Using Onsite Oil Analysis to Drive Down Maintenance Costs

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In a recent plant reliability survey, between 60 to 70% of industrial facilities consider oil analysis an important part of their reliability programs[1]. Oil analysis gives a snapshot of machinery health, preventing unnecessary oil changes and assisting in predicting equipment failures. This paper will take a detailed look into using data to decrease maintenance costs and increase the bottom line. Being able to extend oil drains or even shorten them to eliminate failures, can be an easy way to reduce maintenance costs, but data must be available that allows for making those decisions. This paper will address the role of key performance indicators (KPI's) in predictive maintenance, how to gather useful data that aligns with KPI's and review a few case studies where on-site labs were able to use data to take advantage of warranty periods, justify keeping assets after warranty and extend oil drains to reduce oil consumption.

Oil Analysis Introduction

Lubricant analysis is much like a blood test for humans. By trending the correct parameters like blood pressure and cholesterol, the patient gains an understanding of overall health. Deviations in those trends over time, indicate action needs to be taken. The same concept can be applied to machinery health when looking at the three key areas of oil analysis: wear, contamination, and chemistry. Using data in these three areas can assist in lowering overall maintenance costs, reduce unplanned downtime and increase asset life. Within a plant setting, oil analysis is often paired with several other technologies that encompass the CPM program or Condition Based Maintenance Program. The most common technology seen is vibration analysis. Typically, vibration analysis picks up on faults just a little bit later in the failure progression process than oil analysis, which is why they are typically paired together. Infrared thermography and motor circuit analysis is also used from time to time. Pairing technologies together, gives confidence in the results and helps the engineer make critical decisions if needed to take a machine offline or remove from service.

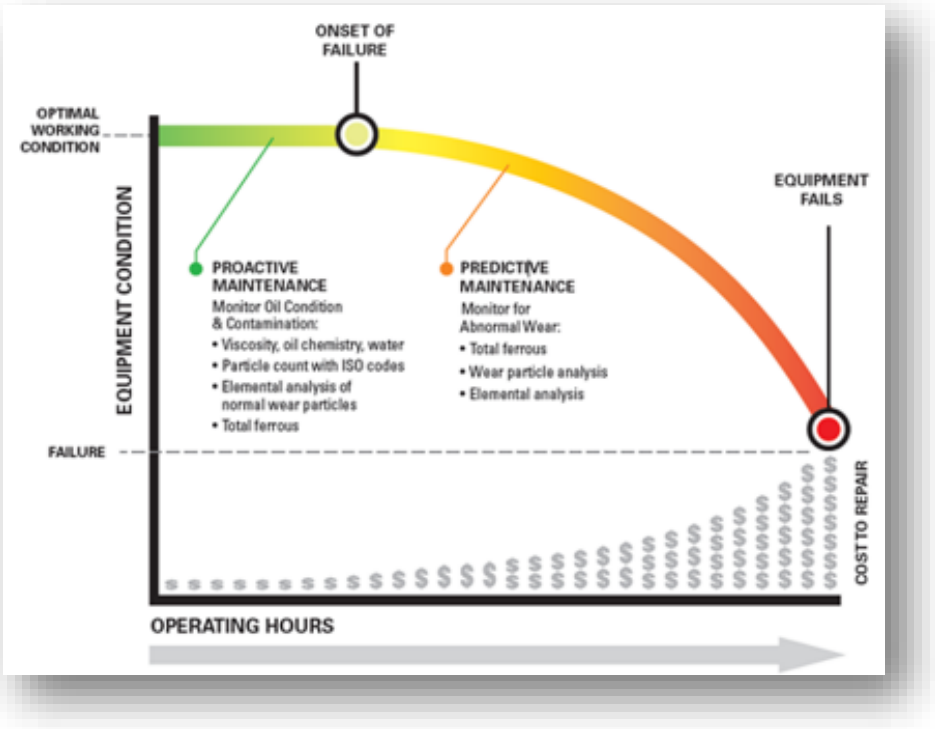


Figure 1: Machine Failure Curve showing the typical progression of problem to failure of the component.

Figure 1 shows a typical machine failure curve. The figure clearly depicts that oil analysis testing like viscosity, elemental and particle count are useful parameters to trend even when equipment condition is considered satisfactory. Any issues detected would still be early enough in the failure process to perform the necessary maintenance in plenty of time before a failure. This keeps the cost of repairs relatively low. As the machine failure progresses, the detection of abnormal wear can be detected and still addressed early in the process to keep costs under control. The later in the process of run to failure, the cost of repair goes up and production time is lost as well.

Establishing Oil Analysis KPIs

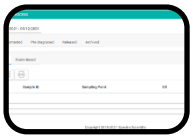
Strong reliability programs typically have Key Performance Indicators (KPIs) tied to company financial goals. KPIs are measurable values that demonstrate how effectively a company is achieving key business objectives. Understanding the company goals is typically going to come from the top down and likely will strictly be expressed in numbers. A manager may say maintenance costs are cut by 25% and end there. If cutting costs by 25% is the main goal of the year, it must be broken down into tangible goals that the maintenance department can achieve. Some tangible examples include: increase production of machines by 25% and/or reduce oil consumption by 25%. However, these are broad KPI's that still need to be broken down even further to achieve the goal. The question then becomes: How to reduce oil consumption by 25% - extend oil changes? Sweeten oil when necessary, instead of draining the entire reservoir? Data helps drive these decisions.

