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Kleenoil Bypass Oil Filtration System Performance Evaluation

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ABSTRACT

This report details the initial activities to evaluate the performance of the Kleenoil USA oil bypass filter technology under test by CalArk Trucking. Two different types of diesel-engined tractor-trailers were equipped with bypass filtration units from Kleenoil USA. Each tractor-trailer averages around 120,000 miles per year. The evaluation included an oil analysis regime to monitor the presence of necessary additives and to detect undesirable contaminants. Preliminary cost analysis of adding the Kleenoil Bypass Filtration System to the CalArk Trucking fleet verifies that the oil bypass filtration system will reduce life-cycle costs. As the report further outlines, through estimating and detailed cost analysis, oil avoidance costs, a large cost saving is possible for CalArk Trucking in both operational costs, reduced oil usage and waste oil avoidance.

INTRODUCTION

Two Heavy-Duty 9778 Kleenoil bypass filter systems were installed on a pair of tractor-trailers that were equipped with two different types of four-cycle diesel engines:

- One Series-60 Detroit Diesel engine
- One Cummins ISX-600 engine

Effort to date has revolved around:
1. Ordering Kleenoil USA Systems,
2. Installation of Kleenoil USA bypass filters systems,
3. Accumulating pre system installation oil samples to determine engine baseline data. These data documents engines wear metal patterns, and initial oil change intervals.
4. Accumulation of test miles necessary to determine efficacy of the Kleenoil bypass oil filter system on the trucks,
5. Oil analysis sampling at regular intervals to track and document oil quality, engine metal-wear patterns and trends.

As of this report, 130,278 total oil test miles have been logged on the Cummins ISX-600 equipped tractor-trailer. 72,071 total oil test miles have been logged on the Series-60 Detroit Diesel equipped tractor-trailer. As more miles are accumulated this test data will be updated allowing an expanded evaluation of the oil bypass filtration system on the Calark Trucking fleet.

This report has several goals, which pertain to CalArk Trucking in running the Kleenoil bypass filtration system on their fleet:

1. Evaluate the performance of the Kleenoil bypass filtration system on the CalArk Trucking fleet.
2. Show the potential to reduce oil cost through extrapolated cost analysis by less oil consumption and generation of waste of oil and other oil change related costs.
3. Validate the concept of extended oil use through using the Kleenoil bypass filtration system.

4. Determine that long term use of the Kleenoil bypass filtration system will substantially reduce maintenance costs on the fleet as well as reduce equipment downtime: a primary cause of cost for most fleets.
5. Reduce oil related environment issues: oil spills, drinking water contamination, and waste oil handling.

CALARK TRUCKING

CalArk is an irregular route, general commodities contract full truckload carrier, serving forty eight states, the Ontario Province of Canada and through service to Mexico via Laredo, Texas. CalArk Trucking runs over 550 Freightliner, Kenworth & International late model tractor-trailers in its fleet. All the tractor-trailers operate on diesel fuel. CalArk Trucking is based out of Mabelvale, AR with terminal facilities in Laredo, TX, Monterrey, Mexico, Mabelvale, AR, and Hurricane Mills, TN. Since CalArk is a nationwide trucking company and each truck averages around 120,000 miles per year, the company was an excellent choice to showcase the benefits and cost savings that the Kleenoil bypass filtration system could provide a nationwide trucking company.

BYPASS FILTER TECHNOLOGY

The testing activities included installation, use, and evaluation of the Kleenoil USA oil bypass filtration system. Kleenoil USA bases its operations out of Shreveport, Louisiana. Kleenoil manufactures and sells the Kleenoil Bypass Oil Filtration System for any application that suffers problems from dirt, water or particulate contaminated oil. KleenOil boasts 25 years of success with over 250,000 units at work world wide in Saudia Arabia, and Sweden, Australia and Canada, Europe and Chile, South Africa and Thailand, India and France, America and Mexico. In North America we are now part of the Pepsi Cola Bottling and Safeway Supermarket Canada fleets. Kleenoil manufacturers multiple filter system sizes and models. The filter system selected for CalArk Trucking was the 9778 Heavy Duty Filter System, designed for 46-quart engine oil capacity. Following are a few details about the Kleenoil Bypass Oil Filtration System:

- The system does not replace the conventional full-flow oil filter system already installed on the trucks but works in conjunction with it.
- The filter system hardware is connected to the engine oil supply system downstream of the standard engine oil full flow filter.
- The system does not affect the engine's oil flow or pressure.
- The oil passes through the Kleenoil Bypass Filtration System unit at approximately 2-3 ***quarts***/minute as opposed to full-flow filters at 100-140 ***gallons***/minute.
- The oil treated by the bypass system is gravity-fed back into the oil pan.
- The replaceable Kleenoil filter cartridge is a proprietary; high-density, high-efficiency densely wound virgin cellulose paper made from a long fiber coniferous pine tree. Pulp is only processed once.
- The KleenOil USA filter removes particles down to 1 micron in size, viscosity robbing blow-by fuel, virtually all water, and massive amounts of sulfurized soot, the major precursors to engine acids.
- There are no moving parts.

The Kleenoil Bypass Oil Filtration System incorporates two main components: the filter housing and the replaceable filter cartridge.

- The Kleenoil filtration housing is made of cast aluminum with a galvanized steel-mounting bracket. It is connected to the engine lubricating oil circulating system in a bypass loop using high pressure braided Teflon hose and fittings to SAE standards.
- The filtration cartridge acts both by absorption and by adsorption in a continuous recycling process. The long fibers of the paper attract the water formed either through the combustion process or by condensation and absorb it like a sponge, at the same time rejecting the large oil molecules that are forced to pass between the tight windings of the cartridge. As the oil passes through the cartridge, minute carbon (soot), wear metals, and silicon particles (dirt) are extracted from the oil by adhering to the many surfaces of the filter - a process known as adsorption. Thus the cartridge, by removing water inhibits the production of acids that both degrade the oil and cause corrosion. The simultaneous removal of minute contaminants as they occur enables the oil life to be extended within its original operating specification.

