Practical, Effective FTIR Technology Reduces Cost on the Plant Floor and/or in the Laboratory. Two Case Histories.

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Abstract: *Companies using conventional commercial-laboratory oil analysis procedures and methods frequently blame costly equipment failures on unrepresentative oil sampling extraction, incomprehensible analysis, or samples (analysis) taken too late to institute any useful corrective action.*

An on-site or lab-based FTIR (Fournier Transform Infrared) spectroscopic analyzer (such as Thermal-Lube's COAT® System) can simply extrapolate a fluid's condition in 'real-time' thereby allowing the user to determine appropriate preventative action to reduce overall lubricant consumption and machinery replacement costs.

Introduction: The need to reduce maintenance costs is becoming a critical factor in the overall ability of a company to compete in a global economy. The past few years have seen major progressions in fluid management technology. Advances in machinery vibration detection, fluid management control through proper proactive maintenance, and personnel education programs have individually and collectively contributed to lubricant life extension. More recently however, the desire to attain ISO 14000 certification necessitates the implementation of a comprehensive fluid Condition Monitoring and Management program.

In the past, we were led to believe that lubricants had a specified life span for a particular application. Equipment manufacturers always dictated lubricant change intervals and these intervals had to be respected to maintain product warranties. It is a known fact that well over 80% of all fluids are changed prematurely. This by itself creates an enormous undue demand on primary resources.

When introducing and implementing a fluid management program, consideration has to be given to overall warranties, insurance, and liabilities. Needless to say, the success or failure of the program remains the responsibility of the person in charge.

In most cases, the direct cost of failure of a flawed fluid management program far outweighs the indirect 'cost savings' of a successful one. To properly implement a Condition Monitoring program, a cooperative liaison must be established between the fluid producer, the laboratory, and the end user. A line of direct communication between parties must be open and synergetic. Once this liaison is established, the desired goals must be identified and agreed upon.

Case History #1: Optimizing the Performance of an 'Industrial' Diesel Engine Oil Formulation for Operating Mobile Equipment (*Caterpillar V225B with a Caterpillar 3208 motor*) in an Aluminum Smelter.

These heavy-duty vehicles operate in a high-temperature, dusty environment located next to aluminum melting pots.
Preliminary tests on mineral-based oils traditionally used by the facility showed premature oxidation and increased viscosity in the motor oils. This inherent weakness showed itself in many applications in and around the smelting operation. FTIR analysis showed a quick, distinct reduction in performance additives, particularly the antioxidant (Fig 1). The end user reported that the life-span of these fluids never surpassed 75 hours of use and that the motors had to be rebuilt every 9 to 12 months.

