

Evaluating the Source of Silicon in Oil

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Let's say you have silicon showing up on your oil analysis report. Where does it come from and what does it mean? The laboratory suggests the source is due to external contamination and is abrasive, and recommends an oil change.

Great Abundance

Being the second-most abundant element on the planet next to oxygen, silicon is versatile in the world of lubrication and can lead to initially misleading analysis reports. Therefore, it is important to know what to look for and how to evaluate the overall source and severity of silicon.

Silicon is used in many oil types as an antifoaming additive. As an additive, silicon is used in engine, gear, circulating and other types of oils. The consistent variable in the use of silicon is the amount in the new oil.

Oil manufacturers will use amounts of silicon based on different types of oil (Figure 1).

It should also be noted that the values of silicon found in new oils vary between lubricant manufacturers.

A common alarm point from commercial oil analysis laboratories is 20 ppm for silicon concentration. At this point, many laboratories consider the silicon to be excessive and recommend some type of remedial action. As mentioned in countless other articles, new oil sampling is critical to determine the appropriate starting point for the lubricant.

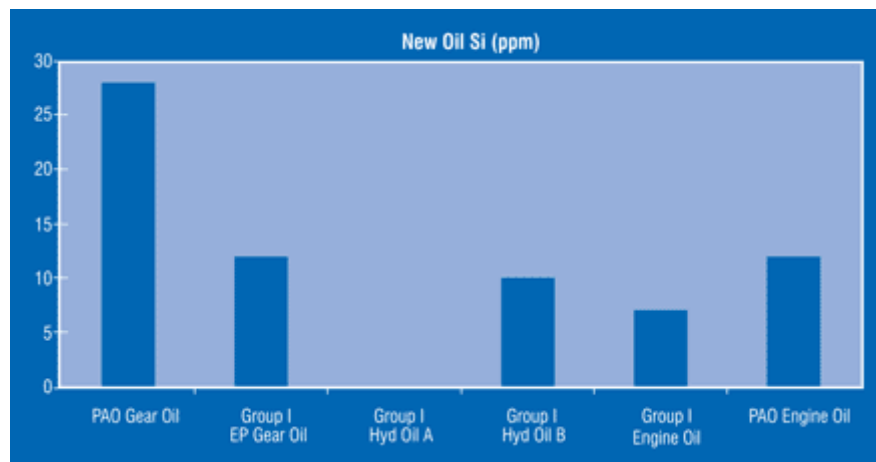


Figure 1. Silicon Levels in Oil

Know the Sources

The evaluation of silicon requires a multi-trend comparison because silicon comes from a variety of sources. Knowledge of these sources is paramount in concluding why/how the silicon is present in the oil as well as to understand what approach to take to remove the silicon if necessary. In addition to the antifoam additive mentioned above, some of these sources of silicon include:

- Silicon sealant

- Steel metal alloy
- Foundry dust
- Common dirt
- Fly ash
- Coolant additive
- New component casting

When evaluating silicon in an oil sample, consider such influencing factors as the following:

- Recent maintenance
- Contamination control measures
- Metallurgy of component tested
- Process debris makeup
- New oil baseline value

Trend Analysis

The proper evaluation of silicon should take place via trend analysis rather than establishing a static alarm point, such as 20 ppm. Take, for example, the classic scenario of dirt ingress. Dirt can be identified on an oil sample report not by the presence of silicon alone, but by the presence of silicon coupled with aluminum at approximately a 3:1 ratio. It should be noted that the actual ratio of silicon to aluminum can be influenced by surrounding areas and actual soil type.

If a hydraulic system has a baseline oil sample containing zero ppm silicon, applying an alarm value of 20 ppm silicon can allow a significant amount of dirt as compared to a gear oil with a starting value of 18 ppm of silicon. Figure 2 shows a typical trend to look for to confirm dirt contamination.

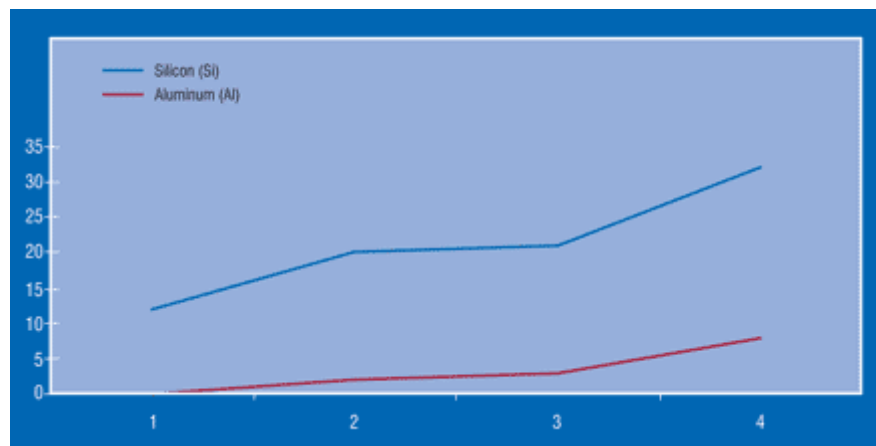


Figure 2

Case Study 1 - Industrial Gearbox

A process-critical industrial gearbox with a 55-gallon sump ran for many years with an extreme pressure (EP) mineral gear oil, and received time-based oil changes on a six-month basis. The oil had a

starting silicon content of 11 ppm and ran at 12 to 14 ppm in used oil samples. The lubricant was changed from a mineral oil to a PAO synthetic gear oil to help facilitate extended oil drains.

After a thorough drain, flush and refill of the gearbox, a regularly scheduled 30-day oil sample was taken for condition monitoring. The results from the lab indicated a silicon value of 25 ppm. The comments from the lab indicated the silicon to be abrasive in nature.

Following laboratory recommendations to change the lubricant, maintenance personnel drained the gearbox of the oil and refilled with another 55 gallons of new PAO gear oil. After pulling the next oil sample, the lab reported 24 ppm of silicon with another recommendation to change the oil.

Upon third-party recommendation, the site decided to sample the new oil. It was at this time that the actual silicon value of the new oil was noticed. This scenario could have been avoided if a sample of the new oil was sent in at the same time as the first oil sample.

Case Study 2 - Gasoline Engine

An individual decided to sample his personal vehicle. Upon receipt of the fourth oil sample, it was noted that silicon and aluminum both spiked significantly, with aluminum being much higher than the silicon value. The overall lubricant properties suggested the oil itself was rather new and there appeared to be no alarming level of other wear debris present. Of particular concern on this sample was the possibility of a "dust down".

"Dust down" is a condition in engine applications where the dirt ingress is so high that severe wear is inevitable or has already occurred. In this instance, a phone call was made to the client to determine what was happening. This engine had suffered a sudden head gasket failure. While replacing the head gasket, a sanding disc was used to remove the old gasket material from the aluminum head.

Taking an early oil sample on this engine would have shown the owner that while the head gasket may have been replaced, the appropriate cleaning and flushing procedures were not followed.