FUTURE **PROVED**

ECOCOOL GLOBAL FACTBOOK

LUBRICANTS.
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PEOPLE.

FUCHS

GLOBAL **PLATFORM**

ECOCOOL GLOBAL 10
THE NEW BENCHMARK IN CUTTING FLUIDS

Metal working fluids are used throughout the machining industry for their cooling, lubricating, and corrosion resistant properties. Such fluids are typically made of complex mixtures of oils, detergents, surfactants, biocides, lubricants, anti-corrosion agents, and other ingredients.

High performance metal working fluids are essential for the metal machining industry. Growing global production is increasingly affected by national chemical registries, legislation and labeling requirements.

In response to these changing market demands FUCHS developed a novel chemical approach for a new generation of machining fluids.

ECOCOOL GLOBAL 10 is the culmination of many years of intensive research.

ECOCOOL GLOBAL 10

INDUSTRY PERFORMANCE TESTS

SCOPE

A series of intensive tests was conducted by a network of independent laboratories to demonstrate the unique performance characteristics of ECOCOOL GLOBAL 10. Listed below are some results.

MILLING PERFORMANCE TEST

Machining performance is tested by measuring wear when milling titanium under controlled conditions. Products that perform well in this test increase tool life, improve surface quality, reduce scrap, and increase production speeds through higher metal removal rates.

TEST METHOD

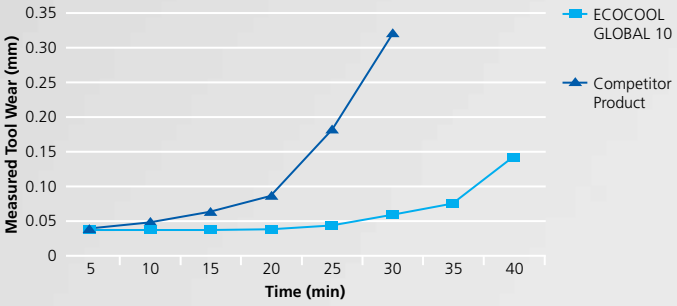
A vertical CNC mill is filled with an emulsion mixed at 9 % concentration. Test blocks of Ti-6Al-4V are milled in sequential cuts using a 10 mm solid carbide end mill from a major tooling manufacturer.

The following parameters are used:
Spindle speed: 3193 RPM
Feed rate: 1019 mm/min
Depth of cut: 3 mm
Width of cut: 3 mm

Flank wear is measured every 5 min. The results are compared against a leading aerospace industry product.

TEST RESULT

ECOCOOL GLOBAL 10 provided longer tool life than a leading aerospace industry product



FRICTION SIMULATION

Lubricating characteristics are evaluated by measuring the torque required to tap metal substrates. When a low amount of torque is needed, less friction is generated between the metal and the tool. Products that perform well in this test generate lower-5,9 torque values and protect tools against wear better than those that generate higher values. As a result, superior performing products increase tool life, improve surface quality, reduce scrap, and increase production speeds through higher metal removal rates.

TEST METHOD

A sample of emulsion at relevant concentration is applied to pre-drilled 6 mm diameter holes in Ti-6Al-4V material with a thickness of 14 mm. The holes are tapped using a microtap apparatus that measures the torque throughout the tapping operation.

The results are compared against a leading aerospace industry product.

TEST RESULT

Metal, emulsion concentration	Mean Torque (N*cm)	
	ECOCOOL GLOBAL 10	Competitor
6061 Aluminum, 10 %	**181**	**197**
Ti-6Al-4V, 20 %	**176**	**191**

SUMP LIFE SIMULATION

Tolerance to microbial contamination is tested by inoculating freshly prepared emulsions with microbial suspensions. Products that perform well in this test are likely to maintain their pH and emulsion stability over long drain intervals, are easy to maintain, and require minimal use of tankside additives.

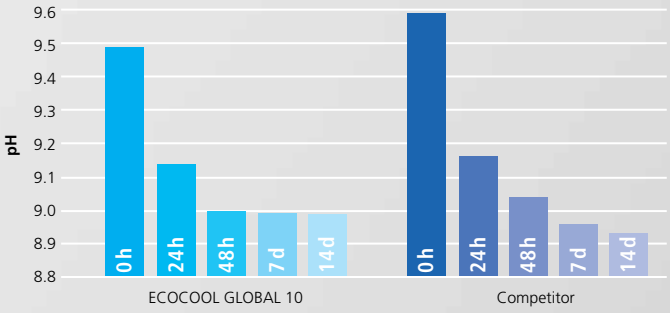
TEST METHOD

Samples of 5 % emulsions using tap water are contaminated with a single inoculation of microbial suspension then incubated at 25 °C ± 2 °C throughout the 14 day test.

The pH is recorded at the start, and after 1, 2, 7 and 14 days and benchmarked against a control product.

TEST RESULT

ECOCOOL GLOBAL 10 maintained it's original pH better than a leading aerospace industry product



SKIN COMPATIBILITY TEST

Skin compatibility is tested by applying a sample to a group of human test subjects with healthy skin aged 24 to 52 years of age. For the duration of the test, the subjects refrain from using substances and creams with active cleansing ingredients on the test areas. Products that perform well in this test are likely to be non-irritating to the skin of production workers who come into contact with the emulsion.

TEST METHOD

A 100 µl sample of 10 % emulsion is applied to the forearm using an aluminum chamber and compared to controls of water (non-irritating) and sodium dodecylsulfate (irritating) after 24 hrs of exposure over 8 days.