Additional benefits of the Kleenoil Bypass Oil Filtration system:

- Extended oil drain intervals
- Reduced frictional engine wear
- Engine Life Extended by up to 3 times normal
- Reduced oil purchases up to 90%
- Reduced waste oil costs up to 90%
- Reduced vehicle downtime and improved productivity
- Better-maintained oil viscosity
- Improved oil circulation
- Decreased sludge and varnish deposits
- Full cost recovery usually within 5 “regular” oil changes
- Independently lab tested and proven
- Easy installation on any engine
- Life Time Warranty to the Original Purchasing Entity

OIL SELECTION AND ANALYSIS

Oil Selection

The engine oil normally used in by the CalArk Trucking fleet is Lubrigard SAE 15W40 motor oil.

Oil Analysis

When extending oil drain intervals, it is imperative to know the fitness of the engine lubricating oil and to establish the wear pattern trends of the engines tested. To evaluate the effectiveness of the bypass oil filtration technology, the oil is periodically analyzed. Oil analysis verifies and validates the “fitness-for-service” of the oil. The results of each analysis are compared to historical and industry standards. To ensure the quality of the data, an independent oil analysis laboratory was contracted for the test. At each filter service period during the test, following strict oil analysis gathering protocol, a 200-ml container of engine oil is shipped to the laboratory. Tested samples are then compared with

the baseline oil sample taken when the Kleenoil filter units were installed. Changes to the oil quality can then be qualified and evaluated. The independent laboratory used in this test was Polaris Laboratories based in Indianapolis, IN.

KLEENOIL BYPASS OIL FILTRATION SYSTEM PERFORMANCE EVALUATION STATUS

The three main evaluation activities were:

1. Installation of the Kleenoil Bypass Oil Filtration system
2. Oil bypass system operations and evaluation
3. Economic analysis of the oil Kleenoil Bypass Oil Filtration system.

Kleenoil Bypass Oil Filtration System Installation

The initial plan called for installation of a Kleenoil Bypass Oil Filtration System on two different diesel motor tractor-trailers in the fleet. We selected one truck with a Series-60 Detroit diesel engine and one with a Cummins ISX-600 engine. We chose these two types of diesel motors for testing because the Detroit diesel engines are renown for being “dirty” diesel motors compared to the Cummins ISX-600’s. This is reflected in the oil analysis test results at the end of this report. The Kleenoil unit was installed on the right driver’s side of the frame on the Series-60 Detroit Diesel motor and the Cummins ISX-600 truck’s bypass filter was installed on the passenger side of the frame in the engine compartment. Installation was straightforward without any problems and took approximately 1 hour per truck.

Oil Bypass System Operations and Evaluation

The operations part of the performance evaluation includes the following:

- Obtaining oil analysis samples of exhausted oil taken just prior to the Kleenoil Bypass Oil Filtration System installation. This oil analysis report established a baseline of engine metal wear patterns before initialization of the oil bypass system performance evaluation.
- Replacing oil filters at the established intervals
- Oil analysis sampling of the test oil (Lubrigard SAE 15W40 motor oil) during each filter replacement to track and document oil quality and engine metal-wear patterns and trends.

Pretest Engine Metal Wear Patterns

Pretest oil analysis and engine metal-wear pattern documentation differed for the two types of diesel motors that were chosen for this test. The truck with the Series-60 Detroit Diesel motor had already accumulated 427,003 miles at the time of the Kleenoil USA filter installation. The truck with the Cummins ISX-600 motor had accumulated substantially less mileage with only 130,132 total miles. The Cummins ISX-600 additive package showed particularly low levels of calcium, phosphorus and zinc due to the depleted state of the lube additive package prior to the Kleenoil USA filter installation.

Filter Replacement Schedule

The previous oil service schedule replaced both the diesel engine full-flow filter as well as the oil at each 20,000-mile oil change interval. With the Kleenoil Bypass Oil Filtration System now in place, each diesel engine has two oil filters: the factory-installed full-flow filter and the new Kleenoil bypass filter. For the purpose of accurate testing and to achieve maximum protection for the engine the test began with new oil, new full-flow and bypass filters for both the Cummins ISX 600 and the Detroit Diesel the new schedule includes the following:

- After the first 22,114 miles only the Kleenoil bypass filter cartridge was replaced (The OEM full-flow filter remained on the engines until the oil was next changed.).
- After an additional 20,364 miles again only the Kleenoil bypass filter cartridge was replaced The OEM full-flow filter remains untouched. After an additional 30,627 miles the Kleenoil bypass filter was again replaced on the Cummins ISX-600 with the full-flow filter remaining in place. The Detroit Diesel as of this writing had still not accumulated enough miles to warrant a third bypass oil filter change.
- The full-flow filter is to be replaced according to cost analysis at either 80,000 or 100,000-mile intervals as outlined in the cost analysis attachments.

Oil Analysis Sampling during the Performance Evaluation

Oil analysis samples were taken at each filter replacement (initially when the bypass oil filter was installed and then at 22,114, 20,364, 30,627, and 25,562 mile intervals) and then sent to Polaris Laboratory for analysis. Any abnormal findings are shown in with gray boxes with up-arrows in them and noted in the comment field. An abnormal condition would require values below the acceptable standard for items such as viscosity, TBN (Total Base Number), additive metals, soot and silicon (dirt) levels, etc. The data from the analysis reports were then compiled to document oil quality and engine metal-wear pattern profiles trends. Over time and through analysis of the data, we can identify when the oil is no longer acceptable for use.

Note: CalArk Trucking exceeded the recommended filter cartridge intervals. When recommended intervals are adhered to, ranging from 15,000 to 20,000 mile intervals depending upon engine and filter size, much more acceptable oil conditions will result with significant increases in oil suitability. Installation of the “next size up” filter will also significantly increase the oil change interval. See your Kleenoil representative for details.

Cal Ark Oil Analysis Sampling Results

Cummins ISX-600 (CalArk Trucking #524 E)

Pre-Installation/Installation-Baseline Oil Analysis

The initial 20,000-mile sample of 8/20/03 reflects exhausted oil pre installation of the KleenOil USA bypass filter.

Oil was analyzed to establish baseline numbers and substantiate the benefits of Kleenoil USA bypass oil filtration. The initial pre Kleenoil oil analysis sample of exhausted oil indicated additive metals such as calcium, phosphorus, and zinc were vastly depleted. Soot

levels reached 1.4%, viscosity, 14.9, and TBN, 4.22. If this pre Kleenoil oil had remained with the additive package this low, soot levels and viscosity would have rapidly increased. The TBN would also have dropped much more quickly than what was noticed with the bypass filtration unit installed.

