CASE STUDY

OPTIMIZING PERFORMANCE OF INDUSTRIAL DIESEL ENGINE LUBRICANTS IN AN ALUMINUM SMELTER

E. Akochi-Koblé, G. Sutra Cole, J. Pinchuk, D. Pinchuk, G. Arsenault

Introduction

Premature engine failure and reduced lubricant service life are common phenomena of vehicles operating in harsh industrial environments. Few environments are more demanding on equipment than what is found in aluminum smelters. High torque diesel engines that power massive mobile machines that are consistently subjected to high ambient temperatures, intense magnetic fields, as well as unavoidable contamination by extremely abrasive, highly reactive airborne aluminum dust particles. Extensive analysis using **COAT® System Technology** has determined that this unique set of circumstances creates a catalytic chemical reaction within the engine oils, causing rapid degradation leading to unscheduled and catastrophic engine failures.

Objectives

- To develop an engine oil capable of retarding the effects of the catalytic breakdown normally experienced under these harsh smelter conditions.
- To develop an Oil Condition Monitoring program that would ultimately extend engine life as well as the re-lubrication intervals.

Lubricant Life Extension Technology

- The **COAT® System** uses Fourier Transform Infrared (FTIR) technology for the analysis of lubricants. The **COAT® System** is capable of *detecting, determining,* and *replenishing* precise levels of performance- enhancing additives to their respective lubricants.
- Through real-time fluid monitoring, the service life of a lubricant may be extended by replenishing depleted additives before an irreversible degradation of the lube oil occurs.

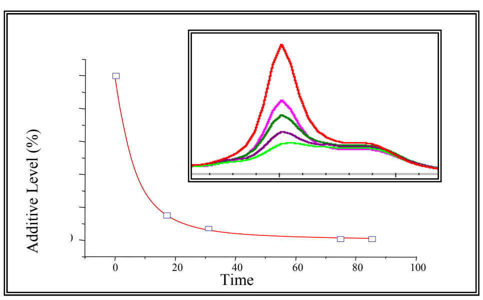


FIGURE 1: *Antioxidant decrease in in-service lubricants as measured from their spectra by the* ***COAT®*** *System*

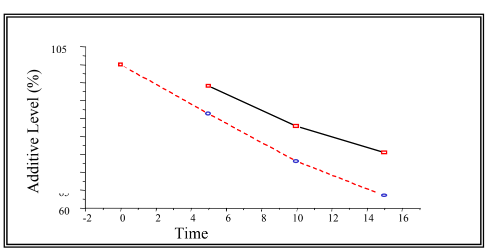


FIGURE 2: *Rate of antioxidant degradation in lab experiment after 16 hours of heating @ 150°C*

Results and Discussion

PART 1: Three industrial lift trucks equipped with CAT3208 engines were selected. Two filled with Thermal-Lube's **POLYON®** 10W40, CG-4 motor oil, and the other filled with conventional 15W40, CG-4 mineral oil. All three machines were returned to normal service and oil samples were taken on a regular basis. **COAT®** analysis of the samples revealed a rapid depletion (>85% after only 17 hours of operation) of antioxidant in both oils [Figure 1]. A simulated laboratory experiment whereby new oil contaminated with aluminum dust and heated to 150°C showed a faster decrease in the level of antioxidant when compared to a non-contaminated sample [Figure 2].

PART 2: Using the analytical diagnostic data feed-back generated by the **COAT®** System, a *semi-synthetic* version of the **POLYON®** lubricant was formulated with an antioxidant "cocktail" providing a higher resistance in the presence of aluminum dust.
Test results showed that 90% of this new antioxidant was retained after 140 hours of service!

The following graphs [Figure 3] compare additive levels, viscosity, and soot loading for *semi-synthetic* **POLYON®** 10W40, CG-4 and the conventional petroleum-based 15W 40, CG-4 motor oil.

