St. Lawrence TECHNOLOGIES

ABSTRACT

Thermal-Lube Inc., in co-operation with the Abitibi-Consolidated Inc. paper mill in Grand-Mère, Quebec, has developed and demonstrated the Continuous Oil Analysis and Treatment (COAT®) system for the analysis and continuous maintenance of lubricating oil.

A lubricant monitoring program was implemented at the mill using the COAT® system, which can identify the additives whose depletion characterizes lubricant degradation.

The results of laboratory tests demonstrated that it is possible to recondition lubricants by returning certain additives contained in the oil to optimal levels. Such reconditioning can double or even quadruple the useful life of lubricants.

INNOVATIVE TOOL

THE COAT® SYSTEM FOR THE ANALYSIS AND CONTINUOUS MAINTENANCE OF LUBRICATING OIL

HIGHLIGHTS

- Technology
  - Analytical instrument based on Fourier transformed infrared spectroscopy
  - Simple, fast and precise analysis in real time
  - Designed to be installed on-line, for continuous monitoring, or off-line, for semi-automatic operation
  - Portable and laboratory models available.
- Environment
  - Optimization of lubricant oil longevity
  - Reduction in volume of waste oil for disposal
  - No chemical solvents or reagents required for oil analysis.
- Cost
  - Savings on the cost of purchasing and disposing of oil
  - Improved diagnosis of equipment wear
  - Analysis can be performed by on-site personnel.

Saint-Laurent Vision 2000

Environment Canada Protection Québec Region

Environnement Canada Protection Région du Québec

THERMAL-LUBE INC.

Canada Economic Development

Développement économique Canada

PROJECT OBJECTIVES

The aim of the project was to develop a technology (the COAT® system) to extend the useful life of industrial lubricants and thereby decrease the volume of waste oil requiring disposal. To this end, a program was set up to monitor the waste oil at the Grand-Mère, Quebec, paper mill of Abitibi-Consolidated.

The project had three phases:

1. **Programming the COAT® system based on information specific to each oil tank (operation, capacity, maintenance, oil type and potential contaminants).**
2. **Monitoring the level of performance additives in each tank.**
3. **Reconditioning lubricants by additive supplements.**

BACKGROUND

In Canada, it is estimated that more than 900 million litres of waste oil is produced annually. Only 50% of this waste is recovered, recycled or reclaimed.

Managing waste oil is a major problem. Companies must regularly change the oil used in their equipment to prevent mechanical breakdowns or poor functioning. Moreover, the cost of disposing of waste oil is often higher than the cost of new oil.

An effective and coherent lubricant monitoring program is therefore necessary—a fact that industry has been slow to accept. There are a number of reasons for this reluctance: conventional analyses are costly in terms of both time and money; the management of samples and mechanisms of getting them to external labs are often poorly co-ordinated; the results of analyses are often not conclusive enough to serve as the basis for decision making.

TECHNOLOGY

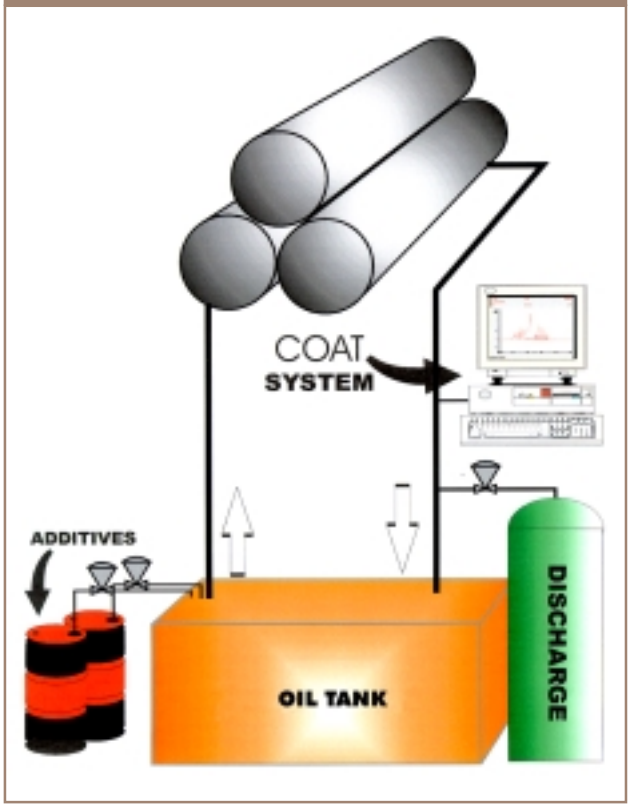
The COAT® system is an analytical instrument based on infrared technology.

It is composed of a Fourier transformed infrared spectrometer (FTIS), a flow-through cell, valves and a pump. A computer equipped with the COAT SCAN® software controls system operation (Figure 1). The analytical procedure is simple: the cell is filled with an oil sample which the system then analyses, displaying the results. The entire analysis takes less than two minutes.

The COAT® system is capable of measuring the level of performance additives (anti-wear, anti-oxidant) in oil, monitoring the formation of by-products from the degradation of oil and additives, and detecting contaminants like water or glycol.