Cummins ISX-60
1st Maintenance: 22,114 Total Oil Miles

By 10/9/2003, the truck accumulated 22,114 total oil miles. The Kleenoil bypass filter was the ONLY item changed. **Note:** Kleenoil recommends Oil and full-flow filter remained. Oil analysis dated 10/14/2003 reports the additive levels remained in excellent condition. Soot levels were at only 1.0%, even after 22,114 miles, viscosity showed a normal measurement of 14.4. TBN demonstrated an excellent higher number at a time when oil would normally be discarded. Oxidation and nitration levels stayed within acceptable ranges.

Cummins ISX-60
2nd Maintenance: 42,478 Total Oil Miles

By 12/2/2003, the truck had accumulated an additional 20,364 miles with a total oil mileage of 46,472. The Kleenoil bypass filter, again, was the only item changed. The oil and full-flow filter remained untouched. The additive package remained in excellent condition, the soot levels lowered to 1.2%, viscosity was 14.9, and the TBN, at 3.43 remained in the acceptable range.

Cummins ISX-60
3rd Maintenance: 73,105 Total Oil Miles

By 2/15/2004, the truck accumulated an additional 30,627 miles (73,105 total miles). The Kleenoil bypass filter was again changed. The oil and full-flow filters were not changed. Additive levels remained excellent. Soot levels were a mere 1.4% (exactly the same value from the first report.) Viscosity, at 15.4, rose slightly, approached the respective original 20,000 reading and remained well within the acceptable for SAE 15W40. TBN dropped to 2.42, slightly below acceptable. Oxidation and nitration levels remained within the acceptable range.

Kleenoil USA requested Polaris Labs to run a total acid number (TAN) on this sample. The result indicated that the Total Acid Number rose to a slightly higher number than the TBN. With this as the determining factor the Kleenoil USA representative recommended an oil change. Shortly after the testing on 3/8/2004, the oil was changed but the bypass filter cartridge remained.

Cummins ISX-60
4th Maintenance: 98,667 Total Oil Miles

By 3/26/2004, the truck accumulated an additional 25,562 miles (98,667 total miles). The Kleenoil bypass filter was again changed. The oil and full-flow filters were not changed. Additive levels on this sample were as expected excellent. Soot levels fell to a minuscule 0.7%, which is representative of new clean oil. Viscosity, at 14.3 was now at the correct level as to be expected with SAE 15W40. TBN rose up to 4.64, which is an excellent number. Oxidation and nitration levels remained within the acceptable range.

Notice that the oxidation and nitration levels at this mileage are not drastically different than the oil tested at 73,105 miles. This shows just how dirty new oil actually is and how well the Kleenoil Bypass Filtration System actually works at keeping the oil clean. With the standard oil change as much as 18% of the old oil remains to mix with the new oil.

Cummins ISX-60
5th Maintenance: 108,149 Total Oil Miles

By 5/7/2004, the truck had accumulated an additional 9,482 miles with a total oil mileage of 108,149. The Kleenoil bypass filter was again changed. The oil and full-flow filters were left unchanged. Additive levels continue to remain very strong. Soot levels were at a low 0.9% and viscosity was steady at 14.3. TBN rose again slightly to 4.68 which was very good. Oxidation and nitration levels each fell just slightly (1 pt each). This still fell into the acceptable range.

Cummins ISX-60
6th Maintenance: 130,278 Total Oil Miles

By 7/14/2004, the truck had accumulated an additional 22,129 miles. The truck had now accumulated a total of 130,278 miles. The Kleenoil bypass filter was again changed. The oil and full-flow filters were not changed. Additive levels were in good shape as was expected. Soot levels were excellent at 1.5. Viscosity was solid at 14.9. The TBN was really the only part of the test that had fallen to a moderately low level at 2.88. Though the wear metal and contaminant metal counts were very low and all the numbers tested well, the mechanics changed the oil although we felt oil was suitable for continued usage. We believe they could have logged another 20,000+ miles before this oil change was necessary.

Cummins ISX-60
Reduced Make-Up Oil

Towards the end of the bypass oil filtration test, the driver of 524E, the ISX-600 equipped truck, brought to our attention that the his truck now consumed far less “make-up” oil than it had prior to the installation of the Kleenoil Bypass Filtration System. Maintenance reports were pulled for a similar reporting period of approximately 7 months pre and post Kleenoil installation. Pre-Kleenoil the truck consumed $104.23 in replacement oil. Post Kleenoil the truck used only $34.70 of make-up oil. This reinforces oil analysis reports detailing how the additive package in the oil continued to remain in excellent shape during the course of the test period. Testing prior to the bypass filtration unit being installed showed vast depletion of the additive package and was a major cause of the truck burning the additional oil. The Kleenoil removal of such vast quantities of soot prevents soot agglutination (the clumping of accumulating soot into a larger mass of sludge) toward the end of the oil life cycle. This thicker mass is then “burned off” from friction within the engine. The removal of the soot in this instance relaxes “pressure” on and preserves that part of the additive package designed to keep soot in suspension.

Series-60 Detroit Diesel (CalArk Trucking #722 E)

Pre-Installation/Installation-Baseline Oil Analysis: 1,000 Total Oil Miles

On 11/5/2003 a pre-Kleenoil installation, 1,000 oil mile sample was taken. Sample results received back on 11/11/2003 indicated that the additive package @ 1000 miles remained in

good shape. Soot levels registered less than .1%; viscosity read 14.6, and TBN was at 8.12. Oxidation and nitration levels were in acceptable range.

Series-60 Detroit Diesel
1st Maintenance: 20,706: Total Oil Miles

On 1/14/2004, at 20,706 total oil miles, the oil and full-flow filters remained in and on the engine. ONLY the Kleenoil bypass filter cartridge was changed. Additive metal package remained in excellent shape, soot levels registered a mere 0.6%, viscosity dropped to 12.7, and the TBN was at 4.12. Oxidation and nitration levels remained in the acceptable range.

Series-60 Detroit Diesel
2nd Maintenance: 45,762 Total Oil Miles

On 3/16/2004, at 45,762 total miles, the oil and full-flow filters again remained in and on the engine. ONLY the Kleenoil bypass filter cartridge was changed. . Additive metals package remained in great shape, the soot levels expectedly rose slightly but only to 0.9%. Viscosity lowered to12.7. TBN was at a slightly below minimum level of 2.71. Oxidation was acceptable and the nitration levels were at a minor level.