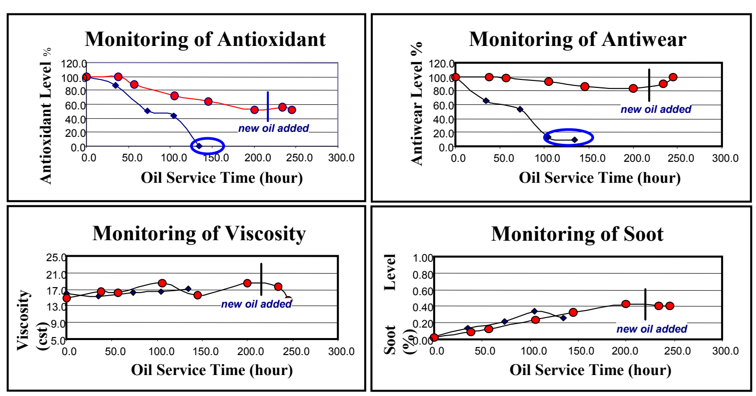


FIGURE 3: *10W40 mineral oil* / *Semi-synth.* **POLYON®** *10W40*

255 Ave Labrosse, Pointe-Claire, Québec, Canada H9R 1A3 | Tel: 514-694-5823 Toll Free: 800-567-5823 Fax: 514-694-8628 | www.thermal-lube.com

CERTIFIÉ ISO 9001:2008 CERTIFIED

CASE STUDY

OPTIMIZING PERFORMANCE OF INDUSTRIAL LUBRICANTS AND EQUIPMENT USING COAT® SYSTEM TECHNOLOGY IN A COPPER MINE

E. Akochi-Koblé, G. Sutra-Cole, J. Pinchuk, M. Guertin

Introduction

Moving lubricants in and out of a subterranean mine is a costly and cumbersome endeavor. The inherent safety issue comes into play as critical equipment must work continuously at optimum efficiency.

Objectives

- Reduce the number of different lubricants used in the mine's various operations.
- To develop superior compressor, gearbox, and hydraulic fluids used in their mining operations.
- To develop an Oil Condition Monitoring program that would ultimately extend fluid life as well as the intervals between re-lubrication.

Lubricant Life Extension Technology

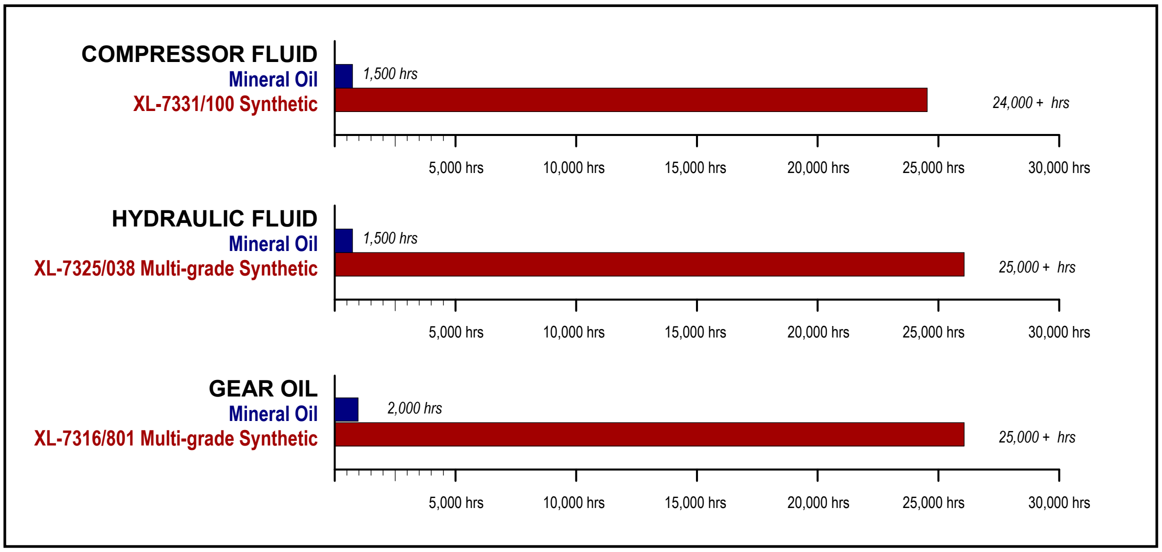
- The **COAT® System** uses Fourier Transform Infrared (FTIR) technology for the analysis of lubricants. It is capable of *detecting, determining,* and *replenishing* accurate levels of performance enhancing additives to their respective lubricants.
- Through real-time fluid monitoring, the service life of a lubricant may be extended by replenishing depleted additives before an irreversible degradation of the lube oil occurs.