The COAT® system monitors the level of performance additives present in lubricants in real time, making it possible to take immediate corrective action when the rate approaches a critical level. The COAT® system can either activate an alarm to draw attention to the problem, or, in automatic mode, recondition the lubricant by adding preset quantities of the appropriate additives.

FIGURE 1.
SCHEMATIC OF THE MAIN COMPONENTS OF THE COAT® SYSTEM



RESULTS

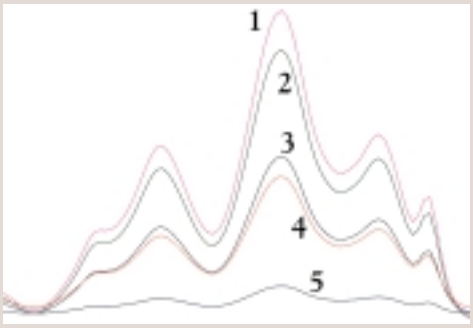
The additive monitoring phase of the project, conducted at the Abitibi-Consolidated Inc. paper mill, allowed us to prepare a profile of the depletion of anti-wear and anti-oxidant additives. This important step demonstrated that the depletion rate of performance additives in a lubricant is directly linked to the application for which the lubricant is used.

The information gathered was used to establish a protocol for lubricant reconditioning by additive supplements. A minimum level was set for each additive as a function of lubricant type and use, as well as the condition of the machine and lubricated parts.

The precision of analyses of anti-wear and anti-oxidant additives was tested in the lab using a polyalphaolefine (PAO)-based oil. The results indicate that these additives can be precisely determined to within ± 0.01% (Table 1).

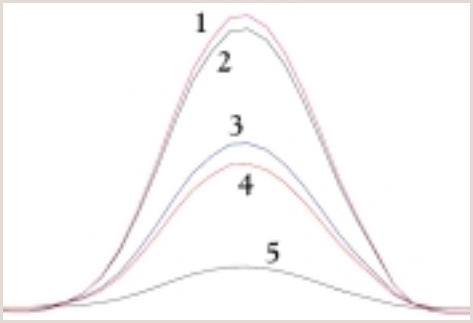
The COAT® system was calibrated using oil from the paper mill and then validated by a procedure of measured additive supplements. In comparing additive percentages determined by the COAT® system against calculated percentages, it was found that the system possesses the analytical precision required to monitor lubricants, and that it can be used to adjust the level of additives during lubricant reconditioning. Laboratory experiments showed that it is possible to bring the level of performance additives to the optimal level simply by adding a predetermined amount of the additives in question (figures 2 and 3). The useful life of lubricants can thus be doubled or even quadrupled.

FIGURE 2.
INFRARED SPECTRA SHOWING LUBRICANT RECONDITIONING AFTER ADDITION OF ANTI-WEAR ADDITIVE



1- New oil: anti-oxidant level = 100%
2- Reconditioned oil: anti-oxidant level = 95%
3- Waste oil sample: anti-oxidant level = 42%
4- Minimum critical anti-oxidant level = 40%
5- Waste oil: anti-oxidant level = 20%

FIGURE 3.
INFRARED SPECTRA SHOWING LUBRICANT RECONDITIONING AFTER ADDITION OF AMINE ANTI-OXIDANT ADDITIVE



1- New oil: anti-wear level = 100%
2- Reconditioned oil: anti-wear level = 98%
3- Waste oil sample: anti-wear level = 45%
4- Minimum critical anti-wear level = 40%
5- Waste oil: anti-wear level = 20%

TABLE 1.
DIFFERENCE BETWEEN ADDITIVE PERCENTAGES PROJECTED BY THE COAT® SYSTEM AND CALCULATED PERCENTAGES

Sampling date	Samples to which additives have been added					
	Projected % of amine anti-oxidant additive	Calculated % of amine anti-oxidant additive	Standard deviation	Projected % of anti-wear additive	Calculated % of anti-wear additive	Standard deviation
19/06/97	1.22	1.08	0.10	0.87	0.71	0.10
24/07/97	1.27	1.16	0.08	0.86	0.76	0.07
07/10/97	1.38	1.30	0.06	0.83	0.69	0.10

POTENTIAL AND LIMITATIONS

Potential

The COAT® system makes it possible to monitor and treat lubricants in real time, so that corrective measures can be taken immediately to prevent the premature degradation of oil. The COAT® system has a number of advantages: there is no need for sample preparation and thus no need for reagents or solvents; analyses can be performed on site without compromising the precision of results; and analysis is simple, fast (1 to 2 minutes per sample) and precise.

The COAT® system can double or even quadruple the useful life of oil, thereby offering an interesting alternative that is both cost-effective and environmentally sound.

Limitations

The COAT® system can not be employed to determine the nature of suspended particles such as metal and fibre debris or solid contaminants from external sources.

INFORMATION

This technology data sheet is based on the results of a technology development and demonstration project conducted by Thermal-Lube Inc., in co-operation with the Grand-Mère, Quebec, paper mill of Abitibi-Consolidated Inc.

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St. Lawrence TECHNOLOGIES

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