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Relying on oil analysis simply to guide oil change decisions leaves lots of valuable information on the table about a machine's health. Here is an overview.

Historically, machine condition monitoring and predictive maintenance activities have been very sectarian in nature. Researchers and practicing engineers alike have maintained a one-dimensional approach to the business of machine condition assessment.

In industrial applications, especially in the power generation and petrochemical industries, vibration analysis has been the technique of choice. Conversely, in the fleet industries, oil analysis has been the technique of choice because of the preponderance of diesel engines. In general industrial applications such as primary metals, pulp and paper, etc., both have been used, but oil analysis has failed to reach its full potential.

In the industrial (nonfleet) applications of machinery condition monitoring, we have experienced in the past a split between oil analysis and other modes of condition assessment or predictive maintenance, with respect to both the responsible department and the purpose for acquiring the information. Vibration analysis and several other technologies typically have resided within the maintenance department where decisions about ensuring machinery reliability are made. Oil analysis has resided within the lubrication group or the chemistry department where decisions about making oil changes are made.

This is changing. Many plants have found significant synergistic opportunities to increase reliability and uptime when oil analysis is administered by the reliability organization and coordinated with other condition assessment activities. The following discussion explains the unique contributions of oil analysis. The mutually reinforcing roles of oil analysis and vibration analysis in assuring machinery reliability will be covered in a future article.

Oil analysis in machine condition monitoring

The role of oil analysis has a varied and inconsistent history. In the petrochemical and power generation industries, oil analysis has been conducted primarily to determine when and/or if an oil change is required. In hydraulic applications, it has been used to control the contamination that jams servo-valves and abrades components, leading to premature component failure. In fleet applications, oil analysis has been applied to determine when additives have depleted, soot is building up in the oil, fuel and/or coolant is contaminating the oil, or abnormal component wear is occurring. Each application is valid and each application provides information to support important, but varied, decisions. In sum, there are three distinct categories, or dimensions, of oil analysis:

1. Fluid health analysis—Oil analysis reveals the general health of oil. The oil's physical, chemical,and additive properties can be measured and trended to guide decisions about if and when an oil should be changed or regenerated with an additive package. Oil analysis also identifies when the incorrect oil has been added to a system. When oil is degrading abnormally, oil analysis often can determine if the degradation is oxidative, hydrolytic, or from another root cause. In addition to simple oil change decisions, oil analysis supports decisions to change oil base-stock or additive formulation or control the environment in which the oil operates. Machines cannot run healthfully without healthy lubrication, making these decisions imperative to the reliability effort.

2. Contamination monitoring—Contamination is a leading cause of machine degradation and failure. Abrasive particles and moisture combined lead to the generation of the majority of wear in various industrial applications. Also, particles and moisture contamination strip the oil of its additives and exacerbate lubricant degradation. Contamination monitoring enables the reliability organization to make effective decisions to control this important cause of machine failure.

3. Wear debris detection and analysis—When a machine is ailing, it generates particles. The detection and analysis of wear debris assists in scheduling maintenance actions and in determining the root cause of a problem.

An effective program of oil analysis should include a focus on each of the three distinct dimensions of oil analysis. Relying upon oil analysis information simply to guide oil change decisions leaves a tremendous amount of information value on the table about the machine's health and the interface between the machine and its environment.