Results and Discussion

Two mineral oil hydraulic fluids were replaced with a single fully synthetic product, **XL-7325/038**. In addition, five different mineral-based gear oils that were in use in the mine were replaced with a single fully synthetic product, **XL-7316/801**.

The following figures show that with proper Condition Monitoring using Thermal-Lube's **COAT® System** technology, the service life of these fluids has been extended from 1500-2000 hours to more than 25,000 hours.

Using the analytical diagnostic data feedback generated by the **COAT® System**, three specially designed synthetic fluids were formulated. The graphs below compare the overall service life of these three fluids with their conventional counterparts as used in the mine.



THERMAL-LUBE INC.

CERTIFIÉ ISO 9001:2008 CERTIFIED

CASE STUDY

A NEW AND COST-EFFECTIVE APPROACH TO MONITOR BLENDING OF NEW LUBRICANTS IN REAL TIME

Introduction

The manufacture of lubricants requires accurate blending of performance additives with base oils. The selection and quantity of additives directly influences the type, viscosity, performance, and cost of the finished lubricant. Batch to batch variability due to *mis*-dosage of any specific additive may lead to adverse effects on the entire blend. Additionally, most commercial additives are sold pre-diluted with a carrier fluid. Therefore, any change of supplier or error in the additive formulation may also influence overall quality of finished products.

Objectives

- Monitor and control in-line blending of lubricant oils in real time
- Ensure batch-to-batch consistency and quality in the manufacturing process

COAT® Technology

An FTIR (Fourier Transform Infrared) based analytical device was designed and built by Thermal-Lube Inc. to monitor Thermal-Lube's real-time blending process of automotive motor oils, and industrial gear, compressor, and hydraulic fluids. This portable system was employed directly on the plant floor and was wheeled from mixer to mixer where data was extracted.

Analytical Approach

- Pre-analyze each additive concentrate to determine an accurate level of active ingredients
- Record infrared spectra of all targeted additives at their pre-established concentrations (i.e., anti-wear, viscosity improver, anti-oxidant)
- Compile a comprehensive infrared database library of finished lubricant products
- Monitor lubricant formulation during production and set *minimum* and *maximum* alarm levels (Figure 2)
- Create a data feedback loop to production and formulation personnel and advise of real-time additive levels (Possibile automation as in Figure 1)

FIGURE 1: *Thermal-Lube's COAT® (Continuous Oil Analysis and Treatment) Technology*

Results and Discussion

- Results obtained from lubricant formulation monitoring demonstrate that FT-IR spectroscopy is an effective method for monitoring formulations.
- FTIR technology virtually eliminates the necessity for weight and volumetric dosing of additives in blending procedure.
- Quality and batch-to-batch control may be maintained at a spectral level thereby optimizing production cost and product efficiency.
- Pre-analysis of each performance additive also acts as a screening device to verify supplier's product and quality
- Reduces Human error due to miscalculation or introduction of incorrect additives.

FIGURE 2: *Spectral depiction of a lubricant performance additive in solution at various levels*

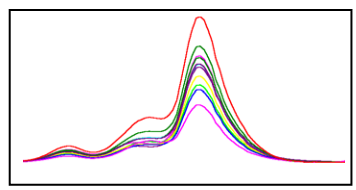


FIGURE 3: *COAT® System automatically controls batch additive dosage through interpreting the lubricant's spectral signature during the blending process.*

