RECO-COOL

TECHNICAL BULLETIN 0013/13

# CLEANLINESS REQUIREMENTS FOR COOLANT/ANTIFREEZE PRODUCTS

There is a growing requirement in the Lubrication industry for increasingly tight specifications for fluid cleanliness. Cleanliness of lubricants is generally measured by a range of technical specifications. The most common in use is the ISO standard of fluid cleanliness (ISO 4406) which determines fluid particulate matter content over a range of particle sizes.

A particle counter instrument measures the concentration of microscopic particles (p/ml, or particles per milliliter) in a lubricant. The lubricant cleanliness can then be rated according to standard ISO 4406:1999 "Method for coding the level of contamination by solid particles". The rating consists of three codes (A/B/C). The first code (A) focuses on the concentration of particles with a diameter of =4 µm (microns). Codes B and C are concentrations of particles with a diameter of =6 µm and =14 µm, respectively.

For example, 16/14/12 indicates the lubricant contains:

- Between 320 and 640 p/ml (particle diameter =4 µm).
- Between 80 and 160 p/ml (particle diameter =6 µm).
- Between 20 and 40 p/ml (particle diameter =14 µm).

In other words, a 55-gallon drum of 16/14/12 lubricant contains the equivalent of 10 drops of contaminant particles, which are invisible to the human eye.

| More Than (p/ml) | Up To and Including (p/ml) | ISO Code |
|---|---|---|
| 80,000 | 160,000 | 24 |
| 40,000 | 80,000 | 23 |
| 20,000 | 40,000 | 22 |
| 10,000 | 20,000 | 21 |
| 5,000 | 10,000 | 20 |
| 2,500 | 5,000 | 19 |
| 1,300 | 2,500 | 18 |
| 640 | 1,300 | 17 |
| 320 | 640 | 16 |
| 160 | 320 | 15 |
| 80 | 160 | 14 |
| 40 | 80 | 13 |
| 20 | 40 | 12 |
| 10 | 20 | 11 |
| 5 | 10 | 10 |
| 2.5 | 5 | 9 |
| 1.3 | 2.5 | 8 |

Table 1. ISO Cleanliness Codes for Rating Lubricant Cleanliness[6]

# Particles Contaminate Lubricants

Lubricants require such high levels of cleanliness for a number of critical performance reasons. Specifically, at boundary hydrodynamic lubrication regions, particulate matter can interfere with the critical metal separation properties of the lubricant fluid, and therefore severely affect the ability of the fluid to properly protect the moving metal surfaces from friction.

In the case of Coolant/Antifreeze product, however, these critical conditions of hydrodynamic lubrication do not exist.

- The application of the coolant in operation (in a cooling system) is primarily to remove latent heat (not friction) and therefore there is limited hydrodynamic funtional performance requirement expected of the coolant fluid.
- The coolant fluid performs a critical function in corrosion prevention. In doing this, the corrosion inhibitor additives in the fluid form refractory type coatings on the bare metal surfaces to prevent corrosive fluid contact with the surface material. This is a very different functional performance (compared with lubrication anti-wear).
- To do this, functional ingredients of the coolant products are typically highly surface active. Such additives rapidly plate out when filtered at super high filtration levels (sub 1um)
- Furthermore, coolants can contain chelating agents which 'neutralise' the ionising effect of hard water chemical agents (like Calcium, Magnesium and Zinc). These chelated molecules are larger than subatomic particulates, and therefore super-filtered coolants will be less stable in varying degrees of hard water.

Recochem typically filters our coolant products to 25µm, which removes particulate matter down to the levels visible by the human eye. This provides appropriate levels of cleanliness for a cooling system, and still prevents the removal and plating of necessary corrosion inhibitor and water-stability ingredients which are present in our formulations in order to function accordingly.

Lubrication cleanliness and coolant cleanliness are very different principles. This is a fundamental outcome of the different technical requirements and chemical attributes of these different fluids.

Using ISO 4406 to measure coolant cleanliness is therefore an inappropriate standard for coolant performance. A much worthier discussion involves an understanding of the chemistry of the corrosion inhibitor packages involved, and their solubility and surface activity; as well as the post production filtration stages employed by the coolant blender during the manufacturing processes.