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Dispersant additives: the crowd-controller in engine oil

Steven Lumley, Technical Development and Training Manager for WearCheck, focuses on how dispersant additives in oil function and why they make effective crowd controllers at social events.

Whenever I think of dispersant additives, an image of a night-club bouncer comes to mind. I know this might seem like a stretch of the imagination, but humour me. Among their many duties, night-club bouncers are also responsible for crowd control in their place of entertainment. Crowd control involves defusing potentially volatile situations by dispersing (keeping apart) club-going patrons who might otherwise want to 'agglomerate' into a brawl.

Similarly, the function of a dispersant additive is to disperse undesirable elements like soot particles that might otherwise agglomerate into larger particles. In this respect, dispersant additives and night-club bouncers display a high degree of commonality – they discourage agglomeration through the process of dispersion.

Unlike night-club bouncers, however, our dispersant additive utilises some pretty nifty chemistry, so let's take a look at how this additive controls crowds of soot particles in oil.

Dispersants are non-metallic, ashless cleaning agents that inhibit sludge formation by keeping insoluble contaminants, like soot, dispersed in the oil and preventing them from coating metal surfaces. They are also mainly found in engine oils.

Dispersants are organic complexes containing nitrogen compounds – polymeric alkylthiophosphonates and alkylsuccinimides – which keep insoluble soot dispersed in the oil. The insolubles are bonded to dispersant molecules by polar attraction, which prevents them from agglomerating.

So, why all the fuss about soot particles agglomerating? Well, soot particles are sub-micron in size when formed, but with progressive fuel usage, large quantities of these particles are continually deposited in the oil. They will eventually agglomerate into larger particles, which can cause a range of problems, including increased soot contamination, sludge formation, higher operating temperatures, loss of anti-wear performance and increased viscosity. Additionally, the increased soot loading puts further strain on the oil's ability to function optimally.

With many engine manufacturers seeking to extend oil-drain intervals, controlling soot agglomeration has become even more challenging for this additive, as longer oil-drain intervals result in increased soot loading of the oil. If the engine oil does not adequately disperse soot, it can cause sludge to form on rocker and front engine covers, bearings to fail, valve bridges and fuel-injection links to wear and filters to plug.

The durability of the oil and additive system, in relation to its ability to disperse soot and maintain a regime of reduced wear, has led to significant changes in additive formulation in recent years. As such, lubricant blenders have had to increase the treat rate of this additive. These days, dispersants are typically one of the major components of fully formulated engine oils, comprising between 30% and 60% of the total additive package.

Now for the nifty chemistry part of how this additive works its magic. Dispersant additives work by enveloping the soot particle in a single layer. The polar head of the dispersant molecule clings to the particle, directing the additive's oleophilic tail outward to dissolve into the oil. This keeps the soot particles suspended in the oil, prohibiting them from agglomerating with other soot particles or depositing onto component surfaces.

In the next instalment of the lube series, we will introduce bulk property chemical additives, starting with detergents.

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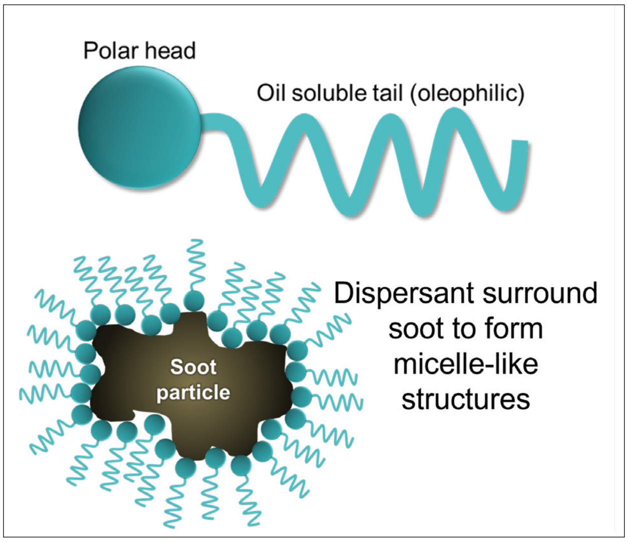

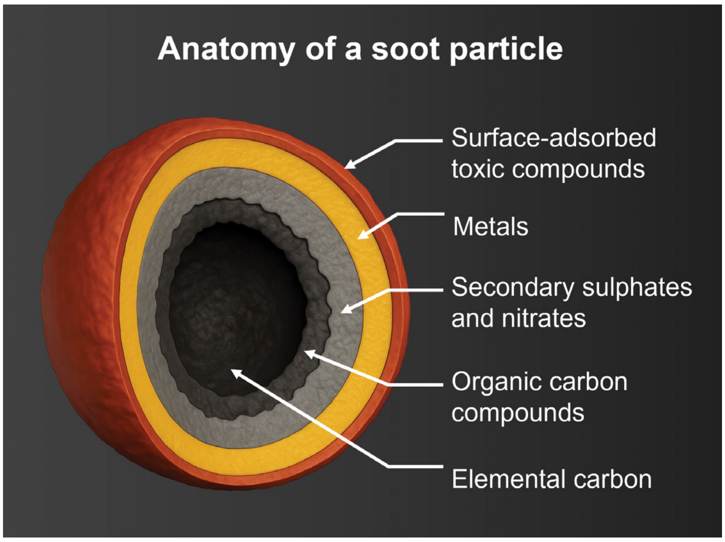

Dispersant additives envelope the soot particle. The polar head of the molecule clings to the particle, directing the oleophilic tail outward to dissolve into the oil.