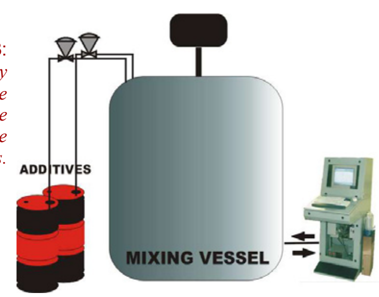
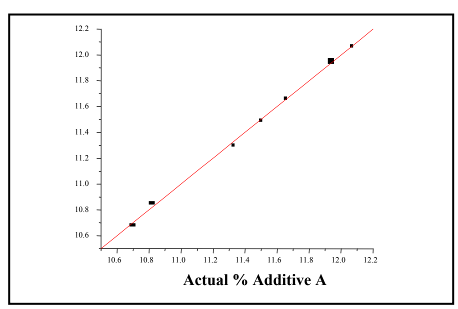


FIGURE 4: *Actual additive dosage level versus the level predicted by the COAT® System. Correlation is nearly 100%*



255 Ave Labrosse, Pointe-Claire, Québec, Canada H9R 1A3 | Tel: 514-694-5823 Toll Free: 800-567-5823 Fax: 514-694-8628 | www.thermal-lube.com

CERTIFIÉ ISO 9001:2008 CERTIFIED

CASE STUDY

CONSOLIDATING INVENTORY USING EXXEL® SYNTHETIC LUBRICANTS

Introduction

In a large mining operation, it is essential that each piece of machinery remain in top operating condition. This means that operators must keep enough lubricant on hand to ensure that the equipment runs smoothly. With each equipment manufacturer listing different lubricant specifications for different pieces of machinery, the cost to keep adequate quantities of each product in stock soon adds up. Add to that the logistical requirements of managing multiple inventories and supply chains, as well as the potential human errors and accidents, and the need for a consolidated solution quickly becomes apparent.

Objectives

- Consolidate a broad range of OEM specifications into a smaller number of products, while still maintaining the equipment in proper working order.
- Reduce logistic and inventory storage costs.
- Increase the efficiency and safety of the operation by reducing the potential for human error
- Present the client with several cost-effective options.

Collecting Data

- Look at the inventory levels required to maintain the equipment currently in operation.
- Examine the equipment operating conditions to ensure proper compatibility.
- Determine the lubrication requirements of each individual piece of machinery.

Results and Discussion

Initially, the equipment in use required a total seven individual lubricant products – two hydraulic fluids, and five separate gear oils, as shown in the table below.

Three options were presented to the client, each of which reduced the inventory requirement:

- **Mineral Oils:** Using Thermal-Lube's formulation technology, the total number of products required could be reduced to a single hydraulic fluid and only four gear oils.
- **Semi-Synthetic:** This option leads to significant savings, reducing the overall requirements to one hydraulic fluid and three gear oils.
- **Fully Synthetic:** This third option is the most cost effective, where the two initial hydraulic fluids are reduced to one product, and all five gear oils can be replaced by a single "multigrade" synthetic lubricant. A synthetic lubricant will last up to **10 times** longer than conventional, mineral-based products

There are significant savings to be realized in reducing the total number of individual products required. Not only is the per-litre price lower when purchasing in larger bulk quantities, less stock is needed to service the entire operation.

In addition, a higher-quality, longer-lasting synthetic oil will produce tremendous savings by greatly reducing the need to change oil and repair machinery underground.

MACHINERY	HYDRAULIC		GEAR OILS				
	AW 32	**AW 46**	**EP 68**	**EP 150**	**EP 220**	**EP 460**	**EP 680**
Ore Crusher (with conveyor)	2200 L	N/A	N/A	2350 L	410 L	205 L	205 L
Fixed Underground Equipment	615 L	205 L	1135 L	1360 L	N/A	610 L	3400 L
Total Volumes:	**2815 L**	**205 L**	**1135 L**	**3710 L**	**410 L**	**815 L**	**3605 L**
THERMAL-LUBE'S RECOMMENDATIONS							
Mineral Oil (2,000 to 6,000 hours)	XL-8525/038		XL-8535/068	XL-8535/220		XL-8535/460	XL-8535/680
Semi-Synthetic Oil (4,000 to 10,000 hours)	XL-7305/038		XL-8316/759			XL-8316/140	
Synthetic Oil (8,000 to 20,000 hours)	**XL-7325/038**		**XL-7316/801**				