

Oils, Lubrication and Cutting
By Rich Croll

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Technical Talk Summary

Richard Croll gave the technical talk for the April meeting. Rich discussed the application of oils to lubrication and cutting. He first identified the various oil types as:

1. Animal
2. Vegetable
3. Mineral (literally from rock)
4. Synthetic

When used as lubricants, oils may be:

- Blended from base stocks
- Mineral oil used straight (no additives)
- Compounded mineral oil with animal fat (i.e. Steam cylinder oil, cutting oils)

A lubricant is used to reduce friction between moving parts, such as, bearings and sliding surfaces by maintaining a thin film of oil between the moving surfaces.

One of the most important properties of oils is the viscosity which may be defined as the resistance to flow. It is the measure of the lubricant to resist shearing stress. If it is too low, then excess wear and heating of the surfaces will occur. On the other hand if the viscosity is too high, then there will be poor flow and excess force needed to move the parts. The viscosity of oil is very much affected by the temperature and that property is called the viscosity index. Other oil properties of interest include:

- Density
- Flash and fire point
- Pour point
- Performance improvement determined by additives.
- Variable viscosity as a function of temperature

Oil performance can be considerably improved by the addition of various components as follows:

- Rust & oxidation inhibitors (R&O)
- Anti-wear agents usually zinc (can cause problems with copper alloys)
- Detergents
- Dispersants (these two keep dirt suspended in the oil until filtered out)
- Extreme pressure compounds (usually found in gear oils) (EP)

Various organizations have described oils by viscosity for their member's use. For example:

International Standards Organization grades industrial oils and defines a mid point viscosity at 40 deg.C.

American Gear Manufacturers Association lists R&O type-turbine oils, EP types, and compounded cylinder oils for worm gears.

Society of Automotive Engineers describe crank case oils and gear oils. Viscosity is measured using Saybolt universal seconds or SUS (sometimes SSU)

General oils types-by application

Spindle oils are lubricated with light oils, ISO 10 to 32, with the high-speed spindles using the lightest oil.

Gearboxes use AGMA numbered lubricants, such as, R&O type turbine oils, EP oils, and steam cylinder oils. Small machine tools will use ISO 68 to 100 while large, slow moving machines will use heavier oil.

Ways on lathes and milling machines are lubricated with Mobil vactra 2, other ISO 68 oils. Grinders use ISO 32 way lube and hydraulic oil.

Electric motors should not be over greased. If the motor has a plug on opposite side of fitting, remove plug and force grease through until clean.

Air Compressors

Smaller units typically use ISO 68 while larger sizes will use correspondingly heavier oil.

Grease is an oil product that has been compounded to be essentially a solid. It is useful in applications where the RPM is low or oil will run out of place. For most applications a multi-purpose lithium or lithium complex EP2 will do. Molybdenum grease is particularly effective on construction equipment. Be aware that different grease bases may be incompatible.

Steam cylinder oil is compounded with animal fat (tallow) to stick to metal surfaces thus resisting being washed out by water. Ideally it should atomize and cover all surfaces.

Cutting Oils are used to perform the following function to improve metal cutting:

Cool the tool and work piece --- increased tool life and increased cutting speeds

Lubricate

Minimize built up edge on cutting tool

Protect against corrosion

Flush away chips

Types of Cutting Oils

Straight Oils

Active Sulfur-dark (discolors to copper)

Inactive Sulfur-transparent to give better view of work piece. Good choice for home work shop

Chlorine free --- important from waste disposal aspect

Synthetic coolants --- flood or mist-don't lend themselves to home shop

Soluble oils-mixed with water provide good cooling, but there may be a problem with bacteria producing that Monday morning odor

Choosing Cutting Oils

Machinability ratings are based on the alloy being machined

Oil can be pumped, brushed, dripped. A continuous flow is preferred to reduce possibility of cracking of hard materials, i.e. carbide. However, manual application is easiest and least expensive. If a ready source of compressed air is available then a mister is a convenient way to apply a coolant. However, there may be an inhalation hazard with the stray mist. Threading is eased by the use of a dark cutting oil blended with active sulfur. Keep in mind that a liberal use of a coolant or cutting oil may facilitate machining, but on the other hand create a disposal problem.

Lubricants for rolling stock

- Steam cylinder lubrication for model work probably is best done with a less viscous oil such as ISO 460. It will flow and atomize easier than the heavier grades.
- Side rod bearings should have oil grooves and be lubricated with a fairly heavy oil.
- Valve gear components are best lubricated with light oil through small oil holes.
- Cross heads are sliding ways so lubricate them with a medium viscosity way lube or cylinder oil.
- Axlebox bearings should be greased if not sealed; otherwise oil may be used.

Synthetic oils are useful in very high or low temperature applications. They cost 3 to 5 times as much as regular oils so may not be a good selection for the home shop. Rich Croll concluded his talk by emphasizing the importance of following manufacturer's instructions regarding lubrication. To help with that, Rich has two handy charts. Contact him if you are interested. Thanks to Rich for a very informative talk. He covered everything except where to squeeze a snake to get snake oil!