Isopropanolamines

Isopropanolamine Use in Metalworking Fluids

Three types of isopropanolamines (MIPA, DIPA, TIPA) can be used in an array of metalworking fluids. Whether you are looking to provide corrosion protection, improved lubricity, foam suppression, reduced friction and/or pH control in metal cutting applications, isopropanolamines and compounds made with isopropanolamines can meet your needs.

Advantages

Some customers and end-users require ethanolamine-free formulations. The use of isopropanolamines in your formulated product makes this goal possible.

In the formulation of metalworking fluids, isopropanolamines provide comparable performance characteristics when compared to diethanolamine (DEA), yet they offer an additional advantage. Since MIPA is in a liquid state at the time the metalworking fluids are formulated and used, this isopropanolamine is easier and safer to handle than solid diethanolamine.

An examination of pH properties of isopropanolamines and ethanolamines reveals that both families of compounds are very similar. As shown in Figures 1, 2 and 3, there are striking similarities between the pH characteristics of MIPA and MEA, as well as DIPA, DEA, TEA and TIPA. Therefore, formulators can use isopropanolamines for pH adjustment with results similar to what would be expected for the corresponding ethanolamine. In addition, the Kritchevsky type (2:1 alkanolamine: fatty material) and 1:1 super amides are readily produced using either isopropanolamines or diethanolamine.

Figure 1—pH vs. Aqueous Weight % of MEA & MIPA

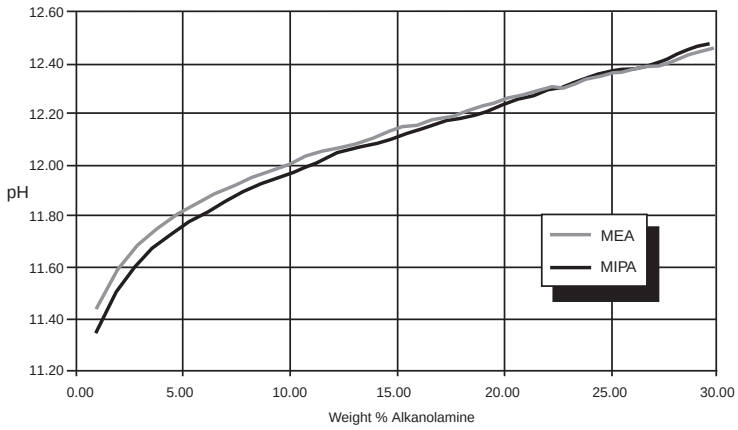


Figure 2—pH vs. Aqueous Weight % of DEA & DIPA

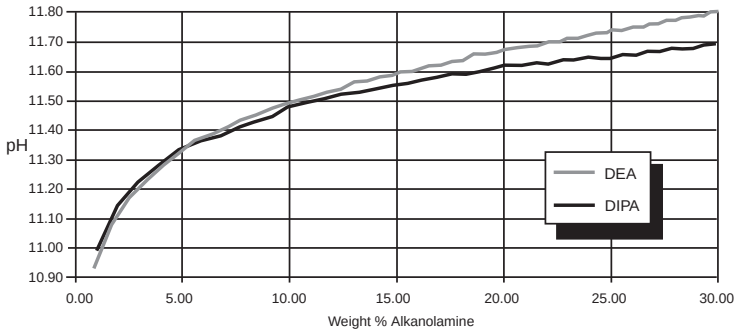
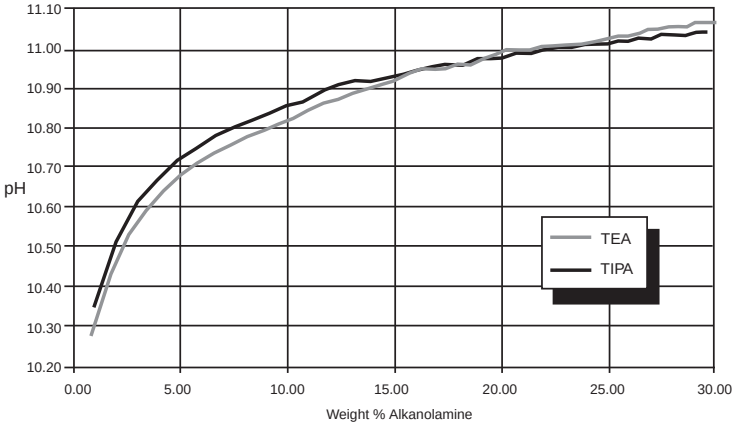