As was previously mentioned earlier in the report, the Detroit Diesel series motors are notoriously dirty motors. Since, all of the testing was done on essentially new oil in the truck, old oil analysis's done at CalArk Trucking were pulled by Jerry Robin and Ed Szarmach to see how these oil analysis's would stack up to other Detroit Diesel trucks in the fleet without the benefit of the bypass filtration units being installed. As was suspected, this oil analysis indicated that trucks with only 16,000 miles on the oil indicated full depletion of the additive metals package: far higher soot levels. Viscosity levels were high with a lower TBN than truck 722 E with 45,762 total oil miles.

Series-60 Detroit Diesel
3rd Maintenance: 71,071 Total Oil Miles

By 5/13/2004, the truck had accumulated an additional 25,309 miles with a total oil mileage of 71,071. The Kleenoil bypass filter was again changed. The oil and full-flow filters were left unchanged. Additive levels have fallen a bit but are still in an acceptable range on all of them. Soot levels rose to 1.4% from 0.9% previously. Viscosity rose a bit to 13.0. The TBN fell to 2.25 which put it below the acceptable minimum level. Oxidation rose 2 points to 12 and Nitration rose 3 points to 19. After analysis of the oil sample, we have recommended an oil change due to the TBN and Nitration levels.

COST ANALYSIS
THE KLEENOIL BYPASS OIL FILTRATION SYSTEM

As the performance evaluation continues, additional information will be generated that will quantify the performance of the Kleenoil Bypass Oil Filtration System. Additional cost information will also be generated that will provide input for a life-cycle economic analysis. However, if some general assumptions are employed on the knowledge gained from the performance evaluation to date, a very preliminary Cost Analysis can be performed to estimate the economics of the Kleenoil USA oil bypass system as it pertains to CalArk Trucking.

Assumptions

1. We are estimating 120,000 miles per truck per year starting January 1, 2004 and it is assumed that they will continue to average the same number of miles for the next few years.
2. For this analysis, a four-year period has been used, a total of about 480,000 miles, has been considered.

3. It is assumed that any oil used while the trucks are in operation is the same, with or without the oil bypass system installed.

NOTE: Oil disposal fees are not considered in this cost analysis. We don't know how disposal is handled at CalArk Trucking. Nor do we know the cost associated with their disposal. Hence, we have left this aspect out of our cost analysis. This should be added in the future though if the data is able to accumulated. Adding in these figures would tilt the balance more favorably than is already shown toward going with the bypass filters since oil changes are less frequent and thus less costly.

4 The "day to day consumed oil cost" section of the cost analysis numbers were obtained from Ed Szarmach from Fleet Maintenance manager of CalArk Trucking. "Day to day consumed oil cost" numbers are utilized for all trucks in the fleet. The Central Maintenance Corp cost sheets indicate oil costs for a six month period on CalArk Trucking #524. The "day to day amount of consumed oil and its associated cost per truck drops considerably when the traditional manufacturer's full-flow filter is combined with the installation of the KleenOil Filtration bypass oil filter

5 **Traditional Oil Change Interval Cost Analysis** assumes "20,000 mile full-flow oil and filter changes."

6 The **Kleenoil USA Cost Analysis** assumes change of ONLY the Kleenoil USA bypass filter cartridge at 20,000 mile intervals changes and 80,000 mile full-flow filter and oil changes on the bypass oil filter cost analysis model.

7 Oil change costs were figured at $68.00 per full-flow oil change. This is assuming an in house oil change at CalArk Trucking.

8 All costs are in 2004 US dollars

Status Quo Traditional Oil Changing Costs

Using the 20,000-mile interval oil change model, after 480,000 miles, the total cost for the labor and parts required for the oil changes totals $2,465.76 per truck.

Kleenoil Bypass Oil Filtration System Oil Changing Costs

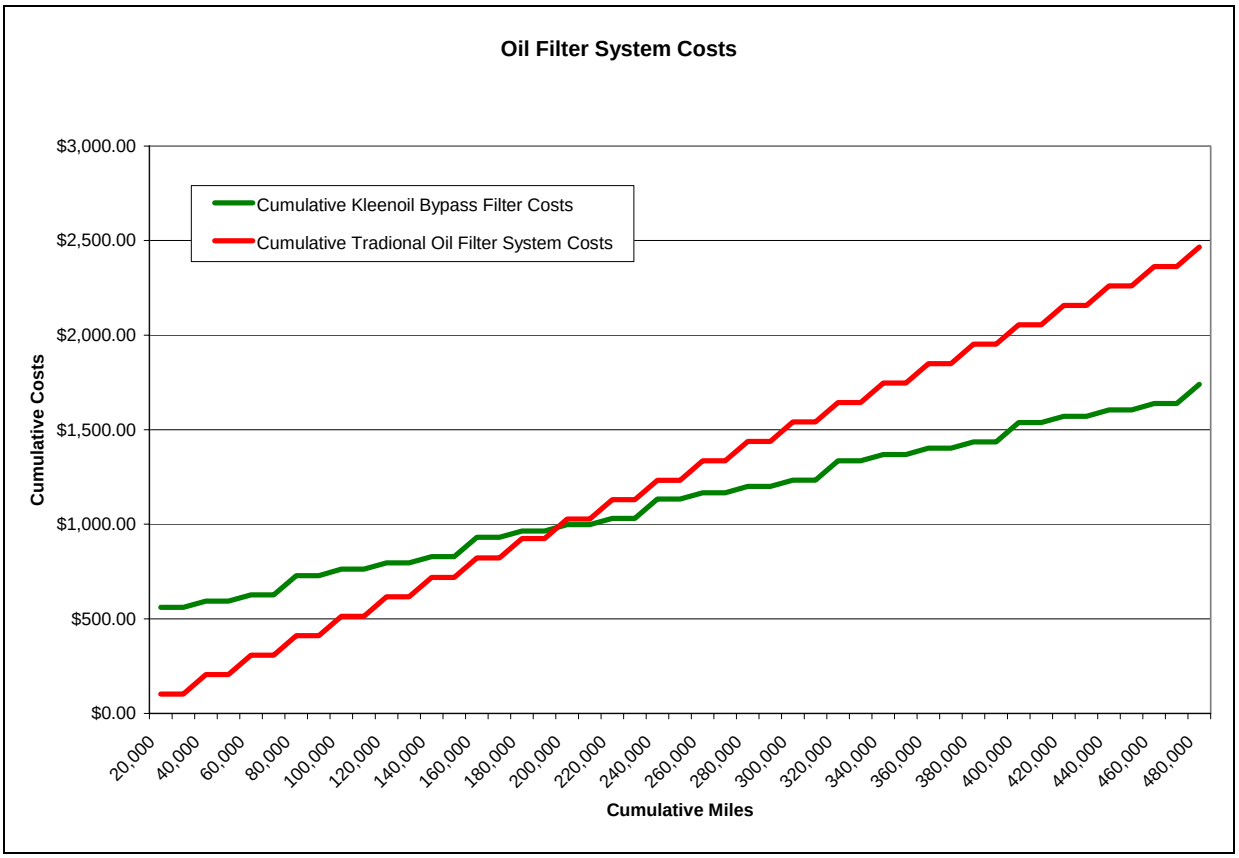
Using the 20,000 mile interval oil change model and assuming 80,000 miles per full-flow oil change, after 480,000 miles, the total cost for the labor and parts required for the oil and bypass filter changes totals $1,740.04 per truck.

