Way oil and coolant separability

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Introduction

The selection of slideway lubricants is integral to the productivity of modern machine shops. Slideway lubricants can affect both machining precision and the service life of the metalworking fluid. The optimum slideway lubricant must provide superior friction control to ensure high machining precision and excellent separability from aqueous coolants that are commonly used in metalworking operations. Ensuring good coolant separability can bring benefits including extending tool life and improving final product quality.

What is coolant separability?

Slideway lubrication is typically a total-loss, open system. As such, they can contaminate the coolant circulation system and eventually form tramp oil if aqueous coolants are being used. Tramp oil is one of the primary contaminants found in such product and can adversely affect its working life.

The ability of the slideway lubricant to separate quickly and completely from water-based coolants is important. If oil separation is not complete, the negative effects on aqueous coolant performance can result in higher operating costs and unscheduled machine downtime.

High quantities of tramp oil in aqueous coolants can:

- **Change the coolant concentration, making monitoring difficult**
- **Affect lubricity, leading to tool wear and poor surface finish**
- **Increase the risk of bacterial growth and undesirable odors**
- **Reduce coolant pH levels, potentially causing corrosion**
- **Promote excessive coolant foaming**

Conversely, contamination of the slideway lubricant with aqueous coolants can compromise the performance of the slideway operation. Emulsification through poor separation characteristics may result in:

- **Reduced lubricity, leading to increased friction**
- **Increased slip-stick and reduced precision**
- **Potentially higher energy consumption**
- **Wear of contact surfaces or coating materials**
- **Corrosion of components and machines**

Good slideway lubricant/coolant separability properties allow the machine tool to operate with optimal precision, and will maximize the life and performance of the aqueous metalworking coolant.

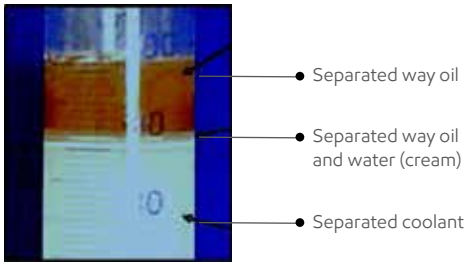
How is coolant separability measured?

There are a number of standardized tests recognized in the machine tool industry described below.

TOYODA Demulsification Test

The TOYODA test simulates a slideway lubricant contaminating a coolant reservoir. 90 mL of coolant (5 percent concentration) is placed in a cylinder with 10 mL of slideway lubricant. Agitated vertically for 15 seconds, the cylinder is then allowed to rest for 16 hours. The volume, in milliliters, of three phases is then measured: separated oil (top), "cream" or emulsified oil and water (middle), and separated coolant (bottom).

In the example below on the next page, the test result is recorded as 90/0/10 (90 mL coolant, 0 mL cream, 10 mL slideway lubricant) which indicates "complete separation" between oil and coolant. A result of 98/2/0 (98 mL coolant, 2 mL cream, 0 mL slideway lubricant) indicates that a stable emulsion has formed and the coolant and slideway lubricant do not separate readily.



SKC Coolant Separability Test

This test simulates the situation where aqueous coolant contaminates the slideway lubricant. Slideway lubricant is tested against 11 standard coolants at a ratio of 80/20, 8 mL of slideway lubricant and 2 mL of coolant. The mixture is agitated at 1500 rpm for 1 minute and then visually inspected after 1 hour, 1 day and 7 days. A 1 to 6 rating is given:

1 = Complete separation
2 = Partial separation
3 = Oil + intermediate
4 = Oil + intermediate + emulsion
5 = Intermediate + emulsion
6 = All intermediate

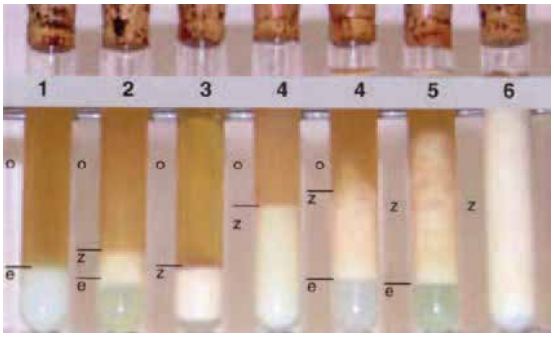


Illustration of SKC Separability Test results from 1 to 6.

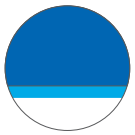
Beyond separability testing

Good maintenance practice

Even if a slideway lubricant with good separability characteristics is in use, cross-contamination of coolants with various machine tool oils requires attention. Oil contamination in the coolant also comes from other lubricants such as hydraulic oil, gear oil and grease. If not periodically removed, tramp oil can accumulate and cover the coolant surface, preventing contact with oxygen. This situation provides a suitable environment for growth of anaerobic bacteria in the coolant, resulting in reduced service life and foul smells.

Tramp oil becomes emulsified into the coolant through system agitation, compromising the performance of the coolant. High volumes of tramp oil may interfere with coolant monitoring.

Coolant monitoring



Routine monitoring of the coolant concentration is important in maximizing coolant life. The simplest method is to use a refractometer. Normally the line will be sharp, but if there is a significant amount of emulsified slideway lubricant in the coolant, the view in the refractometer will be obscured, indicating high levels of tramp oil.

Tramp oil removal

Many modern machine tools are equipped with automatic oil skimmers that run constantly to remove tramp oil. Belt skimmers can also be purchased separately. In larger systems, filters and centrifuges are commonly used to remove tramp oil and other contaminants. Alternatively, removal of tramp oil can be achieved manually using an industrial vacuum.

Offsite lab analysis can quantify the presence of tramp oil. Coolant concentration can be measured by titration compared to fresh coolant to determine the emulsified tramp oil level.

Summary

- **Separability should be considered when selecting a coolant/slideway lubricant combination.**
- **A single supplier for both coolant and machine tool lubricants can help limit compatibility issues.**
- **Even with mutually compatible products in place, good maintenance practice is one of the main drivers to an efficient machine shop operation.**
- **Good separation means coolants last longer and perform better, offering savings on operational costs.**
- **Improved coolant separation prolongs tool life and improves the quality of product finish.**

References

- **TOYODA Demulsification Test**
- **SKC Coolant Separability Test**