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Industrial Equipment Failure Analysis Using FT-IR Microscopic Techniques

This work demonstrates that FT-IR microscopy analysis is capable of determining the cause of failures of many different pieces of industrial equipment. This analysis can then allow the user to take preventative action measures in order to improve the reliability of the system and minimize future failures.

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Introduction
Fourier Transform Infrared (FT-IR) Spectroscopy is used routinely in the analysis of both new and in-service lubricants to determine chemical attributes such as oxidation, nitration, sulfation, water and soot.¹ These chemical species are normally attributed to the chemical stress and oxidation of the fluid and can be monitored using trending or differential techniques.² FT-IR analysis is also used routinely to monitor depletion of lubricant additives such as detergents and corrosion inhibitors. In addition to in-service monitoring, FT-IR spectroscopy has proven to be a valuable tool for identification of contamination in lubricants and for analyzing chemical species found on failed components (survival analysis).³ In such analyses, the qualitative and quantitative information of the bulk sample change is replaced by close attention to gain to the micro-environment except for particle counts. Traditionally, the analysis of particles in used lubricant and grease samples has been problematic, especially when trying to determine failure modes of lubricants for root cause analysis.

A valuable accessory to the FT-IR instrument that can be used for the analysis of microenvironments in lubricants and grease is the FT-IR microscope. The first commercially available FT-IR microscope was invented by PerkinElmer and Molecu Coated in 1993.⁴ Continuous improvements in system hardware combined with intelligent software development has led to highly automated modern-day systems.



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