Cost Comparison Discussion

A comparison of the cumulative costs of the traditional oil filter and Kleenoil Bypass Oil Filtration System shows that the bypass filter system has lower life-cycle costs starting at about 200,000 miles after installation of the bypass oil filters. This means the bypass oil filtration systems are paying for themselves after September 1, 2005. This analysis is preliminary. No costs are currently known for the storing and disposal of the used oil. As the evaluation proceeds, the practices for handling the used oil will be better defined and costed. These oil disposal fees will likely result in an earlier payback period than the 200,000 miles for the oil bypass system. The expected payback period highly depends on the performance of the Kleenoil Bypass Oil Filtration System and the continued satisfactory condition of the unchanged oil.

While this cost analysis assumed a $68.00 per incident in house oil change cost, oil changes on the road typically run $150.00. Cost analysis done using the $150.00 road oil change cost would result in an even earlier payback period further in favor of the Kleenoil USA Bypass Oil Filtration System.

It is estimated that during the 480,000-mile analysis, about 198 gallons (792 quarts) of oil will be saved per truck. While the cost to purchase oil is included in the analysis, the disposal costs are not explored. These costs would include either a recycling method or the paying a third party to remove the oil.



CONCLUSIONS

This cost analysis suggests that the Kleenoil Bypass Filtration System demonstrates the dramatic potential to reduce oil use, reduce the generation of waste oil and other oil-change-related costs. Future cost analysis will include the handling and disposal costs of used oil.

CalArk realized a $725.72 savings per truck going from the traditional full-flow oil change system to the Kleenoil Bypass Filtration System. The expansion of this $752.72 saving to the entire CalArk Trucking fleet of approximately 600 tractor-trailers would realize total $435,432 savings during the four-year analysis period.

If the economic cost analysis was expanded to an eight year period, the savings would be $1,186,680.

It is difficult to quantify the Kleenoil USA savings to CalArk Trucking in terms of maintenance cost. However, previous tests with other Kleenoil USA trucking companies indicate that the useful life of the engine can be expected to double or triple due to the removal of wear abrasives.

Calark Trucking 4 Year Cost Analysis of Traditional Oil Filter System

Traditional Oil Changing Costs									
			Oil Change Cost Breakdown						
Date	Oil Change Intervals	Cumulative Equipment Mileage	Oil Cost	Full Flow Filter Cost	Full Flow Filter Change Labor Cost	Day to Day Consumed Oil Cost	Total Cost Per Oil "Event"	Cumulative 10,000 Mile Intervals	Cumulative Cost at 10,000 Mile Intervals
January 1, 2004									
								10,000	
March 1, 2004	20,000	20,000	$38.00	$10.00	$20.00	$34.74	$102.74	20,000	$102.74
								30,000	$102.74
May 1, 2004	20,000	40,000	$38.00	$10.00	$20.00	$34.74	$102.74	40,000	$205.48
								50,000	$205.48
July 1, 2004	20,000	60,000	$38.00	$10.00	$20.00	$34.74	$102.74	60,000	$308.22
								70,000	$308.22
September 1, 2004	20,000	80,000	$38.00	$10.00	$20.00	$34.74	$102.74	80,000	$410.96
								90,000	$410.96
November 1, 2004	20,000	100,000	$38.00	$10.00	$20.00	$34.74	$102.74	100,000	$513.70
								110,000	$513.70
December 31, 2004	20,000	120,000	$38.00	$10.00	$20.00	$34.74	$102.74	120,000	$616.44
								130,000	$616.44
March 1, 2005	20,000	140,000	$38.00	$10.00	$20.00	$34.74	$102.74	140,000	$719.18
								150,000	$719.18
May 1, 2005	20,000	160,000	$38.00	$10.00	$20.00	$34.74	$102.74	160,000	$821.92
								170,000	$821.92
July 1, 2005	20,000	180,000	$38.00	$10.00	$20.00	$34.74	$102.74	180,000	$924.66
								190,000	$924.66
September 1, 2005	20,000	200,000	$38.00	$10.00	$20.00	$34.74	$102.74	200,000	$1,027.40
								210,000	$1,027.40
November 1, 2005	20,000	220,000	$38.00	$10.00	$20.00	$34.74	$102.74	220,000	$1,130.14
								230,000	$1,130.14
December 31, 2005	20,000	240,000	$38.00	$10.00	$20.00	$34.74	$102.74	240,000	$1,232.88
								250,000	$1,232.88
March 1, 2006	20,000	260,000	$38.00	$10.00	$20.00	$34.74	$102.74	260,000	$1,335.62
								270,000	$1,335.62
May 1, 2006	20,000	280,000	$38.00	$10.00	$20.00	$34.74	$102.74	280,000	$1,438.36
								290,000	$1,438.36
July 1, 2006	20,000	300,000	$38.00	$10.00	$20.00	$34.74	$102.74	300,000	$1,541.10
								310,000	$1,541.10
September 1, 2006	20,000	320,000	$38.00	$10.00	$20.00	$34.74	$102.74	320,000	$1,643.84
								330,000	$1,643.84
November 1, 2006	20,000	340,000	$38.00	$10.00	$20.00	$34.74	$102.74	340,000	$1,746.58
								350,000	$1,746.58
December 31, 2006	20,000	360,000	$38.00	$10.00	$20.00	$34.74	$102.74	360,000	$1,849.32
								370,000	$1,849.32
March 1, 2007	20,000	380,000	$38.00	$10.00	$20.00	$34.74	$102.74	380,000	$1,952.06
								390,000	$1,952.06
May 1, 2007	20,000	400,000	$38.00	$10.00	$20.00	$34.74	$102.74	400,000	$2,054.80
								410,000	$2,054.80
July 1, 2007	20,000	420,000	$38.00	$10.00	$20.00	$34.74	$102.74	420,000	$2,157.54
								430,000	$2,157.54
September 1, 2007	20,000	440,000	$38.00	$10.00	$20.00	$34.74	$102.74	440,000	$2,260.28
								450,000	$2,260.28
November 1, 2007	20,000	460,000	$38.00	$10.00	$20.00	$34.74	$102.74	460,000	$2,363.02
								470,000	$2,363.02
December 31, 2007	20,000	480,000	$38.00	$10.00	$20.00	$34.74	$102.74	480,000	$2,465.76
		Totals	**$912.00**	**$240.00**	**$480.00**	**$833.76**	**$2,465.76**		