Proactive control of machine health

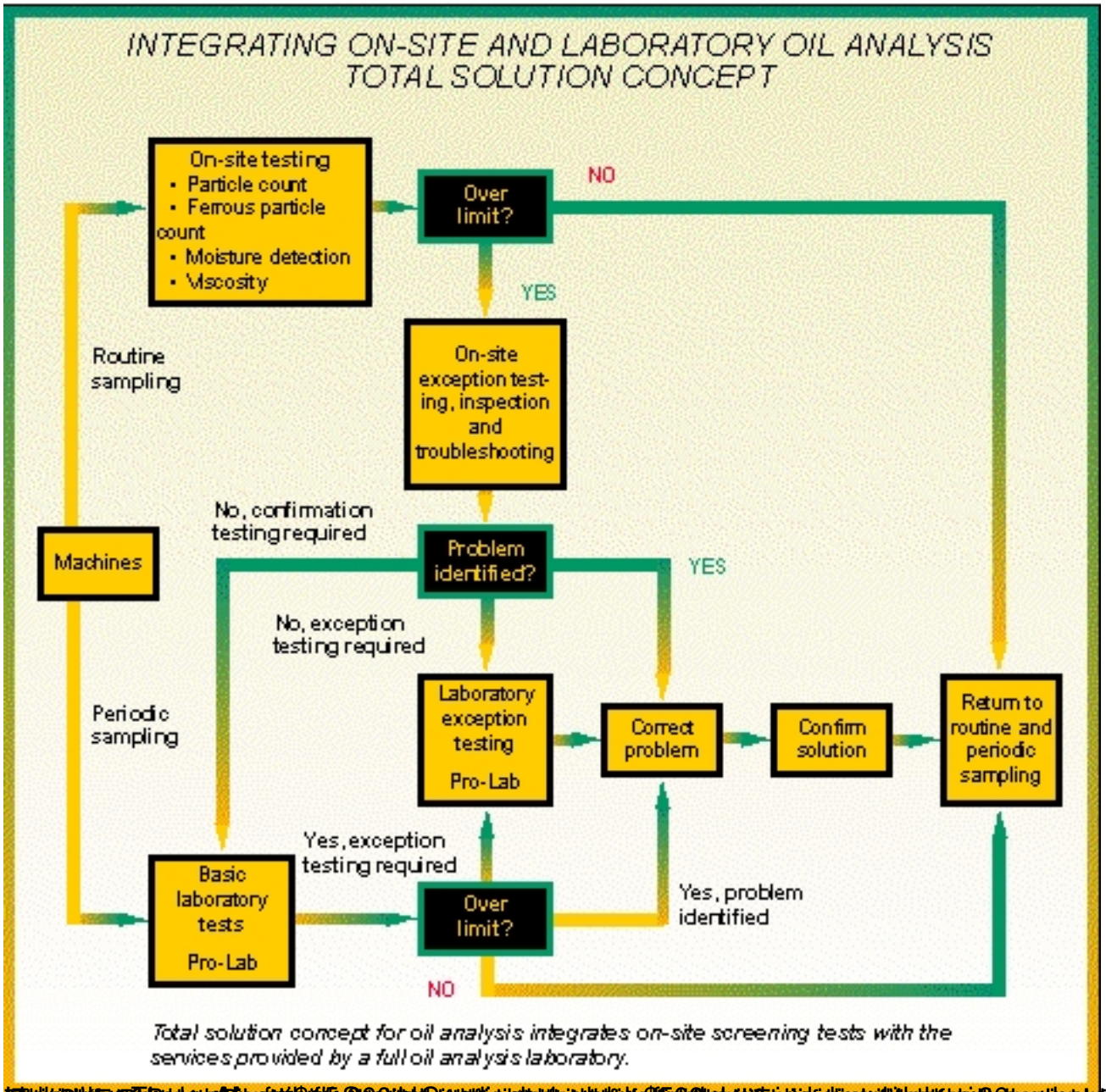
Avoiding machinery failure should be the prime directive of the reliability organization. Once a machine is specified, designed, manufactured, installed, and deployed, there exists a finite number of variables to ensure health. Production management defines load via production schedules. The reliability and maintenance department has control over the following failure root causes that are known to lead to machine degradation:

- Machine alignment
- Machine balance
- High operating temperatures
- Lubricant health
- Lubricant contamination

Precision alignment and balance programs have proven to reduce the occurrence of failure. Likewise, controlling lubricant quality and contamination has proven to be very effective in extending the life of mechanical components and systems. In a study by the Canadian National Research Council, contamination was found to be the leading cause of wear in a variety of industries investigated. In fact, 82 percent of all wear was found to be particle induced (see accompanying table).

The effects of contamination are slow and usually imperceptible until the late stages of failure. The result, however, is very predictable. Particle contamination or water contamination can reduce the life of mechanical components by orders of magnitude. In laboratory studies at Oklahoma State University, the British Hydromechanics Research Association, and others, component life was found to be a predictable function of lubricant contamination.

Nippon Steel reduced bearing failures by 50 percent through aggressive contamination control. International Paper's Pine Bluff mill reported a 90 percent reduction in bearing failures through aggressive contamination control.



Total solution concept for oil analysis integrates on-site screening tests with the services provided by a full oil analysis laboratory.

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