



Product: GAS ENGINE
Model: 3516 GAS ENGINE 4EK
Configuration: G3516 Engine Electronic Ignition System 4EK00001-UP

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Engine News

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Understanding Elevated Copper Levels in Used Oil Samples {1348, 7542}

SMCS - 1348; 7542

Engine: Commercial

- All

Introduction

Note: Caterpillar recommends S·O·S Services for monitoring the condition of the fluid systems in your equipment. S·O·S Services enhance a variety of Caterpillar Preventive Maintenance Programs.

This article explains the reasons for elevated copper levels that are sometimes observed in used oil samples. These elevated copper levels can be dramatic. Customers that observe these elevated copper levels are very concerned about excessive wear or component failure. In most cases, the customer should not be concerned about these elevated copper levels: the condition does not usually indicate excessive wear and/or component failure. However, it is important to understand the cause of the condition.

Affected Compartments

The elevated copper levels that are described in this article occur in compartments with a lubrication system that has an oil cooler with copper tubes.

Many Caterpillar Engines use copper oil cooler cores. Consult your Caterpillar dealer about the type of oil cooler that is used for your engine.

Oil Cooler Break-In

Note: S·O·S Services oil analysis measures the levels of several elements in used oil samples: copper, iron, chrome, lead, aluminum and silicon. Many of the S·O·S Services labs also analyze the used oil for sodium and for potassium in order to check for contamination of the oil by coolant.

Elevated copper levels are usually associated with the break-in of a new oil cooler. The copper level in

the used oil may have a dramatic increase. However, the other wear elements in the used oil remain at normal levels. S·O·S Services analysts are familiar with normal levels of wear elements in used oils and the analysts are trained to identify this condition of elevated copper levels.

When this break-in of the oil cooler occurs, the copper level can reach several hundred parts per million (ppm). In some cases, the copper level can exceed 1000 ppm. Usually, the copper levels diminish within two or three oil changes.

Illustration 1 represents the typical trend of copper levels. The graph demonstrates some results from analyses that were performed during the development of a project. The engine oil was analyzed at every 50 service hours and the engine oil was changed at every 250 service hours.

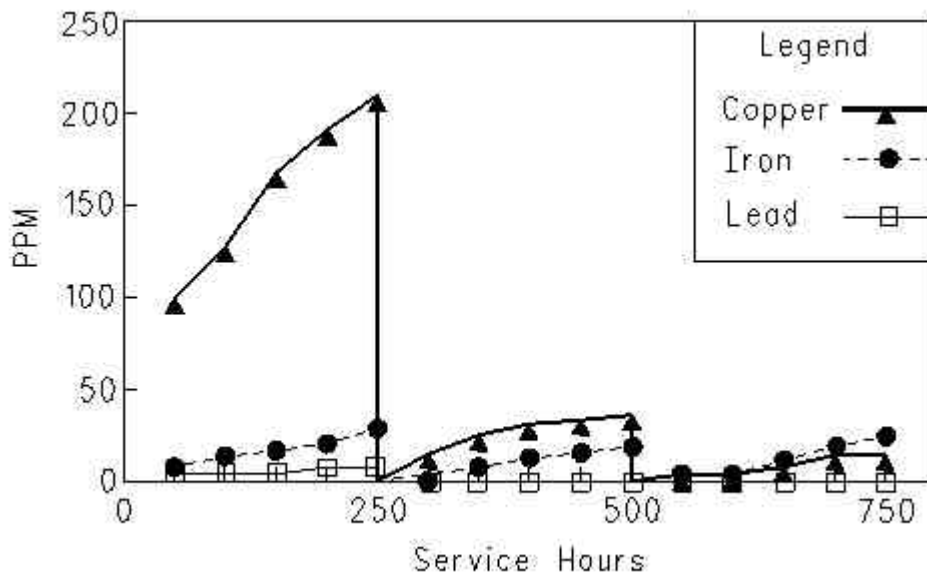


Illustration 1

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The engine oil samples that were obtained during the initial 250 service hours revealed an increasing copper level that exceeded 200 ppm. Between the first oil change and the second oil change, the copper level rose to less than 50 ppm. By the third oil change, the copper level was normal.

Causes of Elevated Copper Levels

Elevated copper levels occur when copper dissolves from the surface of the oil cooler tubes. The copper is in a solution with the oil and an insignificant amount of copper is removed from the oil cooler's tubes.

After a period of time, a protective coating forms on the copper tubes and the reaction stops. The engine will not be damaged and the elevated copper levels will gradually decrease.

For new engines, this reaction typically occurs within the first two oil change intervals. However, this reaction can also occur in used engines under the following circumstances:

- A new oil cooler is installed.
- A different formulation of oil is used.
- The temperature of the oil exceeds the limits of the compartment's design.
- The oil becomes corrosive because an oil change is overdue.

Corrective Measures

The need for corrective measures depends on the cause of the elevated copper levels.

Corrective measures are not needed for elevated copper levels that are observed in the following circumstances:

- The engine is new.
- The oil cooler is new.
- A new formulation of oil is used.

In the above cases, continue to obtain regular oil analyses and observe the trend of the copper. The copper levels will gradually decrease.

Corrective measures are needed for elevated copper levels that are caused by the following conditions:

- Overheating of the oil
- Overdue oil change interval

In either of the above cases, drain the oil and refill the compartment with the correct oil.

If overheating occurred, make corrections to the cooling system in order to eliminate the overheating.

If the oil change interval was late, review the maintenance practices and improve the practices.

In either of the above cases, the oil cooler may not be the only source of the elevated copper levels. A more severe corrosion can occur on bronze bushings and bearings. The more severe corrosion may reduce the service life of the engine. After corrections are made, it is important to obtain regular oil samples. Make sure that the copper and all the other wear elements return to normal levels.