EASTMAN

Synergex™

Aluminum corrosion properties of Synergex™ and Synergex™ T

Synthetic and low oil semi-synthetic metalworking fluids were formulated using Synergex™ neutralizing amine additives. These were then checked for aluminum corrosion on two types of aluminum: 6061 and 7075 coupons. The coupons were immersed in the diluted metalworking fluids for 24 hours and the weight loss was measured. The concentration of aluminum which migrates into the fluid during the test is measured by ICP and also reported. Lastly, a visual inspection of the surface of the aluminum coupon is made (see figures 1 and 2). The concentration of the comparative amine in the end use dilution is at a long life level of 2400 ppm for both the synthetic and semi-synthetic formula. Table 1 summarizes the aluminum corrosion data.

Table 1

Formula type	**Low oil semi**	**Low oil semi**	**Low oil semi**	Synthetic formula	Synthetic formula	Synthetic formula
Comparative amine	Synergex T	Synergex	Corrguard 95[1]	Synergex T	TEA 99%	Corrguard 95
Dilution	4%	4%	4%	6%	6%	6%
pH	8.45	8.65	8.60	8.05	8.00	8.25
Aluminum alloy	**AL 6061**	**AL 6061**	**AL 6061**	**AL 6061**	**AL 6061**	**AL 6061**
Wt. change, grams	-0.0003	-0.0005	-0.0007	-0.0001	-0.0001	-0.0002
ppm Aluminum	14	30	40	<5	<5	13
Appearance	Dark stain	Dark stain	Dark stain	No stain	No stain	Med-dark
Aluminum alloy	**AL 7075**	**AL 7075**	**AL 7075**	**AL 7075**	**AL 7075**	**AL 7075**
Wt. change, grams	-0.0005	-0.0008	-0.0009	-0.0005	-0.0006	-0.0008
ppm Aluminum	14	32	41	<5	<5	17
Appearance	Dark stain	Dark stain	Dark stain	Light/faint	Light/faint	Dark stain

Results:

In both the synthetic and semi-synthetic formula, Synergex T caused the least amount of aluminum corrosion. Past work has also shown low ferrous dissolution from mild steel (1/20 that of Corrguard 95).

Synergex T has shown very low volatility by means of ASTM E1648 (<8%) and has a very low odor profile and scores well in both global and amine odor tests.

The HLB of Synergex T is 12 and this provides balanced oil/water solubility, allows for surface activity without foam, and gives excellent emulsion stability with good tramp oil rejection.

[1] Corrguard® 95 is a registered Trademark of ANGUS Chemical Company

Figure 1 — Aluminum 6061 synthetic fluid with Synergex T

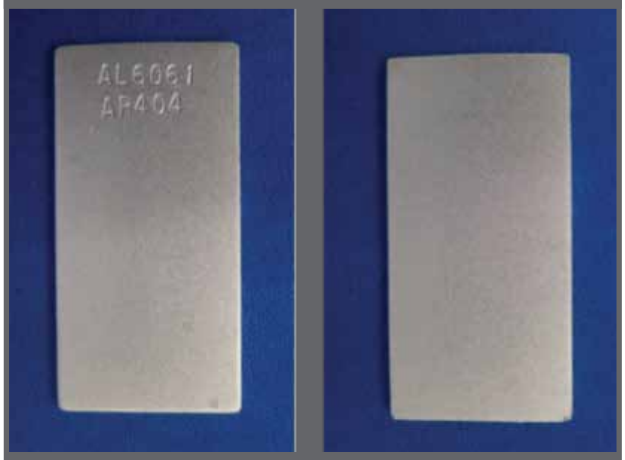

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Figure 2 — Aluminum 7075 synthetic fluid with Synergex T

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Table 2 — Synthetic metalworking fluid for ferrous and non-ferrous machining

Phase A	%	
PERFAD™ 3950[2]	16	Multi-functional additive
Synergex T	4	Long life amine
Neodecanoic acid	3	Rust inhibiting acid
TAS COR PE 401	0.8	Phosphate ester
Water	10	
Phase B		
Water	49.5	
Amietol M12 (MDEA)	4	Neutralizing amine
MIPA (monoisopropanolamine)	3.2	Neutralizing amine
Isononanoic acid	3	Coupling acid
TAS COR 215A Dicarboxylic acid mix	5.6	Rust inhibiting di-acid
Troyshield FX 40	0.5	Anti-microbial
TT40DC (Cobratec)	0.4	Multi-metal inhibitor

Formulation tips:

There is information available about blending with Perfad 3950 from the Croda web site. In general, it must be neutralized with an amine such as Synergex T and blended with co-surfactant before bulk water addition at ambient temperature. For the synthetic version, very little co-surfactant is needed. Inverse solubility polyalkylene glycols can also be added for heavy duty machining or additional co-surfactants and petroleum oil for a semi-synthetic version.

Many co-surfactants have residual acid values which can be neutralized with Synergex and Synergex T.

Summary:

Synergex T is a high-performance tertiary amine additive for use where secondary amine issues are a concern. Synergex T is a very low-odor, low VOC amine ideal for use in neutralizing semi-synthetic and full-synthetic metalworking fluids and emulsion lubricants. The very low vapor pressure and volatility of Synergex T and its molecular stability allows for significantly extended fluid life.

Synergex is a low-odor amine ideal for pH adjustment in semi-synthetic and full-synthetic emulsion lubricants where secondary amines can be tolerated. Synergex was first introduced to the metalworking market over 30 years ago and gives extended fluid life with an impressive balance of benefit/cost.

[2] PERFAD™ is a registered Trademark of Croda International Plc.

To learn more about Synergex, visit
www.SynergexAmine.com

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The results of **insight**™

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