The test area is then observed for appearance, chromametry, and transepidermal water loss and graded from not irriatating to strongly irritating.

TEST RESULT

ECOCOOL GLOBAL 10 (10%) is designated as "not irritating"

ECOCOOL GLOBAL 10

INDUSTRY PERFORMANCE TESTS

FOAMING CHARACTERISTICS SIMULATION

The ability to control foam is tested by circulating the fluid at a high turn-over rate. Products that perform well in this test are likely to remain low foaming when mixed in low hardness water and used in high pressure through-the-tool fluid delivery systems as well as other high turn-over, high agitation systems.

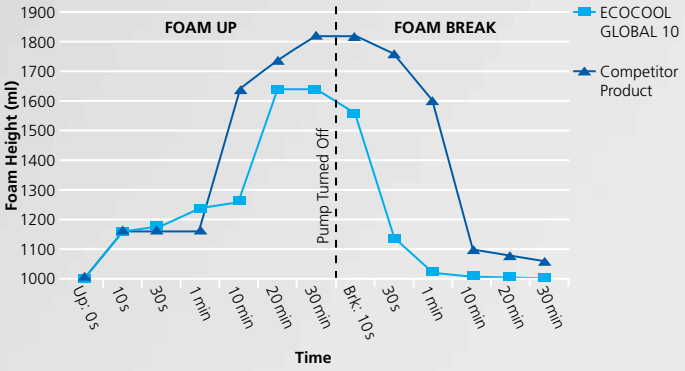
TEST METHOD

A 1000 ml sample of a 7 % emulsion is prepared using de-ionized water (0 ppm as $CaCO_3$) and added to the bottom of a water-jacketed graduated 2000 ml test cylinder. Using a centrifugal pump drawing from the bottom of the cylinder, the fluid is circulated at a rate of 250 l/hr (1.1 gal/min) and cascaded back upon itself from a height of 390 mm above the 1000 ml mark.

The total volume of foam + fluid is recorded at 10 s, 1 min, 10 min, 20 min and 30 min after starting the pump to record "foam up", and at the same time intervals after the pump is turned off for "foam break".

TEST RESULT

ECOCOOL GLOBAL 10 shows lower foaming characteristics than a leading aerospace industry product



HARD WATER EMULSION STABILITY TEST

The tolerance to build-up of calcium and other minerals from source water and machined alloys is tested at 3 levels of water hardness. Products that perform well in this test are less likely to exhibit coarsening of the emulsion leading to instability and residue formation on machine surfaces and parts.

TEST METHOD

Samples of 7 % emulsions are made in graduated neck flasks and left to stand. Appearance and emulsion separa-
tion are observed after 24 hrs. (Pass ≤ 0.1 ml separation).

TEST RESULT

De-ionized water (0 ppm as $CaCO_3$)	Soft water (40 ppm as $CaCO_3$)	Hard water (400 ppm as $CaCO_3$)
PASS Tight milky emulsion with no separation	**PASS Tight milky emulsion with no separation**	**PASS Tight milky emulsion with no separation**

STAIN TEST

The potential to stain metals is tested at 3 levels of water hardness. Products that perform well in this test are less likely to cause staining or discoloration of machined components requiring subsequent re-work and cleaning.

TEST METHOD

Relevant metal specimens are abraded with P240 emery paper under running water until free of signs of marking. They are subsequently degreased, dried and partially immersed in samples of 7 % emulsions at relevant water hardness.

After 24 hrs, the staining is graded as no stain or from 1A (mild) to 4C (strong).

TEST RESULT

Metal	De-ionized water (0 ppm as $CaCO_3$)	Soft water (40 ppm as $CaCO_3$)	Hard water (400 ppm as $CaCO_3$)
7000 Series Aluminum	**No Staining**	**No Staining**	**No Staining**
2000 Series Aluminum	**No Staining**	**No Staining**	**No Staining**
Titanium	**No Staining**	**No Staining**	**No Staining**
Low Carbon Steel	**No Staining**	**No Staining**	**No Staining**
99.9 % Copper	**1A**	**1A**	**1A**

CORROSION TEST

Corrosion protection is tested by combining metal substrates with millings of similar and dissimilar metals. Products that perform well in this test are less likely to exhibit corrosion on machined parts and machine surfaces.

TEST METHOD

Relevant metal specimens are abraded with P240 emery paper under running water until free of signs of marking. They are subsequently degreased and dried. 2 g mounds of relevant millings (chips) are applied to the surface and 57 ml of 7 % emulsion at relevant water hardness applied to the mound.

After 24 hrs, the appearance of specimens are graded according to the following key:

A = No. of corrosion pits
B = area of stain (0 = nil, 5 = 75 + %)
C = intensity of stain (0 = nil, 4 = surface damage)

Rating of 0 and 1 denote minimal or no effect on metal surfaces.

TEST RESULT

Metal	Soft water (40 ppm as $CaCO_3$) [A/B-C]	Hard water (400 ppm as $CaCO_3$) [A/B-C]
2000 AL + 2000 AL millings	**0/0–0**	**0/0–0**
7000 AL + 2000 AL millings	**0/0–0**	**0/0–0**
Cast iron + 2000 AL millings	**0/1–1**	**0/0–0**
Cast iron + copper millings	**0/1–1**	**0/0-1**
Cast iron + low carbon steel millings	**0/1–1**	**0/0–1**
7000 AL + no millings	**0/1–1**	**0/0–0**
2000 AL + no millings	**0/0–0**	**0/0–0**

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