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In Search of Environmentally Friendly

Cutting Oil

Cherry Point Prototypes Alternative Metal Working Fluid

Naval Air Depot (NADEP) Cherry Point, NC needed to replace an oil (VV-C-850) that was used extensively in machining applications but no longer available. And the alternative they found is biodegradable.

Metal working fluids (MWFs), also called machining fluids, cutting fluids, and cutting oils are designed to cool the components, to remove chips from the cutting zone, to lubricate, and to inhibit corrosion during a given machining application. There are four classes of MWFs: straight oils, soluble oils, semi synthetic oils, and synthetic oils. Straight oils, or neat oils, are not designed to be diluted with water. Straight oils are normally used for heavy duty machining operations. The other three classes of MWFs are designated water-soluble fluids or coolants. The water-soluble MWFs mainly contain oil, water, emulsifiers, a

biofouling resistance package, and corrosion inhibitors.

Table 1 shows the characteristic of MWFs. The classes of water soluble MWFs are distinguished by the quantity of oil contained in the product. This oil includes severely hydrotreated petroleum oils, vegetable oils, animal oils, marine oils, and seed oils that are used singly or in combination. Soluble oils have a 30–85 percent oil content, semi-synthetic oils have a 10–30 percent oil content, and synthetic oils have a 0–10 percent oil content. Normally, the higher the oil contents of the MWF, the better the lubricity thus providing a greater capacity to reduce friction. However, the downside of using this material is that it produces less cooling capacity during machining operations. MWFs that contain less oil provide a cleaner work environment and reduce the frequency to replace the MWF. However, the replacement frequency is dependent

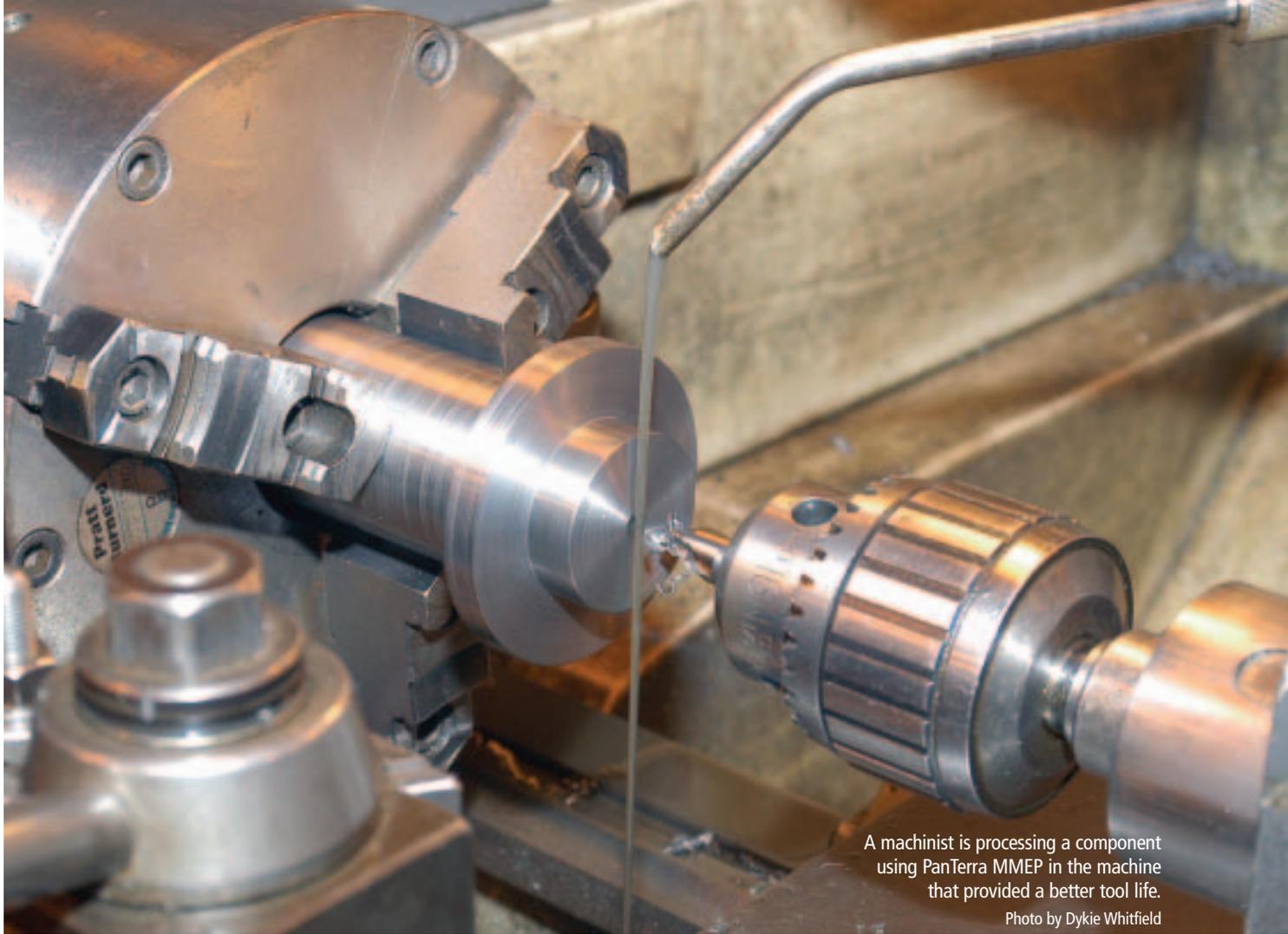
upon workload throughput. Since straight oils do not contain water, it is rare to encounter biofouling problems, and thus the machine sump does not require replacement of MWFs as often as the water-soluble MWFs.