Calark Trucking 4 Year Cost Analysis of Kleeoil Bypass Oil Filter Systems

Kleenoil Bypass Oil Filter System Costs												
					Oil Change Cost Breakdown							
Date	System Action Intervals	Cumulative Equipment Mileage	Kleenoil Bypass Filter Element Cost	Element Change Labor Cost	Oil Cost	Full Flow Filter Cost	Full Flow Filter Change Labor Cost	Day to Day Consumed Oil Cost	Initial Kleenoil Bypass Filter System Parts and Labor	Total Cost Per Oil "Event"	Cumulative 10,000 Mile Intervals	Cumulative Cost at 10,000 Mile Intervals
January 1, 2004									$526.36	$526.36		$526.36
											10,000	$526.36
March 1, 2004	20,000	20,000	$22.00					$11.57		$33.57	20,000	$559.93
											30,000	$559.93
May 1, 2004	20,000	40,000	$22.00					$11.57		$33.57	40,000	$593.50
											50,000	$593.50
July 1, 2004	20,000	60,000	$22.00					$11.57		$33.57	60,000	$627.07
											70,000	$627.07
September 1, 2004	20,000	80,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	80,000	$728.64
											90,000	$728.64
November 1, 2004	20,000	100,000	$22.00					$11.57		$33.57	100,000	$762.21
											110,000	$762.21
December 31, 2004	20,000	120,000	$22.00					$11.57		$33.57	120,000	$795.78
											130,000	$795.78
March 1, 2005	20,000	140,000	$22.00					$11.57		$33.57	140,000	$829.35
											150,000	$829.35
May 1, 2005	20,000	160,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	160,000	$930.92
											170,000	$930.92
July 1, 2005	20,000	180,000	$22.00					$11.57		$33.57	180,000	$964.49
											190,000	$964.49
September 1, 2005	20,000	200,000	$22.00					$11.57		$33.57	200,000	$998.06
											210,000	$998.06
November 1, 2005	20,000	220,000	$22.00					$11.57		$33.57	220,000	$1,031.63
											230,000	$1,031.63
December 31, 2005	20,000	240,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	240,000	$1,133.20
											250,000	$1,133.20
March 1, 2006	20,000	260,000	$22.00					$11.57		$33.57	260,000	$1,166.77
											270,000	$1,166.77
May 1, 2006	20,000	280,000	$22.00					$11.57		$33.57	280,000	$1,200.34
											290,000	$1,200.34
July 1, 2006	20,000	300,000	$22.00					$11.57		$33.57	300,000	$1,233.91
											310,000	$1,233.91
September 1, 2006	20,000	320,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	320,000	$1,335.48
											330,000	$1,335.48
November 1, 2006	20,000	340,000	$22.00					$11.57		$33.57	340,000	$1,369.05
											350,000	$1,369.05
December 31, 2006	20,000	360,000	$22.00					$11.57		$33.57	360,000	$1,402.62
											370,000	$1,402.62
March 1, 2007	20,000	380,000	$22.00					$11.57		$33.57	380,000	$1,436.19
											390,000	$1,436.19
May 1, 2007	20,000	400,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	400,000	$1,537.76
											410,000	$1,537.76
July 1, 2007	20,000	420,000	$22.00					$11.57		$33.57	420,000	$1,571.33
											430,000	$1,571.33
September 1, 2007	20,000	440,000	$22.00					$11.57		$33.57	440,000	$1,604.90
											450,000	$1,604.90
November 1, 2007	20,000	460,000	$22.00					$11.57		$33.57	460,000	$1,638.47
											470,000	$1,638.47
December 31, 2007	20,000	480,000	$22.00		$38.00	$10.00	$20.00	$11.57		$101.57	480,000	$1,740.04
		Totals	**$528.00**		**$228.00**	**$60.00**	**$120.00**	**$277.68**	**$526.36**	**$1,740.04**		

DATE: 3/12/04 **SZAE** **CENTRAL NAINTENANCE CORP** **FLOCR4 –**

TIME: 11:13:12 R.O. SYSTEM **SUMMARY**

BY SPECIFIC REASON PAGE:1

FOR PERIOD: FROM 8/20/03 TO 3/12/04

FLEET.....: VEHICLE .....524 SITE: MAIN

	LABOR COST	%	PARTS COST	%	FLUIDS COST	%	OUTSIDE COST	%	TOTAL % COST REASON
REASON FOR REPAIRS: 03 Cnsmutn - 1									
SYSTEMS									
O53 Nut Bolt Fluids	.00	0	34.70 *100*		.00	0	.00	0	34.70 100
REASON TOTALS:	.00		34.70		.00		.00		34.70