Figure 3—pH vs. Aqueous Weight % of TEA & TIPA



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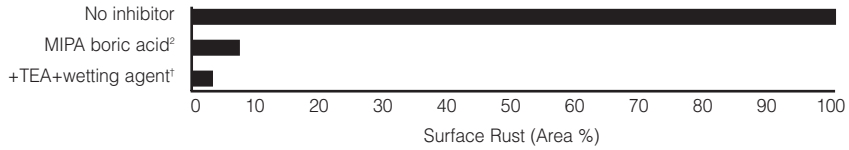
With the increased use of water-based metalworking fluids comes the need for more effective corrosion protection. Monoisopropanolamine (MIPA) and triethanolamine (TEA) plus a wetting agent were added to the MIPA-boric acid formulations to successfully reduce the corrosion of metal in the presence of water and oxygen. As shown in Figure 4, the boric acid/MIPA formulation, and that of TEA plus a wetting agent, deliver significantly better corrosion protection than fluids without an inhibitor. Additional advantages of the MIPA-borate inhibitor system are the broader range of solubilities (in aqueous and organic solutions) in addition to greater resistance to precipitation from hard water ions.

Alkanolamine products are used in a variety of typical metalworking fluid applications (reference Figure 5). A significant number of isopropanolamine compounds are already on the TSCA inventory as shown in Figure 6.

For more information on DOW isopropanolamines, call 1-800-447-4DOW (4369). Please refer to the appropriate Material Safety Data Sheet (MSDS) for safe handling information.

Figure 4—Evaluation of Various Corrosion Inhibitors[1] on the Corrosion of Iron in the Presence of Water and Oxygen



[1] Concentrations were 0.3% by weight for the acid salts and 0.1% by weight for the triethanolamine.

[2] The monoisopropanolamine (MIPA) salt of (ortho) boric acid was prepared by slowly adding MIPA to a slurry of boric acid until complete solubility was obtained. A slight excess of amine (i.e., about 1.1 to 1 molar ratio) was used. The concentration of the resulting MIPA-boric acid salt was 50% by weight.

[†] Triton X 100, Rohm and Haas Co.; antifoams, if used, should be non-silicone based.

Figure 5—Typical Metalworking Fluid Formulations

Typical Soluble Oil		
Oil base	Napthenic oils	40–80%
Emulsifier/coupling agent	Sodium sulfonate & amine soap/propylene glycols	7–20%
Extreme pressure additive	Cl^-, sulfur or phosphorous compound	5–10%
Rust inhibitor	Alkanolamide	3%
Buffer/pH control	Alkanolamine	3–5%
Biocide	Triazine or Isothazoline	1%

Typical Semi-Synthetic		
Lubricant	Mineral oil	5–30%
Oiliness agent	Lard oil	0–10%
Extreme pressure additive	Phosphate ester	0–20%
Metal passivator	Triazole	0–2%
Corrosion inhibitor	Amine borate (MEA, MIPA)	5–20%
Emulsifiers	Alkanolamide Petroleum sulfonate	20–40% 20–40%
Reserve alkalinity (rust protection)	TEA	5–20%
Biocide	Triazine	0–3%
Diluent	Water	30–50%

Typical Synthetic		
Lubricant	PEG ester or EO/PO polymers	0–40%
Corrosion inhibitors	Alkanolamine borates	5–10%
Reserve alkalinity	TEA	10–30%
Biocide	Oxazolidine	0–3%
Plasticizer	Glycerin	3–5%
Diluent	Water	30–50%

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Figure 6 — Isopropanolamine Compounds on the TSCA Inventory

