Cooling System Maintenance Impacts Overall Engine Health

Almost everyone understands how important a properly maintained lubrication system is to optimum engine health. But what most people don't understand is that engine coolant and the cooling system are just as important to engine design, maintenance and optimum performance.

The demands of today's Tier 4 engines have dramatically changed cooling system design and coolant formulation. Today's heavy-duty diesel engines produce a tremendous amount of power from a relatively small package placing much higher demands on the cooling system to absorb heat transferred from engine, transmission and hydraulic fluids. At the same time, cooling systems have become smaller and operate at higher temperature, pressure and flow rates making efficient heat removal and adequate metal protection even more challenging.

While oil analysis is an invaluable condition monitoring tool, it tells us very little about what's happening inside the cooling system. Coolant analysis gives us the rest of the story by pinpointing coolant and cooling system issues that can lead to premature engine failure.

How critical is it?

An estimated 50% of all engine failures are associated with problems in the cooling system. Once initiated, these problems can spread through the lubrication, hydraulic and transmission systems damaging components, causing scale, clogging passages and forming deposits. Yet, the cooling system is the least understood and most neglected.

Cooling system problems can potentially reduce the life of components within all machine systems. Proper cooling system maintenance is essential to achieving optimum machine performance and longevity. Coolant analysis takes the guess work out of maintaining this system. Implementing a predictive maintenance program that includes analyzing the in-service coolant has proven to optimize reliability, decrease unscheduled downtime, reduce in-service failures and field repairs, establish proper coolant drain intervals, increase component lifespan and control equipment costs.

Why test extended life coolants?

Coolant analysis is recommended for both conventional and extended life coolants. Fluid design cannot prevent or correct the mechanical issues or chemical reactions that affect cooling system performance. Air and combustion gas leaks, localized overheating, hotspots or electrolysis can chemically affect or destroy the coolant and its inhibitors. Changes in coolant composition can cause chemical reactions that can destroy metals and result in premature component failure. Mechanical problems and chemical reactions affect conventional and extended life coolants equally and neither fluid formulation can correct the root cause of a mechanical problem.

Inhibitor and glycol levels should be analyzed regularly not only to ensure adequate system protection but to a lso identify any mechanical issue or chemical reaction occurring that could result in catastrophic engine or component failure. To realize the full benefit of a truly predictive maintenance program, an efficient fluid analysis program should address the four primary goals of quality coolant analysis.

PRIMARY GOALS OF A QUALITY COOLANT ANALYSIS PROGRAM

Goal #1 – Preventive Maintenance

Small problems with the coolant or cooling system can become catastrophic component or system failures if left unchecked. Regular coolant testing and analysis can determine that:

- the coolant is suitable for continued use or needs to be replenished or replaced – your laboratory should be able to identify proper fluid change recommendations
- coolant mixing has occurred
- contaminants are present that can cause the formation of scale or acids
- additive depletion is compromising metal protection

Goal #2 – Predictive Maintenance

Coolant analysis can help in predicting impending failures by noting abnormalities and trends in test results. Trends can identify mechanical and formulation issues that can jeopardize the life and longevity of the system and it components:

- the formation of acids and scale
- contamination ingression
- air and combustion gas leaks
- electrical ground problems
- localized overheating, or hotspots

Goal #3 – Life Cycle Management

Coolant analysis can identify deficient maintenance practices and assist you in implementing corrective action to ward off issues within the cooling and lubrication systems and provide indications of shortcomings in equipment operational practices and maintenance procedures.

Goal #4 – Root Cause Analysis

When an engine or cooling system component failure does occur, quality coolant analysis at the proper intervals can identify the root cause of the problem:

- blown head gasket
- electrolysis
- hot spots or localized overheating
- air or combustion gas leaks
- blocked coolant line
- EGR failure

Once identified, an experienced data analyst can make informed recommendations for correcting the issue and assist in establishing the proper fluid maintenance procedures for preventing a recurrence.

COOLANT ANALYSIS AND OIL ANALYSIS DO MIX

Whenever you review a coolant analysis, it is very important to evaluate it in concert with the oil analysis done at the same maintenance interval. The effects of engine overheating may be evident in both oil and coolant samples. Cooling system deficiencies affect all systems - the engine, transmission and hydraulics.

Engines

High coolant temperatures can cause high oil temperatures reducing the oil's operating viscosity and thereby, it's hydrodynamic lubricity. This leads to oil oxidation and eventual engine wear. This could be evident in ring sticking, piston glazing or varnishing or valve wear, which often masks the fact that a problem with the cooling system was a contributing factor.

Transmissions

An overheated cooling system can also shorten transmission life. Transmission disc slippage may occur as a result of reduced oil viscosity at elevated temperatures. Transmission slippage creates more heat, which causes oil oxidation, and a vicious cycle is established.

Hydraulics

Hydraulic pumps and motors become less efficient at elevated temperatures and may reduce the life of valves, pump slippers, barrels and plungers and seals due to reduced oil viscosity and oil oxidation.

Engines, transmissions and hydraulics are often repaired with no consideration given to the possibility of that a serious cooling system problem may have precipitated it. As a result, the same failures happen again and again. Coolant analysis can dramatically improve machine performance, reduce unnecessary repair and replacement costs and extend the life of your equipment by optimizing the condition of the mechanical systems involved and the fluids that keep them running.