DATE: 3/12/04 **SZAE** **CENTRAL NAINTENANCE CORP** **FLOCR4 –**

TIME: 11:34:27 R.O. SYSTEM **SUMMARY**

BY SPECIFIC REASON PAGE:1

FOR PERIOD: FROM 11/7/02 TO 7/30/03

FLEET.....: VEHICLE .....524 SITE: MAIN

	LABOR COST	%	PARTS COST	%	FLUIDS COST	%	OUTSIDE COST	%	TOTAL % COST REASON
REASON FOR REPAIRS: 03 Cnsmutn - 1									
SYSTEMS									
O53 Nut Bolt Fluids	10.50	100	104.23 *100*		.00	0	.00	0	114.73 100
REASON TOTALS:	10.50		104.23		.00		.00		114.73

UNIT ID:

524 E

SECOND ID

CALARK
TRUCKING
ED SZARMACH

Tel # - 501-407-3380

P.O. BOX 990
MABELVALE , AR 72103

UNIT TYPE	DIESEL ENGINE						
APPLICATION	TRANSPORTATION	**MFR**	CUMMINS				
MODEL	ISX 600			**LUBE/FLUID MFR**	76 LUBRICANTS		
LUBE TYPE	LUBRIGARD	**SUMP CAPACITY**	00044	**LUBE TIME**	201671	**DATE SAMPLED**	03/26/2004
GRADE	SAE 15W40	**HYD SYS PRESS**	00000	**UNIT TIME**	201671	**DATE RECEIVED**	04/02/2004
FILTER TYPE	FULLFLOW	**MICRON RATING**	010	**LUBE ADD**		**DATE COMPLETED**	04/06/2004

SEVERITY:	0						
ACCOUNT #	46101200030000						
Loc - Lab# - DA	I - 383264 - SM						

COMMENT Total Base Number is MODERATELY LOW; Data flagged for observation only; Lubricant change acknowledged;

WEAR METALS											CONTAMINANT METALS			MULTI-SOURCE METALS					ADDITIVE METALS				
Fe	Cr	Ni	Al	Cu	Pb	Sn	Cd	Ag	Ti	V	Si	Na	K	Mo	Sb	Mn	Li	B	Mg	Ca	Ba	P	Zn
13	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	11	0	868	0	221	313
																				^^^		^^^	^^^
33	4	0	1	1	3	0	0	0	0	0	4	7	0	0	0	0	0	63	0	4116	0	1121	1326
48	4	0	1	2	9	0	0	0	0	0	4	3	0	0	0	0	0	41	18	4010	1	1047	1240
87	5	0	2	4	46	3	0	0	0	0	5	5	0	0	0	0	0	47	19	4520	0	1312	1405
					^^^																		
29	4	0	1	1	8	0	0	0	0	0	3	2	0	0	0	0	0	44	12	3966	0	1031	1202
24	5	0	1	1	2	0	0	0	0	0	3	2	1	1	0	0	0	50	13	3956	1	1137	1261
42	6	0	1	4	6	0	0	0	0	0	1	4	1	2	0	0	0	31	8	3859	8	1142	1260

TEST DATA																				
SAMPLE RECEIVED	LUBE UNIT	LUBE CHANGED	FUEL Vol.	SOOT Vol.	WATER Vol.	VIS 40C CS	VIS 100C CS	TAN Total Acid#	TBN Total Base#	I-R OXIDA	I-R NITRA	ISO CODE	4 MICR	6 MICR	10 MICR	14 MICR	21 MICR	38 MICR	70 MICR	100 MICR
08/20/2003																				
09/12/2003	130132	Y	0.5	1.4	<.1		14.9		4.22											
10/09/2003	22114																			
10/14/2003	152246	N	0.5	1.0	<.1		14.4		4.27	10	16									
12/02/2003	20364																			
12/05/2003	172610	N	0.5	1.2	<.1		14.9		3.43	11	18									
02/15/2004	30627																			
03/08/2004	203237	Y	0.5	1.4	<.1		15.4		2.42	13	19									
									^^^											
03/26/2004	25562																			
04/02/2004	228799	N	0.5	0.7	<.1		14.3		4.64	11	17									
05/07/2004	9482																			
05/11/2004	238381	N	0.5	0.9	<.1		14.3		4.68	10	16									
07/14/2004	22129																			
07/20/2004	260410	Y	0.5	1.5	<.1		14.9		2.88	12	19									
									^^^											

UNIT ID:

722 E

SECOND ID

CALARK
TRUCKING
ED SZARMACH

Tel # - 501-407-3380

P.O. BOX 990
MABELVALE , AR 72103

UNIT TYPE	DIESEL ENGINE								
APPLICATION	TRANSPORTATION	**MFR**							
MODEL				**LUBE/FLUID MFR**			76 LUBRICANTS		
LUBE TYPE	LUBRIGARD	**SUMP CAPACITY**	00011	**LUBE TIME**	25309	**DATE SAMPLED**	05/13/2004	**SEVERITY:**	3
GRADE	SAE 15W40	**HYD SYS PRESS**	00000	**UNIT TIME**	448074	**DATE RECEIVED**	06/03/2004	**ACCOUNT #**	46101200030000
FILTER TYPE	FULLFLOW & BYPASS	**MICRON RATING**	003	**LUBE ADD**		**DATE COMPLETED**	06/07/2004	**Loc - Lab# - DA**	I - 435718 - JJS

COMMENT Lubricant and filter change is suggested if not done at sampling time; Iron is at a MINOR LEVEL; Base number is below acceptable minimum; Infared results indicate that NITRATION is at a MINOR LEVEL;

WEAR METALS											CONTAMINANT METALS			MULTI-SOURCE METALS					ADDITIVE METALS				
Fe	Cr	Ni	Al	Cu	Pb	Sn	Cd	Ag	Ti	V	Si	Na	K	Mo	Sb	Mn	Li	B	Mg	Ca	Ba	P	Zn
10	0	0	1	0	0	1	0	0	0	0	4	2	1	31	2	0	0	45	364	2346	0	1167	1230
56	2	0	1	1	2	3	0	0	0	0	6	3	0	26	0	0	0	23	351	2943	0	1134	1328
92	3	0	1	3	7	2	0	0	0	0	6	11	0	17	0	0	0	23	199	3389	0	1042	1262
118	3	0	1	3	13	4	0	0	0	0	7	8	1	11	0	1	0	27	129	3196	1	970	1176
^^^																							

