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The Value of Oil Analysis or How Oil Analysis Can Save You Money

Lubricating oil is as important for an engine or gearbox as blood for a human. Today, a huge volume of information about human health can be obtained from blood tests.

And now, the same applies for any system using lubricating oil. Used Oil Analysis is one of the most important, and maybe the simplest, approaches to diagnosing the health of a machine. It is, however, not that easy for users or engineers to understand and interpret each analysis parameter correctly and to assess the condition of the oil and the lubricated system. This is where the Technical Staff from the oil laboratory can assist by carrying out used oil diagnosis for the engineers, training the engineers in oil diagnosis and working with them as a team.

Used oil analysis provides plant maintenance personnel with three indicators of oil and machine condition;

1. ***The condition of the oil*** - To provide recommendations on its suitability for further use and optimization of the oil change intervals.
2. ***The contamination levels of the oil*** – Provide data on the level of contamination in the oil,
    - Is the oil contaminated with another fluid?
    - Is the oil contaminated with particulate matter, what is the size range and where may it have come from?
3. ***The condition of the equipment*** – Is the machine wearing, at what rate, and what components.

It is standard practice to change oil at the OEM recommended period regardless of the oil blend and quality. The OEM recommends an oil change period that will be 100% safe to ensure they have no warranty claims. However, nowadays most quality engine oils will provide at least double the recommended operating life, 250 hours to 500 hours. A large number of major companies have implemented an oil life extension program but with the support of a used oil analysis program.

Implementing a used oil analysis program saves direct costs of oil and labour plus it will allow your machines to be working in the field not parked in the workshop. Major oil companies now actively promote used oil analysis, the following example is from Fuchs.

"Experience shows that every SEK 10 you spend on oil analysis results in a saving of SEK 45 somewhere else in your operations, primarily in the form of fewer breakdowns and longer oil drain intervals," says Charlotta Brodin, Laboratory Manager at FUCHS Lubricants Nordics.

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Following is a summary of some of the costs that can be controlled when decisions are made with the benefit and guidance of oil analysis.

1. ***Repair Costs*** - If a machine presently fails once every year, one can estimate the average costs for parts and labour to restore the machine and present that as an annualized value to ease analysis. For instance, if a machine fails once a year and, on average, requires $55,000 for restoration, the average annual repair cost is $55,000
2. ***Downtime Costs*** - When a mission critical machine is not running, the cash flow is zero. One can estimate the typical downtime cost associated with a machine's failure and multiply it by the average duration of the lost production time. It is important to look only at the profit of the production in the financial analysis (production loss minus cost of goods sold). (If a process plant in a large gold mine is not operating the lost revenue is USD50,000 per hour of down time)
3. ***Lubricant Costs*** - Often, changes in lubrication management, oil change intervals guided by oil analysis reduce the consumption of lubricants. Savings will come from reductions in lubricant costs, labour and disposal costs.
4. ***Energy Consumption Costs*** - Usually, improving lubrication results in reducing friction. By comparing energy consumption of individual machines and the total plant during normal operation before and after changes in oil cleanliness and oil types, these savings can be effectively estimated.
5. ***Quality Costs*** - Often, percent defect is reduced through good management of lubrication quality. This is especially true in applications like moulding, machining, rolling and casting where the precision of hydraulic control is affected by the lubricant's quality. But it is true elsewhere as well. Simply stated, good running machines seem to make better products over the long haul.
6. ***Increased Production*** - In some cases, properly lubricated machines can produce more. For example, contamination or varnish can slow the cycle time of a moulding machine, reducing its output. Likewise, proactive and predictive lubrication analysis and management may enable management to turn production up a notch or two with greater confidence that reliability will be assured.
7. ***Risk based Costs*** - Insurance, safety risk, environmental damage and other risk-based costs should be assessed on a case by case basis and included in a rigorously followed oil analysis program in fixed plant operations as this example illustrates.

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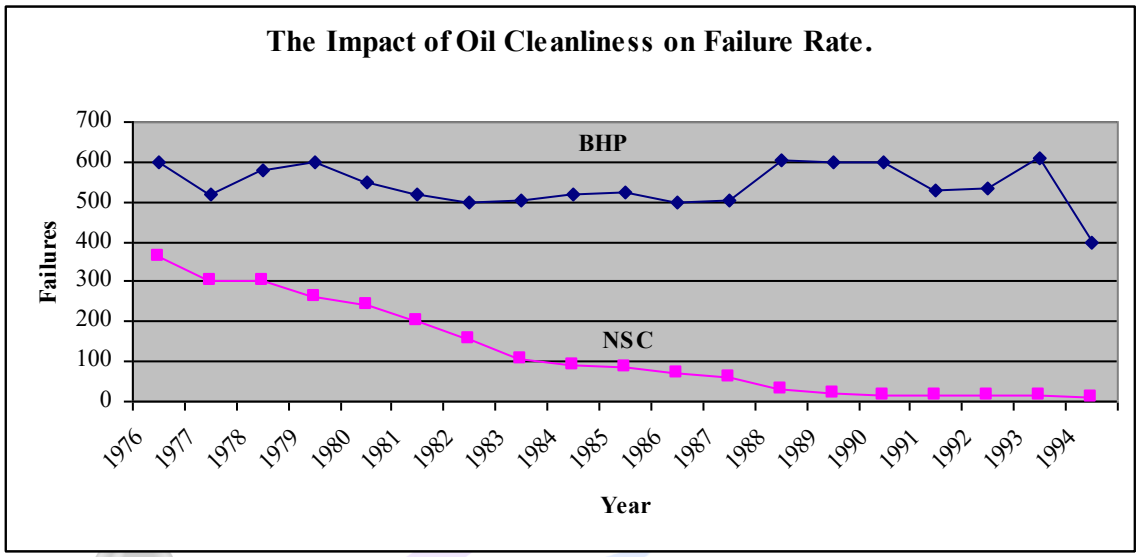


