



Metalworking Fluid Additives



Do any of these problems sound familiar?

- ***My customers say our fluids don't last long enough.***
- ***My coolant leaches too much cobalt.***
- ***Our fluids perform well except they foam too much.***
- ***I use triazine biocides. They're cheap and work great, but some of my fluids grow fungi.***
- ***I still use some DEA, but I'm getting pressure to replace it.***
- ***Customers complain that my fluid releases ammonia odor.***
- ***Some plants worry that our coolants may release formaldehyde.***

If so, ANGUS additives can help.

ANGUS Chemical Company supplies four basic performance additives to manufacturers and end-users of metalworking fluids. These products are briefly described below.

AMP-95™

AMP-95 is our premier primary amino alcohol, designed for use in all water-dilutable metalworking fluids, especially where a colorless product is required. AMP-95 is used worldwide, providing superior performance among commonly available amine products.

CORRGUARD™-A

The composition of CORRGUARD-A is virtually identical to AMP-95, however, it is intended for applications where color is not critical. CORRGUARD-A provides all of the same advantages as AMP-95, and is currently available for purchase in the U.S. and Canada only.

AEPD-85™

AEPD-85 is an excellent primary amino alcohol, designed for use in all water-dilutable fluids. AEPD-85 exhibits intermediate base strength, has low volatility, and is an excellent choice for directly replacing diethanolamine (DEA).

ALKATERGE™ T-IV

ALKATERGE T-IV (an ethoxylated oleyl oxazoline) is a low-foaming nonionic surfactant intended primarily for use in soluble oil and semi-synthetic metalworking fluids. ALKATERGE T-IV is an effective co-emulsifier and wetting agent which also acts as a coupling agent to help stabilize fluid concentrates.

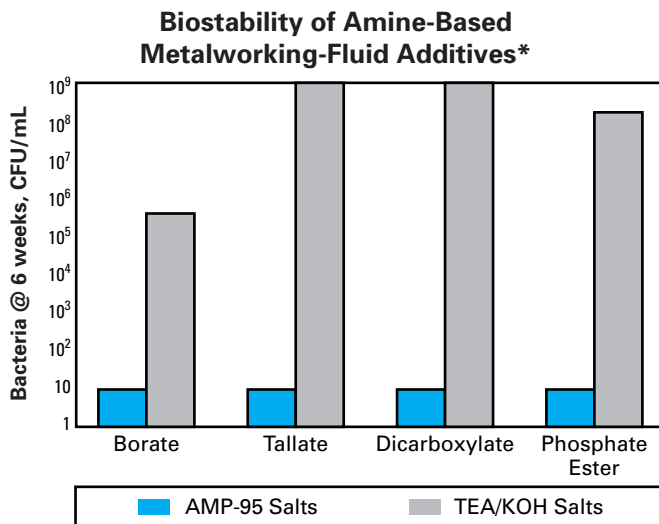
Please read on to learn how these ANGUS products may help solve some of your problems.

Problem

My customers say that our emulsion-based fluids don't last long enough. What can I do to improve fluid life?

Solution

One of the leading causes of short fluid life is microbial degradation. This can lead to loss of emulsion stability, corrosion problems, and bad odors. Fluids that have been properly formulated with **AMP-95** or **CORRGUARD-A** and which contain appropriate biocides, are reported to last longer than fluids based on other amines. The data below demonstrate the enhanced bacterial resistance of **AMP-95** salts vs. salts of triethanolamine (TEA) plus potassium hydroxide (KOH).