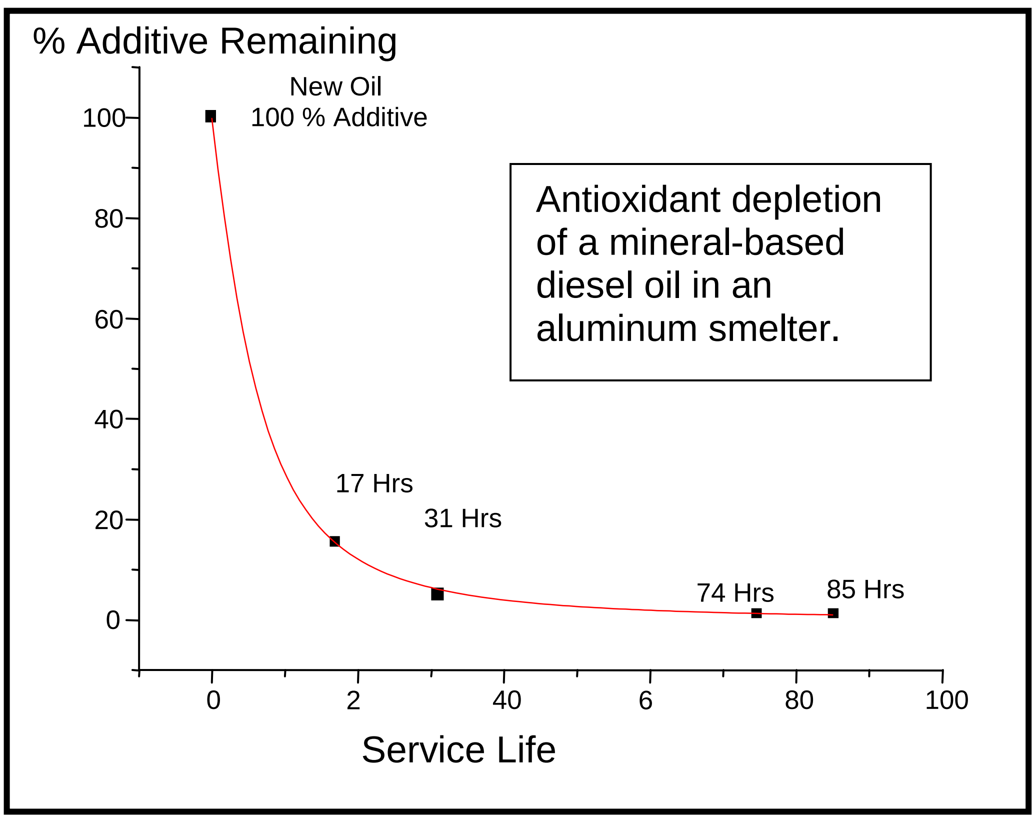

Fig. 1

After forming a cooperative liaison with the smelter and our own analytical laboratory and lubricant production facility, a ‘loop-back’ information flow was instituted. This entailed:

a) proper representative fluid sample retrieval
b) timely acquisition (in duplicate)
c) analytical testing
d) formulation revision
e) product replacement

Note: *An independent commercial laboratory was also employed for data verification.*

Using FTIR spectroscopy data collected over a period of time, it was proved that the airborne alumina dust (Al_2O_3) caused a catalytic degradation of the performance additive package, in particular to the antioxidant (Fig 2).

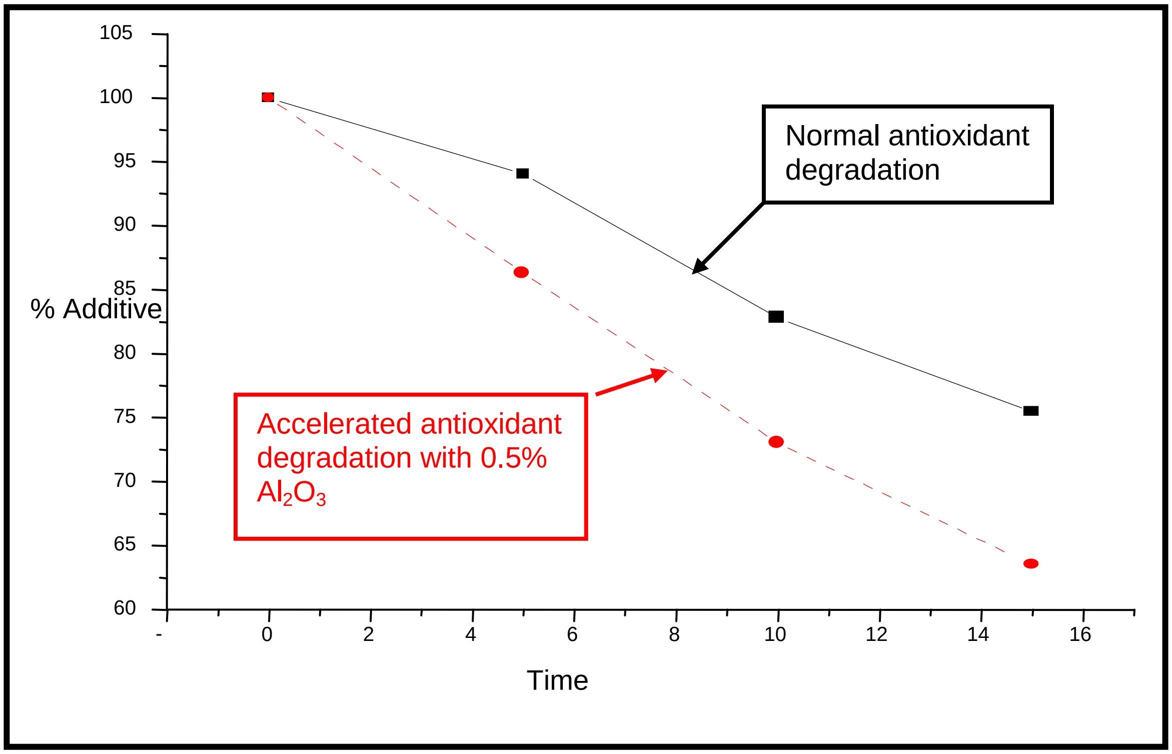

Fig. 2

A stable semi-synthetic base-stock was chosen (PAO/mineral), and was formulated with an antioxidant specifically developed to resist the catalytic degradation. The resultant degradation curve is depicted in Fig. 3.