The above graph illustrates the relationship of contamination in lubricants on machinery failures related to. BHP and NSC operate similar steel plants; in 1976 NSC commenced a plant wide program to improve oil cleanliness in their machinery.

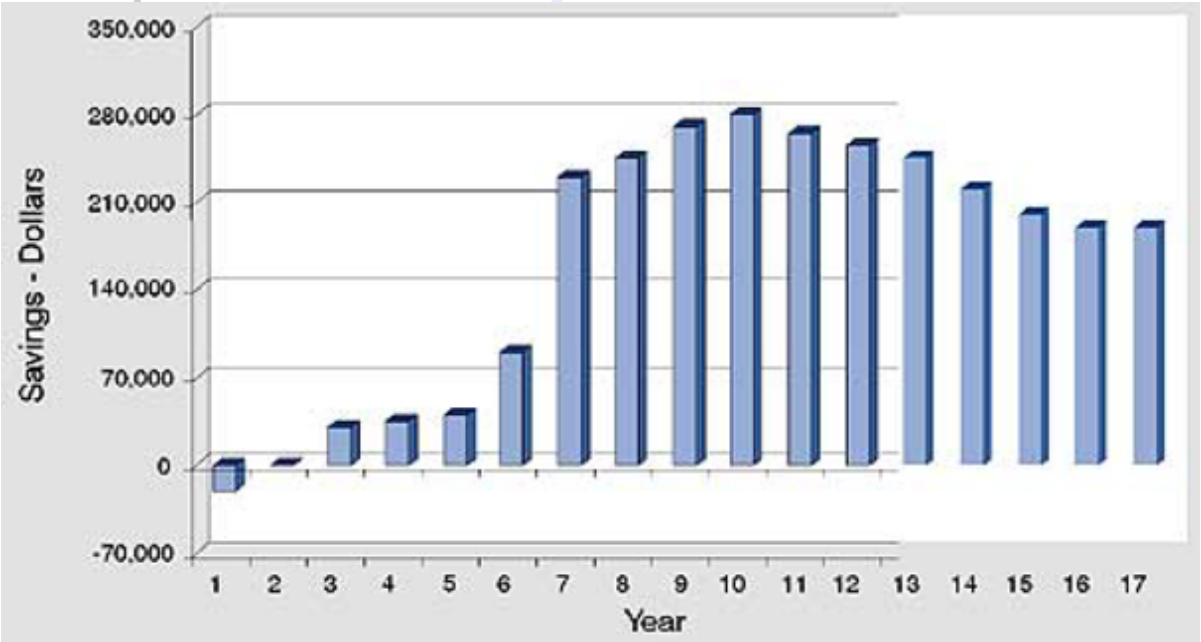
This program resulted in;

- 50% Reduction of Bearing Purchases plant wide
- 80% reduction in hydraulic pump replacements
- 85% reduction in oil consumption
- 90% reduction in pump overhauls
- 90% reduction in lubrication related failures

A further example was at the Pilbara Iron operations of Rio Tinto, before a used oil analysis system was implemented for the locomotive fleet used to move processed ore from the mines to the ports, locomotive engines were averaging 250,000km between major rebuilds. Once the used oil condition monitoring system was adopted and rigorously followed, the service life between major rebuilds increased to one million kilometres. Of course, there were a few early engine failures and a few false alarms, but the majority of the fleet reached the million-kilometre mark. The exact dollar saving resulting from a reduced number of engines rebuilt are not available, but it can be deduced that they are in excess of 50%.

Oil Analysis Savings Case Study

This case study was jointly prepared by Wearcheck, an International Oil Analysis Service and their client, a major US manufacturing and transport company.
The graph shows annual savings from oil analysis over a 17-year period. The first year showed a loss due to upfront costs and time taken to establish a system that actually worked. The second year was pretty much breakeven. The next four years showed a steady climb in savings, and after about seven years there seemed to be a plateau. However, after about 10 years, the inflation adjusted savings appeared to drop off. (see graph below)



What was being observed was a truly world-class maintenance system of which oil analysis was the keystone. After 10 years, most failure modes either had been eliminated or were being controlled. In other words, maintenance had been optimized. What oil analysis was now doing was maintaining that high level of availability, productivity and, of course, profit.