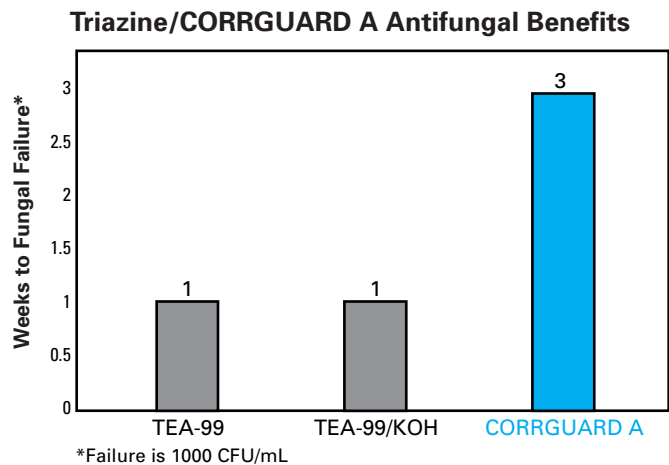


Problem

I formulate many of my fluids with triazine biocide because it is very cost-effective. However, some customers complain about fungal growth. I am trying to avoid use of fungicides because they are expensive. Is there anything else I can do?

Solution

Triazine is normally not effective against fungi. However, formulations containing triazine along with **AMP-95**, **CORRGUARD-A**, or **AEPD-85** often exhibit increased resistance to fungal growth. This benefit is illustrated in the following chart for the indicated synthetic fluid formulation containing **CORRGUARD-A**, and comparing with TEA and TEA/KOH.



Synthetic Fluid Formulations (Triazine/CORRGUARD-A Antifungal Study)

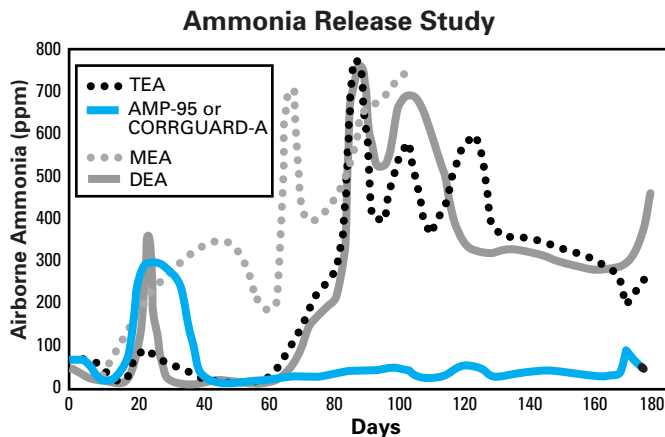
	Ingredients, wt. %		
	TEA-99	TEA-99/KOH	CORRGUARD-A
Deionized Water	73	71	79
Amine Carboxylate	5	5	5
Inversely-Soluble Ester	10	10	10
Amino Alcohol	10	10	4
KOH (45%)	–	2	–
Triazine	2	2	2
pH @ 20:1 Dilution	8.8	9.6	9.7

Problem

I rely heavily on ethanolamines, particularly TEA and monoethanolamine (MEA), as relatively inexpensive sources of alkalinity for my fluids. However, in the field some fluids demonstrate microbial degradation and pH drop. When this happens, my customers often complain about release of ammonia odors. How can I correct this?

Solution

Biodegradation of ethanolamines has been shown to lead to ammonia formation. The dissolved ammonium hydroxide can suddenly be released as gaseous ammonia when fluid pH is adjusted upward. This results in what is commonly known as an "ammonia flush." In tests conducted under controlled laboratory conditions, it has been found that **AMP-95** and **CORRGUARD-A** generate only a fraction of the ammonia formed by ethanolamines (see chart). **AMP-95** and **CORRGUARD-A** are therefore, excellent choices for low ammonia-release fluids.

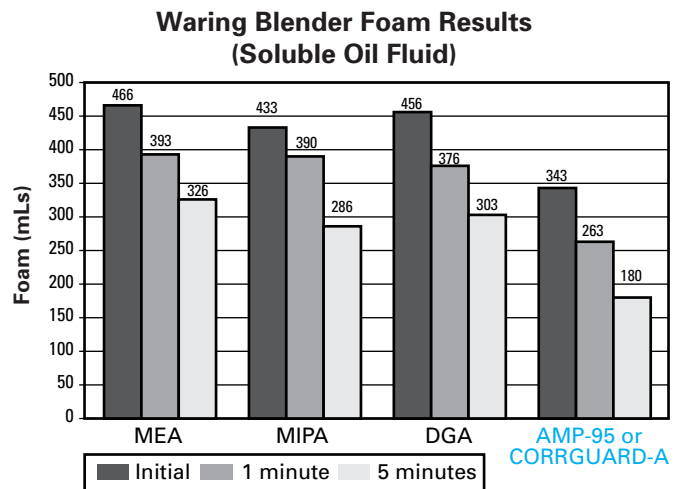


Problem

My fluids foam like crazy. As machining speeds increase, this is becoming more and more of a headache for my customers. I use some defoamers but they are often difficult to formulate with. What can I do?