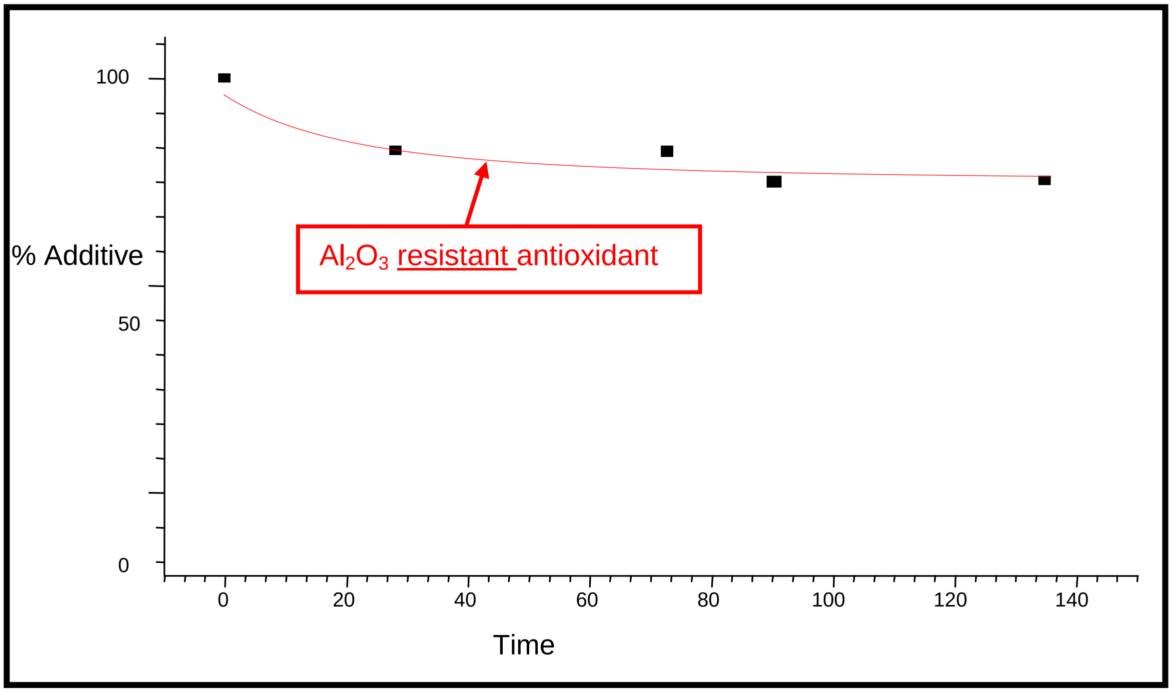

Fig. 3

The cooperative liaison between the lubricant supplier, lab, and customer provided the lubricant manufacturer with enough time and analytical data to formulate a product specific to the application.
From the customer side, the new lubricant resulted in prolonged oil change intervals (increasing from 75 hours to 200 hours) thus reducing fluid consumption as well as disposal costs. Furthermore the service life of the vehicles increased from an average of 9-12 months to more than 3 years of continuous operation.

Case History #2: Performance Optimization of Industrial Equipment at a Copper Mine in Northern Canada.

Moving lubricants in and out of a subterranean mine is a costly and cumbersome endeavor. Inherent safety issues come into play as critical equipment such as air compressors and sump pumps must work continuously at optimum efficiency.

Again, as in the previous 'history', a working liaison was established with the customer. Specific goals were proposed, discussed, and agreed upon as follows:

- To develop superior compressor, gearbox, and hydraulic fluids used in the mining operations.
- To develop an Oil Condition Monitoring program that would ultimately extend engine life as well as re-lubrication intervals.

After a comprehensive lubricant audit and discussion:

- A consolidation of lubricant types was recommended.
- Most reservoirs were drained and replaced by synthetics.
- The proposed life expectancy target of each lubricant was set to 12,000 hours of operation to deem this endeavor a cost-effective success.
- Oil sample ports were defined and a timetable of oil analysis was established (in duplicate) with our own laboratory and
- An independent commercial lab was designated to verify duplicate oil samples.

Using the analytical diagnostic data feed-back generated by the Thermal-Lube COAT® System, three specially designed synthetic fluids were formulated and later enhanced through this analytical 'feed-back loop'. Figs. 4,5, and 6 compare the overall service life of these three fluids with their conventional mineral oil counterparts as used in the mine.