Data is powerful, but it must be the correct data that aligns with the KPI's to achieve company goals. If trying to increase production on a particular machine by 25%, then it is necessary to reduce the chances that unexpected downtime will occur. Unexpected downtime can be related to several issues, some of which relate to either improper equipment installation or lubricant contamination issues. A great place to start is lubricant

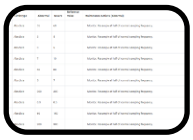
contamination issues and getting control of moisture and particle contamination. About 80% of machine failures can be traced back to particle contamination. By starting with filtration, the chances of increasing uptime are strong. Increasing bearing life can also be related to lubricant cleanliness. Reducing oil consumption can be related to contamination and preservation of the oil and additive chemistry. Extending oil changes will be related to preserving and maintaining the integrity of the oil chemistry and keeping the oil clean. For additional assistance on developing test slates and choosing correct parameters, ASTM Standards ASTM D6224, ASTM D4378 and ICML 55.1 Section 7 can be used.

On-site Oil Analysis Solutions Support Reliability

Dashboard and TriVector Distribution



Sample Analysis Process



Adaptive Rules Engine

Reporting

Figure 2 shows key components of software solutions needed to support onsite oil analysis programs.

Advances in software that integrate the expert knowledge of the onsite equipment specialist and lubricant analyst are available to help maintenance professionals justify oil analysis programs within their facilities and maximize equipment life. Understanding how to quickly and effectively implement Industry 4.0 techniques becomes increasingly important in an era when many maintenance programs are being downsized or absorbed by other areas of the company.

Effective oil analysis techniques that provide value to the facility require the incorporation of two main concepts: knowledge of the component behavior and an understanding of the lubricant data generated by the component. By pairing these two concepts, proper diagnostics and recommendations can be made that are practical and easily implemented by the maintenance staff[2].

Connecting Globally

Enterprise thinking is the practice of considering the entire organization in the decision-making process, not just an individual department or group. Enterprise thinking can make the organization leaner and more agile.

Enterprise solutions typically develop at the corporate reliability level with the intention of promoting efficiency, consistency and a more system-wide approach to the complex process of asset management. Enterprise or networking of knowledge is an efficient way to share information over a certain platform at varying locations. This mentality works best when an organization already has a well-established site and can easily share that information with other locations or parts of the organization. Organizations that have standard equipment across multiple sites, have similar Key Performance Indicators (KPI's) or use the same software are good candidates to deploy enterprise solutions[3].

On-site Analysis Case Study: Food & Beverage Industry

Figure 3 Food & Beverage Industry

In the Food and Beverage industry, there are two processes where oil analysis can play an important role: One is the washdown process and the other is a dry process. In food processing applications, proper cleaning and sanitation are key to produce safe product. Cleaning and sanitation involve a washdown process. They usually have 16-18 hours shifts of running equipment. Then, shut down for 4-8 hours for the complete washdown, and cleanout of the facility. During this process, getting water in the oil is of primary concern. For the dry processes, like breakfast cereal, fine dust particles in the air can enter the oil. In this case, oil cleanliness is of primary concern.

In the Food and Beverage industry, the real interests lie in increasing availability, avoiding shutdowns and unnecessary spending. Looking at an example:

- A plant has 1000 assets.
- 10% are considered critical equipment (100 of them are critical).
- Overall equipment availability is 93%
- Total downtime is 58,800 hours.
- Downtime Cost = $200/hour
- Equates to about 11.8M annual downtime cost.
- Assuming implementing an onsite oil analysis program improves the availability by 0.1% (from 93% to 93.1%).
- Drive down the downtime by 840 hours (from 58,800hrs to 57,960hrs).
- **Equals to $168K in annual downtime cost savings.**

Improved Equipment Availability	Units	Ratio of A Crit Eqp	# of A Crit Assets	Plnd Shifts / Wk	Plnd Run Hrs / Shift	Plnd Wks / Yr	Plnd Run Hrs / Yr	Avail %	DT Hrs	Cost Slowdown Hrs	Ann DT Cost
Current Availability	1,000	10%	100	14	12	50	840,000	93.0%	58,800	$ 200	$ 11,760,000
Targeted Availability	1,000	10%	100	14	12	50	840,000	93.1%	57,960	$ 200	$ 11,592,000
Net Annual Improvement											**$ 168,000**

Conclusion

Maintenance cost savings and productivity increases continue to be driving forces for implementing condition monitoring programs within an organization. Lubricant analysis plays a critical role in a condition monitoring program and pairs well with other technologies such as infrared, ultrasound and motor circuit analysis. Being able to quickly and effectively implement the data is now a reality with advancements in on-site techniques. With the addition of new data, management of the data and knowledge-sharing become increasingly to justify program costs and sustain a reliability program. Software that captures expert knowledge of the machine behavior and lubricant are critical in creating analysis reports that are helpful and easily implemented at the plant level. Once those initial rules, limits and observations are captured by the expert, enterprise tools and other features can be deployed company-wide to synchronize reliability programs within an organization.

References

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