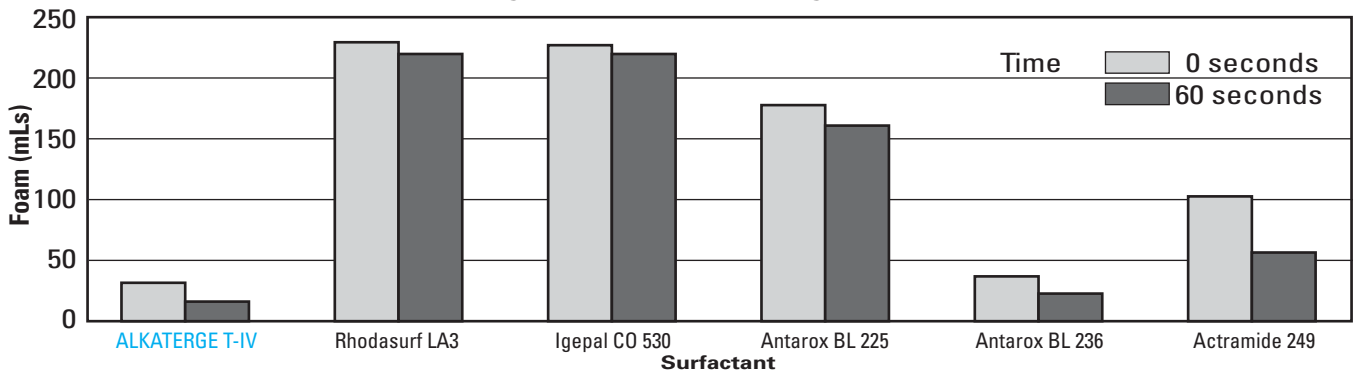
Solution

One of the keys to minimizing foaming is to select raw materials that are inherently low foaming. Two foaming culprits can be amines and surfactants. For example, amine/fatty acid soaps tend to foam in emulsion-based fluids. The amine choice can, however, significantly influence foaming potential. In a controlled laboratory study using high-shear mixing, a soluble oil, formulated with **AMP-95** or **CORRGUARD-A** foamed significantly less than did identical fluids with other amines, as illustrated in the chart.