MIPA (monoisopropanolamine) Compounds
• Fatty acids, C14-C18 and C16-C18 unsaturated, compounds with isopropanolamine — CAS 68855-74-3
• Fatty acids, C8-C18 and C18 unsaturated, compounds with isopropanolamine — CAS 688855-73-2
• Fatty acids, C14-C18 unsaturated, compounds with isopropanolamine — CAS 68783-39-1
• Fatty acids, soya, reaction products with isopropanolamine — CAS 68457-10-3
• Fatty acids, tallow, reaction products with isopropanolamine — CAS 68440-33-5
• Fatty acids, tall-oil, reaction products with isopropanolamine — CAS 68440-26-6
• Fatty acids, linseed oil, reaction products with isopropanolamine — CAS 68440-08-4
• Fatty acids, coco, reaction products with isopropanolamine — CAS 68440-05-1
• Fatty acids, coco, hydrogenated, reaction products with isopropanolamine — CAS 68440-02-8
• Fatty acids, tallow, reaction products with isopropanolamine — CAS 68424-57-7
• Fatty acids, C16-C18 unsaturated, compounds with isopropanolamine — CAS 68188-86-3
• Fatty acids, C16-C18 and C18 unsaturated, compounds with isopropanolamine — CAS 68154-23-4
• Fatty acids, C16 and C18 unsaturated and C18 unsaturated hydroxy, compounds with isopropanolamine — CAS 68002-83-5
• Fatty acids, tall-oil, compounds with isopropanolamine — CAS 67701-22-8
• Fatty acids, C18 unsaturated, dimers, compounds with isopropanolamine — CAS 67701-16-0
• Hydrocarbon waxes (petroleum), oxidized, compounds with isopropanolamine — CAS 67891-83-2
• Napthenic acids (petroleum), compounds with isopropanolamine — CAS 67891-84-3
• Resin acids and rosin acids, compounds with monoisopropanolamine — CAS 68990-69-2
• Lauric acid monoisopropanolamide — CAS 142-54-1
• Oleic monoisopropanolamide — CAS 111-05-7
• Steric isopropanolamide — CAS 35627-96-4

DIPA (diisopropanolamine) Compounds
• Fatty acids, tallow, compounds with diisopropanolamine — CAS 68953-37-7
• Fatty acids, tall-oil, compounds with diisopropanolamine — CAS 68953-28-6
• Fatty acids, C16-C18 and C18 unsaturated, compounds with diisopropanolamine — CAS 68855-71-0
• Fatty acids, C14-C18 and C16-C18 unsaturated, compounds with diisopropanolamine — CAS 68855-70-9
• Fatty acids, C8-C18 and C18 unsaturated, compounds with diisopropanolamine — CAS 68855-69-6
• Fatty acids, C14-C18 unsaturated, compounds with diisopropanolamine — CAS 68188-91-0
• Fatty acids, C16 and C18 unsaturated, and C18 unsaturated hydroxy, compounds with diisopropanolamine — CAS 68038-06-2
• Fatty acids, C18 unsaturated, dimers, compounds with diisopropanolamine — CAS 96278-59-0
• Benzoic acid, compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 68480-02-4
• Benzoic acid, 4-(1,1-dimethylethyl), compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 68213-81-0
• Caprylic acid, compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 68213-73-0
• Citric acid diisopropanolamine salt — CAS 67952-30-1
• Dodecanoic acid, compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 64608-94-2
• Isoocatadecanoic acid, compounds with 1,1'-iminobis (2-propanol) (1:1) — CAS 93920-27-5
• Montanic acid, compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 67953-00-8
• Oleic acid, diisopropanolamine salt — CAS 38618-12-1
• Steric acid, compound with 1,1'-iminobis (2-propanol) (1:1) — CAS 10042-66-7

TIPA (triisopropanolamine) Compounds
• Fatty acids, sperm oil, compounds with triisopropanolamine — CAS 85631-44-3
• Fatty acids, tall-oil, compounds with triisopropanolamine — CAS 68911-36-4
• Fatty acids, tallow, compounds with triisopropanolamine — CAS 68910-96-3
• Fatty acids, C16-C18 and C18 unsaturated, compounds with triisopropanolamine — CAS 68855-77-6
• Fatty acids, C14-C18 and C16-C18 unsaturated, compounds with triisopropanolamine — CAS 68855-76-5
• Fatty acids, C8-C18 and C18 unsaturated, compounds with triisopropanolamine — CAS 68855-75-4
• Fatty acids, C16 and C18 unsaturated and C18 unsaturated hydroxy, compounds with triisopropanolamine — CAS 68855-68-5
• Fatty acids, C14-C18 unsaturated, compounds with triisopropanolamine — CAS 68188-90-9
• Isooctadecanoic acid, compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 93920-26-4
• Montanic acid, compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 67952-99-2
• Octadecanoic acid, compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 10042-67-8
• Oleic acid, compound with triisopropanolamine — CAS 68527-64-0
• Oleic acid, compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 67952-35-6
• Benzoic acid, compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 69121-22-8
• Benzoic acid, 4-(1,1-dimethylethyl), compound with 1,1',1"-nitrilotris (2-propanol) (1:1) — CAS 68258-65-1
• Citric acid, triisopropanolamine salt — CAS 67952-34-5

For more information, contact

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or visit our web site at **www.dowamines.com**

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