Petroleum oil is considered a hazardous material for its possible cancer producing agent(s). Water-soluble MWFs contain alkanolamines for corrosion protection of the component being processed. However, alkanolamines are one of the ingredients that Occupational Safety and Health Administration officials recommend avoiding because of concern over adverse liver and kidney organ effects in animals. Natural or synthetic sodium sulphonate, another common ingredient found in water-soluble MWFs, acts as a corrosion inhibitor and emulsifier.

There are about 160 machines at NADEP Cherry Point that operate with MWFs that are water soluble, straight oils, tapping fluids, or water. Personnel from the Materials Engineering Division and the Industrial Engineering Division at NADEP Cherry Point prototyped a

TABLE 1: Characteristics of Metal Working Fluids

Classes	Oil in Concentrate (in percent)	Lubricity	Cooling	Replacement Frequency
Straight Oil	100	↑	↓	N/A
Soluble Oil	30–85	↑	↓	↑
Semi-Synthetic	10–30	↑	↓	↑
Synthetic	0–10	↑	↓	↑



A machinist is processing a component using PanTerra MMEP in the machine that provided a better tool life.

Photo by Dykie Whitfield

straight oil called “PanTerra MMEP” as a replacement for VV-C-850 straight oil. The urgency to find a replacement cutting oil was due to the fact that VV-C-850 is no longer manufactured. PanTerra MMEP is a seed oil based straight cutting oil containing molybdenum disulfide as an insoluble compound. Seed oil

including canola, sunflower, or soybean oil is used in lieu of petroleum or petroleum-derived compounds in the formulation. PanTerra MMEP does not contain chlorine, sulfur, active sulfur, or petroleum. Since all the ingredients of PanTerra MMEP are manufactured from sources in the United States, it

does not depend on the export of materials from foreign markets. It is also a biodegradable and environmentally friendly product. Molybdenum disulfide, known as a dry lubricant, imparts lubricity to machine tools that work under high friction and heat where most other lubricants would breakdown.

TABLE 2: Physical Property of Cutting Oils

	PanTerra MMEP	VV-C-850
Appearance	Dark Gray	Dark Amber
Specific Gravity (@ 60°F)	0.93	0.92
Viscosity (in Centistokes @ 40°C)	38-41	Unknown
Flash Point	640°F (338°C)	390°F (199°C)
Chlorine	No	No
Sulfur	No	Yes
Active Sulfur	No	No
Petroleum	No	Yes



A machinist is applying PanTerra MMEP to a part as a tapping fluid using a brush application.

Photo by Dykie Whitfield

Seed oil including canola, sunflower, or soybean oil is used in lieu of petroleum or petroleum-derived compounds in the formulation.

The product usage was critiqued and the following observations were noted:

- The flashpoints of straight oils used in the past were 350 degrees Fahrenheit (°F) to 400°F. PanTerra MMEP has a high flash point of 640°F. Because of its high flash point, PanTerra MMEP provided better heat dissipation and produced less smoke when machining.
- The graphite like material from the molybdenum disulfide source allowed metals to be processed requiring less friction and less torque compared to VV-C-850.
- PanTerra MMEP provided better tool life compared to VV-C-850.
- PanTerra MMEP can be used as a tapping oil in addition to heavy duty machining operations.
- PanTerra MMEP provides a safer and healthier environment due to the use of less hazardous ingredients during the manufacturing process.
- Shop personnel promoted PanTerra MMEP as an excellent tapping oil and a better performer than any other straight oil used in the past at NADEP Cherry Point.

So the search is over. PanTerra MMEP, an environmentally friendly product, functions exceptionally well as an alternative to VV-C-850. [⚓](#)

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