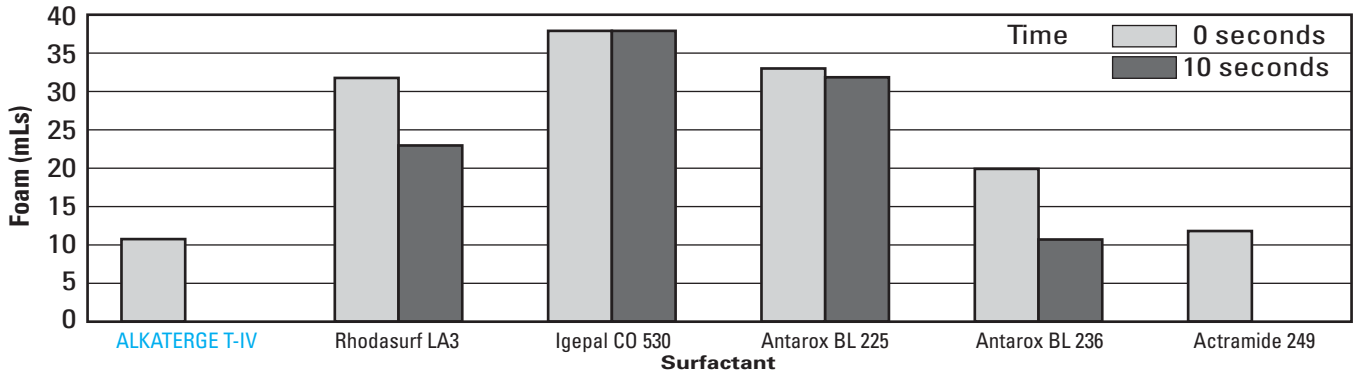


Surfactant choice can also play a big role in foaming. Testing of stable emulsions formed from a severely hydrotreated naphthenic oil containing typical industry surfactants revealed that **ALKATERGE T-IV** generates the least foam under both low and high shear conditions (see below). **ALKATERGE T-IV** is therefore an excellent building block for low foaming emulsion fluids.

Waring Blender Foam Test (High Shear)



Hand Shake Foam Test (Low Shear)



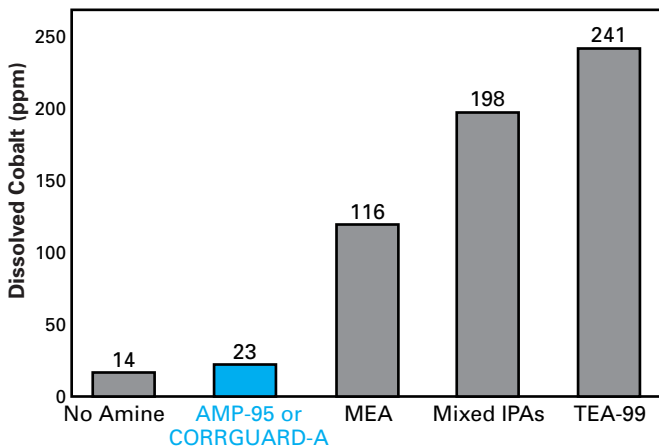
Problem

I have a customer that uses one of my fluids to produce carbide tools. They complain that the fluid changes color over time and are concerned that high levels of dissolved cobalt may harm their workers (dermatitis, etc.) I add inhibitors to my fluids but they only work for a certain amount of time. What can I do?

Solution

Here is another situation where raw materials are the culprit. In particular, amines can dissolve or leach cobalt from the fines generated during tool production. However, there are significant differences in the leaching potential of the commonly-used amines. In a laboratory study comparing the leaching tendencies of dilute amine solutions (using carbide swarf) it was found that **AMP-95** and **CORRGUARD-A** leached significantly less cobalt from the swarf than did the other common amines.

**Cobalt Leaching Study
(1% Aqueous Amine Solutions)**



Fluids formulated with **AMP-95** or **CORRGUARD-A** will inherently leach less cobalt than fluids based on other amines. A suggested starting formulation for a synthetic grinding fluid for carbide tool production is

shown below. To maintain very low cobalt levels, it is suggested that inhibitors such as tolyltriazole be added to the concentrate (or tankside as necessary).

Low Cobalt – Leaching Grinding Fluid

Deionized Water	71.6 %
Corfree M1	5.0
Boric Acid	5.0
Phosphate Ester	4.0
AMP-95 or CORRGUARD-A	14.4

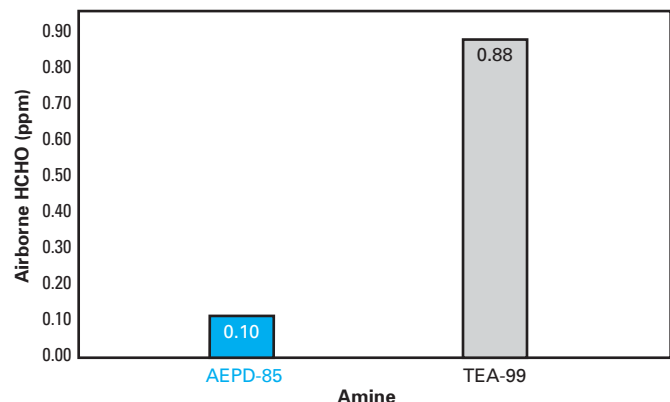
Problem

My customers are concerned that fluids containing formaldehyde-based biocides such as triazine may release formaldehyde at levels exceeding 0.1 ppm in their plants. This would require us to label our products and force our customers to enact training programs for their employees. Do I have any options short of replacing the formaldehyde-based biocides?