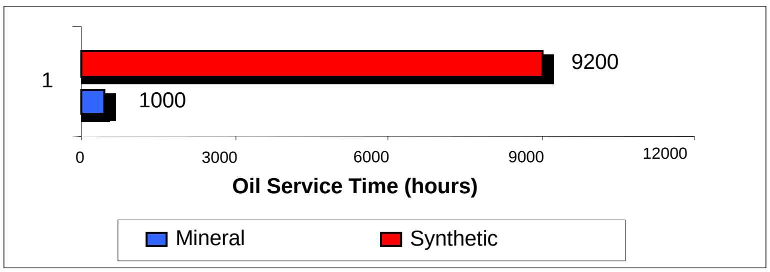

Fig. 4 (Compressor Lube)

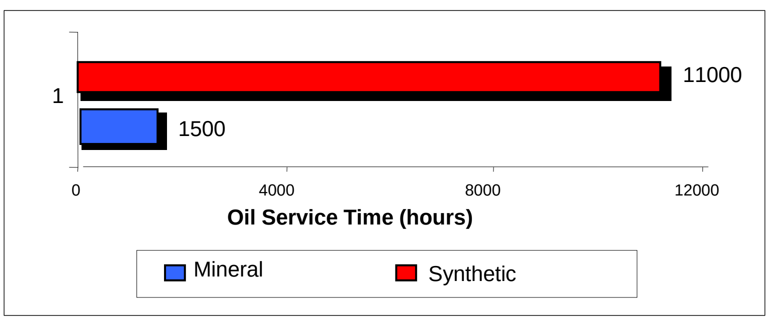

Fig. 5 (Hydraulic oil)

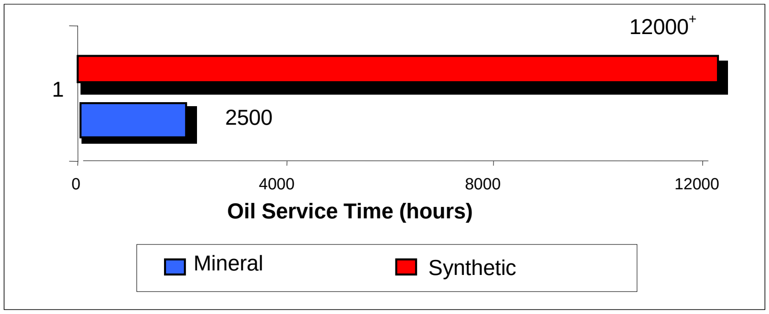

Fig. 6 (Gear Lube)

At the time of writing, all these fluids are still in service and expect to surpass the 12,000 hour target level.

One particular incident is worth noting. A preliminary FTIR analysis of the mineral-based hydraulic fluid was done after only 500 hours of operation. It was noted that approximately 90% of the antioxidant was depleted. Due to lack of proper communication between the laboratory and the mine, this situation continued for an additional 1500 hours even though they were alerted to the problem. An additive package of 'antioxidant' was formulated and blended into the hydraulic reservoir. The oil was 'rejuvenated' and was consequently changed after an additional 4000 hours of operation (Fig. 7)

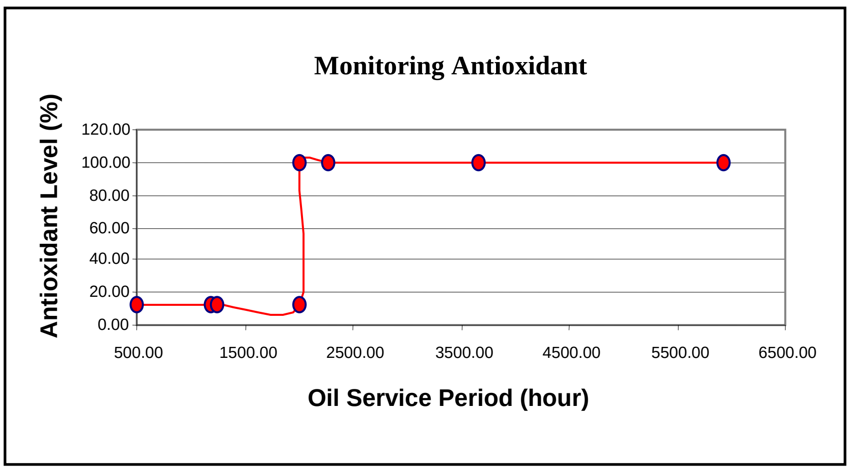

Fig. 7

Conclusion: There is no doubt that a collaborative Conditioning Monitoring program will be cost-effective and profitable. The effort from all parties involved is substantial. Technological advances in monitoring equipment are accurate with a high degree of reproducibility. Ultimately, on-line analysis and treatment systems will be the cost-effective way to go.
Results attained from the two case histories are as follows:

- Substantial lubricant life extension is attainable with a well managed Condition Monitoring program.
- Direct cost benefits to the end user through reduced fluid consumption and overall cost reduction.
- Reduced waste, transportation cost, demand on primary resources, and environmental damage.
- Direct cost benefits to the commercial laboratory through increased sales.
- Direct cost benefits to the lubricant supplier through sales of higher profit lubricants and additives.
- Indirect benefits to the lubricant supplier by establishing, participating in, and maintaining a viable Condition Monitoring program, therefore promoting customer loyalty.