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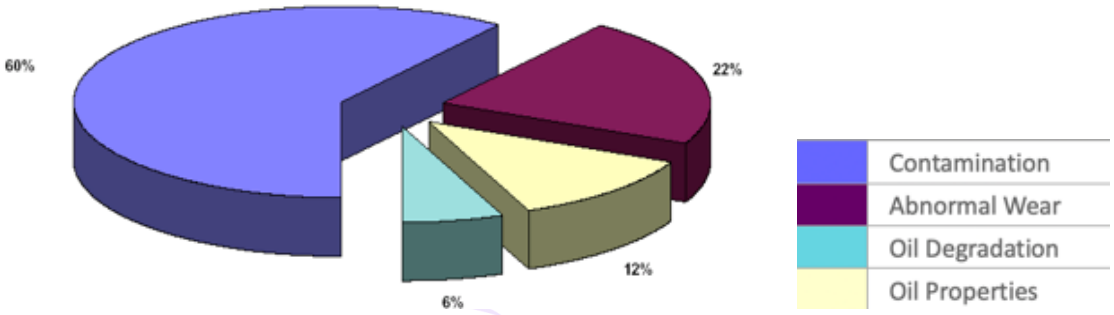
This chart was prepared by the Institution of Mechanical Engineers in the UK after analysing the causes of equipment breakdowns in gearboxes, hydraulic system and transmissions over a 20-year period.



Maintenance teams then used oil analysis to identify what the problem in their operations was, they could then take actions to remedy the problem removing the cause of failure.

The table below illustrates the savings that can be achieved when using a correctly implemented used oil analysis program in a process plant and server failure is one that takes two shifts to fix

Cost	Severe Failure	Moderate Failure	Minor Failure	Weighted Total Cost
Downtime (Less COGs)	$100,000	$20,000	$0	
Parts	$5,000	$2,000	$1,000	
Labour	$10,000	$5,000	$2,000	
Raw Total Cost	$115,000	$27,000	$3,000	
No Oil Analysis - Probability	20%	30%	50%	
Weighted Cost	$23,000	$8,100	$1,500	$32,600
With Oil Analysis - Probability	5%	10%	85%	
Weighted Cost	$5,750	$810	$1,275	**$7,835**
			Savings Per Event Using Oil Analysis	**$24,765**

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Equipment Life Extension Tables

Life extension table have been produced by a number of companies and research bodies, these are used to set contamination targets in hydraulic systems, gearboxes and transmissions. These tables are based on the proven fact that the cleaner an oil is the longer the operational life of a machine or system will be. Using these tables in conjunction with used oil analysis a company can, cost and measure the effort required to achieve a target oil cleanliness level and easily measure the benefits resulting from this approach to maintenance.

Hydraulic Systems:

Life Extension Factor (LEF)

Initial ISO	2x	3x	4x	5x	6x	7x	8x	9x	10x
23/20	20/17	19/16	18/15	17/14	17/13	16/13	16/12	15/12	15/11
22/19	19/16	18/15	17/14	16/13	16/12	15/12	14/11	14/11	14/10
21/18	18/15	17/14	16/13	15/12	15/11	14/11	14/10	13/10	13/10
20/17	17/14	16/13	15/12	14/11	13/11	13/10	13/9	12/9	12/8
19/16	16/13	15/12	14/11	13/10	13/9	12/9	12/8	11/8	11/8
18/15	15/12	14/11	13/10	12/9	12/8	11/8	-	-	-
17/14	14/11	13/10	12/9	12/8	11/8	-	-	-	-
16/13	13/10	12/9	11/8	-	-	-	-	-	-
15/12	12/9	11/8	-	-	-	-	-	-	-
14/11	11/8	-	-	-	-	-	-	-	-
13/10	11/8	-	-	-	-	-	-	-	-
12/9	11/8	-	-	-	-	-	-	-	-

Example: By reducing the particulate levels from an ISO 21/18 to an ISO 15/12, component life is increased by a factor of 5.

Rolling Element Bearings:

Life Extension Factor (LEF)

Initial ISO	2x	3x	4x	5x	6x	7x	8x	9x	10x
23/20	19/16	17/14	15/12	14/11	13/10	13/10	12/9	11/8	11/8
22/19	18/15	16/13	14/11	13/10	12/9	11/8	11/8	-	-
21/18	17/14	15/12	13/10	12/9	11/8	11/8	-	-	-
20/17	16/13	14/11	13/10	11/8	-	-	-	-	-
19/16	15/12	13/10	11/8	-	-	-	-	-	-
18/15	14/11	12/9	-	-	-	-	-	-	-
17/14	13/10	11/8	-	-	-	-	-	-	-
16/13	12/9	-	-	-	-	-	-	-	-
15/12	11/8	-	-	-	-	-	-	-	-
14/11	11/8	-	-	-	-	-	-	-	-
13/10	11/8	-	-	-	-	-	-	-	-
12/9	11/8	-	-	-	-	-	-	-	-

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