Solution

Laboratory experiments measuring airborne formaldehyde above a synthetic fluid containing ~1000 ppm triazine biocide (use-diluted), showed that when TEA is the sole amine, formaldehyde levels in a confined airspace reached ~0.88 ppm. When TEA was replaced with **AEPD-85** (present at 2x the level of triazine), airborne formaldehyde was reduced to 0.1 ppm (see chart). Since field monitoring of formaldehyde levels in actual plant environments where triazine-based fluids are used has shown the levels to be lower than in these lab studies, use of **AEPD-85** in fluids containing triazine may allow airborne formaldehyde levels to be maintained below 0.1 ppm.

**Formaldehyde Monitoring
(Synthetic Fluid Containing Triazine Biocide)**



For more detailed information on these products, ANGUS offers the following literature references. To access the literature, visit our website or contact The Dow Chemical Company Information Group.

AMP-95 Technical data sheet for AMP-95. Uses include pigment dispersion in latex emulsion paints, emulsifier for polyethylene wax, resin neutralization in waterborne coatings, corrosion control in boilerwater solutions, ethanolamine alternative in cosmetics, hairspray resin neutralization and formaldehyde scavenging. Includes information on toxicity, storage and handling.	319-00016	"Metalworkers Choose Quality Over Quantity" A reprint from <i>Lubricants World</i> . Article discusses how fluid-manufacturing companies are responding to market demands for safer, less costly and higher performing metalworking fluids. REPRINTS ARE NOT AVAILABLE ON THE ANGUS WEBSITE.	319-00088
ALKATERGE T-IV Surface Active Agent Technical data sheet for ALKATERGE T-IV, a multi-functional oxazoline-type surfactant, highly dispersible in water, soluble in hydrocarbons and alcohols. Includes information on typical properties, solubility, toxicology and handling precautions.	319-00027	"Water Hazard" A reprint from <i>Cutting Tool Engineering</i> which outlines the performance benefits of AMP-95 as an additive for low cobalt-leaching metalworking formulations. Compares the cobalt-dissolving tendencies of different amines and includes recommendations for building a better fluid. REPRINTS ARE NOT AVAILABLE ON THE ANGUS WEBSITE.	319-00092
AEPD-85 High Performance Amino Alcohol for Metalworking Fluids Technical bulletin for AEPD-85, a primary amino alcohol with an intermediate base strength that provides a good balance of pH development and reserve alkalinity properties in metalworking fluids. Includes key performance benefits and typical properties.	319-00043	"AMP Benefits" Reprint from Harts <i>Lubricants World</i> . REPRINTS ARE NOT AVAILABLE ON THE ANGUS WEBSITE.	319-00096
AMP-95 Performance Additive for Metalworking Fluids Technical bulletin for AMP-95, a primary alkanolamine for metalworking fluid formulations; specifically in emulsifier systems and for clarity improvement, pH control, corrosion protection and foam control. Includes information on product benefits, typical properties, toxicology and lubricity effects.	319-00046	"Boost Your Resistance" Reprint from <i>Lubes 'N' Greases</i> . Article presents data on the use of AMP-95 in metalworking fluids, focusing on how it can enhance their useful life. REPRINTS ARE NOT AVAILABLE ON THE ANGUS WEBSITE.	319-000145
AMP-95 The Amino Alcohol of Choice for Reduced Cobalt Leaching in Metalworking Fluids Benchmark presents results of a laboratory cobalt leaching study, highlighting the performance of AMP-95.	319-00064	CORRGUARD-A Technical data sheet for CORRGUARD-A; includes physical properties, toxicity, handling and storage, and shipping/packaging.	319-00325
		CORRGUARD-A Technical bulletin for CORRGUARD-A; includes information on product benefits and comparative performance data.	319-00326

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