TEST DATA		LUBE CHANGED	FUEL Vol.	SOOT Vol.	WATER Vol.	VIS 40CCS	VIS 100CCS	TAN Total Acid#	TBN Total Base#	I-R OXIDA	I-R NITRA	ISO CODE	4 MICR	6 MICR	10 MICR	14 MICR	21 MICR	38 MICR	70 MICR	100 MICR
SAMPLED RECEIVED	LUBE UNIT																			
11/05/2003	1000																			
11/11/2003	427003	Y	0.5	<.1	<.1		14.6		8.12	9	11									
01/14/2004	20706																			
01/20/2004	447709	N	0.5	0.6	<.1		12.7		4.12	12	17									
03/16/2004	25056																			
03/19/2004	472765	N	0.5	0.9	<.1		12.7		2.71	14	20									
									^^^		^^^									
05/13/2004	25309																			
06/03/2004	498074	Y	0.5	1.4	<.1		13.0		2.25	13	21									
									^^^		^^^									

Villeneuve Tank Lines

R.R.1, DYER ROAD, MAXVILLE, ONTARIO K0C 1T0
OFFICE (613) 538-2461 - FAX (613) 538-2452

TO WHOM IT MAY CONCERN:

We installed a Kleenoil filter unit on a 3406C Caterpillar engine. We did oil sampling on the engine at regular intervals up to 160,000 kilometers with no breakdown of the oil. Every unit we have purchased has had a Kleenoil filter installed on it. We operate a local and a long distance fleet. Prior to installing the Kleenoil filter units we used to change the main and rod bearings on our Tandem Milk Trucks at approximately 200,000 kilometers due to the effect of the liquid load shifting back and forth in the tank with no baffles. Now we do not bother to check the bearings until we do an inframe because there is very little wear on them.

On our Long Distance Highway Tractors we do not look at or change the rod and main bearings as we used to do in the past.

When the valve cover is removed the top of the valve train is very clean with no deposits of carbon or sludge. We run around 150 power units and I would not think of not installing a Kleenoil filter unit on any of them.

Yours truly,

G MacDonald

Glen MacDonald
Maintenance
Supervisor Villeneuve
Tank Lines Villeneuve
Milk Transport

U-PAK DISPOSALS (1989) LIMITED
15 TIDEMORE AVE., ETOBICOKE, ON M9W 7E9
Telephone: (416) 675-3700 Fax: (416) 675-3701

To Whom It May Concern:

We were interested but skeptical when Richard Wright of Kleenoil approached us regarding a bypass engine oil system. This system would lengthen our oil and drop intervals on our PM2 Maintenance program from 15,000KM to 60,000KM.

After Richard's demonstration of product data we tested the product on two trucks. In conjunction with the Toromont Oil Analysis program, we were currently using; we monitored the results of the oil quality. We were very impressed with the results.

We have decided to run this program on our entire fleet of 60 disposal and recycling trucks, including city and long haul units. There has been a substantial cost savings not only on the oil and filters but the labour costs have also decreased dramatically due to the time saving for a 10 minute oil filter cartridge change.

Upon installation of the system we do a full oil drop including all the filters. Then we change only the Kleenoil cartridge every 15,000KM. At the 60,000KM milestone we do another full drop.

We have also used the Kleenoil product on the hydraulic systems of a large industrial baler and a garbage compactor that we also have on site.

We have been pleased with the service from Kleenoil and have found them to have a good availability of filters. We will be installing the Kleenoil System on any future equipment purchases and highly recommend the product.

Trevor Micallef
U-Pak Maintenance Manager

SCHOONER TRANSPORT

35 JAMIE AVENUE
NEPEAN, ONTARIO K2E BC1
CANADA

Phone (613) 225-9588
Fax (613) 225-9669

November 13, 2002

To Whom It May Concern

We at Schooner Transport are always looking for new technology to help reduce the costs associated with running a transport fleet. We have been using oil analyses as a key tool to help extend our drain intervals on our oil changes.

Since we have switched to Chevron Delo 400 with the help of Kleenoil Filtration Systems, we have twice had oil samples return a admirable report after running the unit's over the 100,000 km mark.

We would not hesitate to inform others of the results we have had using Kleenoil and Chevron Delo 400 15W40. We have the oil sample reports to prove it.

Should you require additional information, please do not hesitate to call.

Steen McDonald
Schooner Transport

B E R T R A N D & F R E R E C O N S T R U C T I O N

56 LONGUEUIL, C.P. 301, L'ORIGNAL. ONTARIO, KOB 1KO FAX: 613-675-2610

To whom it may concern:

Kleenoil Filtration Products for my company is a sure way of saving. Our operations are quarry crushing, gravel transportation, excavation and floating.

We first experienced two Kleenoil filters four years ago on a 966D wheel loader and a Western Star 350 big cam Cummins engine. We scheduled a Kleenoil filter change on the loader at 200 hours and manufacturer filter & oil change at 500 hours. On the tractor we scheduled the Kleenoil filter change at 20,000 kilometers and the manufacturer filter and oil change at 100,000 kilometers or once a year.

We have sent oil samples to Wear Check and Crothers and the results were very satisfactory.

The following year we purchased 30 more units & installed them on our front end shovel, euclids, stationary engines, dump and mixer trucks and balance off wheel loaders.

Sleeve pitting on a Cummins engine was the reason why we opened an engine and inspected the crankshaft, the bearings were done at the same time and let me tell you, we are very well pleased with this product.

Fuel, water, antifreeze and aluminum and copper sediments could be detected in the filter before any failure. I strongly recommend Kleenoil filter to anyone.

Jocelyn Cadieux

Jocelyn Cadieux
Service Manager

CRS CONTRACTORS RENTAL SUPPLY
2600 Edinburgh Place, Ottawa, ON K1B SMI Tel.: (613) 744-8889 Fax (613) 746-6333

30th June 2003

Regarding the use of Kleenoil Filters on rental equipment

To whom it may concern:

We have been using Kleenoil Filters on rental equipment since 1989 both with this company and with previous organizations. Rental equipment often has a very hard life since it is not always possible to adhere to regular service intervals. As a result we found that we had to carry out major repairs to some of our engines every year. However, since we fitted our fleet with these filters, we have not had to re-build a single engine and, as you can imagine, this represents a considerable savings to our organization. We absolutely recommend this product as a simple, reliable method of increasing your profitability and efficiency. If there is any further information that you may require please do not hesitate to contact the undersigned.

Randy Speaker