and before injectors.

XRD Quantitative Results

Ref.Code	Mineral Name	Compound Name	Chem. Formula	Weight %
03-065-3107	Magnetite	Iron Oxide	Fe_3O_4	5.7
04-004-6370	Iron	Iron	Fe	41.0
00-001-1180		Aluminum	Al	36.9
01-075-8320	Quartz	Silicon Oxide	SiO_2	5.1
04-008-0198	Calcite	Calcium Carbonate	$Ca(CO_3)$	1.4
04-014-0288		Magnesium Oxide	MgO	1.5
04-016-4857		Iron Manganese	$Mn_{0.165}Fe_{0.835}$	0.4
04-017-0892	Albite	Sodium Calcium Aluminum Silicon Oxide	$Na_{0.84}Ca_{0.16}Al_{1.16}Si_{2.84}O_8$	4.4
01-072-1616	Vaterite	Calcium Carbonate	$Ca(CO_3)$	0.5
01-088-5338		(iron bis(cyclopentadiene)) tetrachloroferrate* (possible phase, there are other organic phases also fit for the same peak)	$(Fe(C_5H_5)_2)(FeCl_4)$	1.8
01-076-3430	Sylvine	Potassium Sodium Chloride	$(K_{0.2}Na_{0.8})Cl$	0.4
04-006-2066	Rutile	Titanium Oxide	TiO_2	0.8

Table 2: XRD Analysis Results on the wear contamination captured by the magnetic filter.

The XRD analysis determined that high quantities of iron and aluminum particles as well as smaller quantities of quartz and calcium were present in the fuel on site, all of which are damaging to the fuel delivery system and reduce fuel combustion efficiency.



Picture 7: Particle size distribution of contamination collected.

Particle solids analysis (PSD) of the contamination captured by OEI filter were as follows. 15.7% of total particles were found to be under 1 micron and 67.5% of particles were found to be under 4 microns. These results identify OEI magnetic filtration of diesel fuel is necessary to improve cleanliness to below 1 micron, extending injector life thus improving combustion and reducing fuel consumption and emissions.

	Size (um)								
Statistical Value	D10	D25/Quartile 1	D50/Median	D75/Quartile 3	D90	Maximum	Minimum	Mean	Mode
Magnetic Filter Sample	0.76	1.40	2.50	5.51	30.76	4574.37	0.06	16.11	1.594 - 2.033

Table 3: Statistical representation of PSD

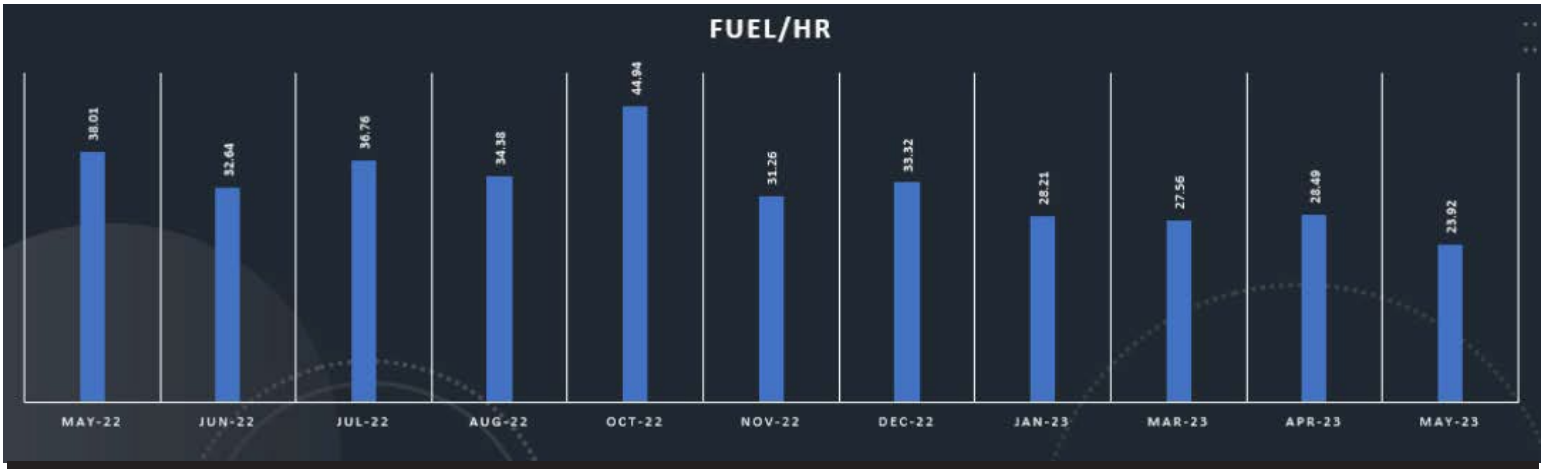
CONCLUSION

The Introduction of OEI magnetic filtration technology resulted in the following benefits:

- Stop the production and circulation of wear particles, extending component life.
- Reduced internal engine friction, results in improved efficiency, reduced fuel consumption and emissions
- Fuel use reduction of 8% or 18,000L of fuel per unit per year
- Extended engine oil life and service intervals from 250 hours to 500 hours
- Substantial reduction in GHG emissions from reduced fuel consumption and extended oil life (see below)
- Added benefit of OEI filtration technology with a 22+ year service life

CO2 Emissions:
Emissions factor: 2.681 kg CO2 emitted for every 1 liter of diesel burnt
Total CO2 emissions: 2.681 kg CO2/Kl * 18,000L = 48,258 kg CO2
CH4 emissions:
Emissions factor: 0.073 kg CH4/Kl
Total CH4 emissions: 0.073 kg CH4/Kl * 18 Kl = 1.314 kg CH4
N2O emissions:
Emissions factor: 0.02 kg N2O/Kl
Total N2O emissions: 0.02 kg N2O/Kl * 18 Kl = 0.360 kg N2O

Therefore, the total GHG emissions reduction from 18,000 liters of diesel fuel saved would be: CO2: 48,258 kg CH4: 1.314 kg N20: 0.360 kg



Picture 7: graph showing average fuel cost before and after implementing OEI technology in January.

BENEFITS OF SUB-MICRON FILTRATION WITH OEI FILTRATION TECHNOLOGY

Reduced Friction: Sub-micron filtration removes abrasive wear particles, minimizing friction between engine components. This reduced friction translates into enhanced fuel efficiency, as the engine operates more smoothly and requires less energy to overcome internal resistance.

Improved Lubrication: By removing sub-micron contaminants, the oil maintains its optimal lubricating properties. Proper lubrication reduces friction and wear on engine parts, allowing them to operate more efficiently. This improved lubrication directly contributes to fuel savings by reducing the energy lost to internal engine friction.

Enhanced Engine Performance: Sub-micron oil filtration helps maintain a cleaner engine environment, preventing the build-up of contaminants that can negatively impact engine performance. Cleaner engines experience improved combustion efficiency, resulting in better fuel economy and reduced emissions.

Extended Engine Life: By reducing wear caused by sub-micron contaminants, sub-micron oil filtration helps extend the lifespan of critical engine components. This longevity not only saves money on costly repairs but also contributes to sustainable practices by reducing the need for frequent engine replacements.

Environmental Benefits: The fuel savings achieved through sub-micron oil filtration