Texas Refinery Corp's

ADVANCED ANALYSIS PROGRAM

Wear Limits or Trends?

By PATTY COLLINS. Texas Refinery Corp. offers a fantastic maintenance tool with the Advanced Analysis Program (TRAAP) we provide to customers who purchase our oil products. Often, customers only sample one time and expect to know the condition of their unit by the one oil sample. And, many times a customer will ask, "What levels are normal and abnormal?"

While some OEMs (Caterpillar, Cummins, etc) specify wear limit ranges for their equipment, unfortunately they are not generally an effective means of determining the health of the component. The levels of contamination and wear debris in an oil sample depend on too many factors. That's why "trending" is important through the Texas Refinery Advanced Analysis Program.

Limits and Trends

Wear limits produced by OEM's are based on testing by the manufacturers, but in the "real world" these numbers can only be used as a "guideline". Machines rarely work in average situations, and limits determined in certain environments often have little relevance in other environments.

The common factors that influence the concentration of wear debris and contaminants in an oil sample include: Type of Equipment, Environment, The job it is performing, Operator skill, Length of time the oil has been in use, and Oil Consumption.

Due to these factors, each piece of equipment must be looked at individually. It is more beneficial to assess the well-being of a machine or lubricant based upon ***trend analysis***.

When using trend analysis for the health of a component, a minimum of three samples is required to establish a trend. This makes one-time sampling very difficult to diagnose the health of the unit. Remember, oil analysis detects minor problems and helps to corrects them before catastrophic failures occur. Regular oil sampling, as opposed to taking samples only when a problem arises, is important in preventing unnecessary failures. Typically a one-time sample without a trend won't supply enough information to determine the cause of a problem.

Dirt Entry . . . Or is It?

Dirt, grit, airborne dust – it's all the same thing. It is also damaging to machinery because if it gets into the oil, it will form a grinding paste that causes wear rates to accelerate rapidly. Fortunately for the oil analyst, dirt is composed mainly of a compound called silicon dioxide, and silicon can be easily detected in oil by spectrometric analysis.

So, would an increase in the silicon level indicate that the level of dirt entering the system is increasing? The answer is: “Yes, sometimes, but not necessarily”.

In the table below, the second example shows an increase in silicon with higher wear readings. This is typical of dirt entry through the air induction system: the silicon indicates dirt during an increase in iron (liners), chrome (rings) and aluminum (piston).

Example	Fe	Al	Cr	Cu	Na	Si	
1	35	8	3	15	12	15	Normal
2	92	29	16	20	16	69	Severe Dirt Entry
3	38	9	4	124	243	101	Internal Coolant Leak
4	35	8	3	15	12	250	Silicon Sealant Used
5	36	10	5	10	19	31	High Anti-Foam Level
6	105	134	38	20	21	145	Fuel System Fault-Piston Torching

The third example also shows an increase in silicon, but this was caused by an internal coolant leak. When cooling water leaks into the engine, it typically evaporates. However, the additives (such as antifreeze) in the cooling water are left behind, and silicon may be part of the coolant conditioner makeup (sodium meta silicate). In this case, the sodium and copper readings increase but others do not. The sodium is also an additive and the copper is not a wear metal but has leached from the radiator core. The silicon is high;, however, it is a contaminant from the cooling system and not abrasive dirt.

The fourth example shows a higher level of silicon, but all other readings remain more or less constant. This is an example of a silicone-based sealant or gasket compound being used. These compounds leach into the oil but do not cause any harm. If this high silicon level were caused by dirt entry, wear readings would be expected to increase due to the abrasive nature of the dirt. It should be noted that dirt is generally a mixture of silicon oxide and aluminum oxide so, in the case of dirt entry, the aluminum level should also increase.

The fifth example shows a slight increase in the level of silicon which is caused by an additive in the oil, poly methyl siloxane, used to prevent the oil from foaming. It does not cause the wear readings to increase and, therefore, does not cause any harm.

The final set of readings is the table illustrates an increase in silicon, iron, chrome and aluminum and appears similar to the second example of dirt entry through the air induction system. However, the aluminum to silicon ratio is almost 1:1, which is unusual. This is an example of piston torching. If an injector is faulty, it allows fuel to lie on top of the piston and burn. The resulting high temperatures can cause the piston to melt with the resulting increase in aluminum (piston), iron (liner) and chrome (ring). The increase in silicon is the result of silicon carbide being alloyed with the piston material in order to reduce the coefficient of expansion of the aluminum. In this case, the silicon is a wear element and is not identified due to the high level but because of the ratio of aluminum to silicon.

Once again, while wear limits can be beneficial, they should be used with caution. Many factors that affect oil analysis results are outside the control of the OEM, owner, operator and oil analyst, and all factors should be considered when making a diagnosis. Trending with several oil analysis samples is the key to preventive and predictive maintenance.

(Special thanks to WearCheck laboratory for some of the information used in this article)