Metalworking Chemicals

Delivering proven and sustainable metalworking fluids

INDORAMA VENTURES

Integrated Oxides & Derivatives

> Empowering potential.

Indorama Ventures Oxides & Derivatives manufactures a broad range of amines, surfactants and related products essential in formulating metalworking fluids. The table (right) lists primary applications for each of the product classes. Integrated Oxides & Derivatives is a global integrated supplier of amines, emulsifiers and surfactants, offering a wide range of products to the Metalworking industry.

More than being merely a supplier, Indorama offers direct benefits through synthesis-based and application research, attention to manufacturing efficiencies, and personalized technical support.

Primary Applications

Description / Product Line	Alkalinity Control	Corrosion Inhibitor	Emulsifiers	Lubricity Additives	Coupling Agents	Intermediates	Low Foaming
ALKYLPHENOL ETHOXYLATES SURFONIC® NP / OP series surfactants TERIC® N / X, series surfactants			■			■	
CASTOR OIL ETHOXYLATES SURFONIC® CO series surfactants TERIC® 380 surfactant		■	■				
EO:PO BLOCK COPOLYMERS SURFONIC® POA-L series surfactants TERIC® PE series surfactants			■				■
FATTY ACID ETHOXYLATES SURFONIC® E-400 series surfactants TERIC® SF / OF series surfactants			■	■			
FATTY ALCOHOL ALKOXYLATES HYDRAPOL® RP series surfactants SURFONIC® LF series surfactants TERIC® BL series surfactants			■		■		■
FATTY ALCOHOL ETHOXYLATES SURFONIC® L24, TDA series surfactants TERIC® 12A / 13A / 17A series surfactants			■		■		
FATTY AMINE ETHOXYLATES SURFONIC® T series surfactants TERIC® 16M / 18M series surfactants			■	■			
FUNCTIONAL FLUIDS UNIMAX® series fluids				■			■
GLYCOLS MEG, DEG, TEG					■		
GLYCOL ETHER SOLVENTS GLYCOL® series solvents SURFONIC® SM series surfactants		■	■				■
PHOSPHATE ESTERS SURFONIC® PE series surfactants		■	■	■			
POLYETHYLENE GLYCOLS PEG and POGOL® series glycols				■			
POLYPROPYLENE GLYCOLS PPG						■	
PRIMARY AMINES MEA, DEA, TEA	■	■				■	
REVERSE EO:PO BLOCK COPOLYMERS SURFONIC® POA-17R2, POA-17R4, and POA-25R2 surfactants			■				■

Indorama Metalworking Chemicals

Amines

Amines are an important component in both metalworking fluids and metal cleaning applications where they act as a corrosion inhibitor and a source of reserve alkalinity. Amine selection is based on metals encountered, misting concern, toxicity, alkalinity requirements and stability.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Equivalent Weight	Appearance @ 25°C	Max. Color Pt-Co	pH, 5% Aqueous Solution @ 20°C	Viscosity Cst @ 25°C	Flash Point PMCC, °C	Suggested Dosage	
MEA	Monoethanolamine	61	Clear liquid	15	11.8	-	96	1-10%	• Reserve alkalinity source • Acid neutralizer • Common intermediate for amides
DEA	Diethanolamine	105	Clear liquid	15	11.5	321[2]	176	1-10%	• Common intermediate for amides
TEA	Triethanolamine	149	Clear liquid	40	11	527	202	1-15%	• pH adjuster • Enhances pH stability as a pH buffer

1. Properties are for reference only. Please approach Indorama for actual specifications. Only selected products have been showcased in this brochure.
2. Measured at 30°C

Amine Ethoxylates

SURFONIC® T series surfactants can be used in different types of metalworking operations. These products can be applied to both soluble oil and semi-synthetic formulations and act as co-emulsifiers to help solubilize additives.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Equivalent Weight	Appearance @ 25°C	Max. Color Pt-Co	pH, 5% Aqueous Solution @ 20°C	Viscosity Cst @ 40°C	Flash Point PMCC, °C	Suggested Dosage	
SURFONIC® T-5 surfactant	Tallow amine ethoxylate	-	Amber liquid	9 (HLB)	9.0-10.5	71	374	5-10%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids
SURFONIC® T-10 surfactant	Tallow amine ethoxylate	-	Clear to turbid amber liquid	12.4 (HLB)	9.4 (1%)	69	350	5-10%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids

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Surfactants

Linear alcohol ethoxylates are widely used as emulsifiers, cleaners, penetrants and wetting agents. Appropriate selection of the alcohol chain length and degree of ethoxylation can provide the surfactant properties for a particular application. Primarily emulsifiers are most appropriate to the formulation of vegetable oils, glycerides, higher viscosity paraffinic oils, cycle oils and waxes. Castor oil ethoxylates are used as emulsifiers and dispersing agents for water-miscible formulations. Indorama offers a variety of castor oil ethoxylates with varying degrees of ethoxylation to suit customer needs.

Properties

Product	Description	Function
TERIC® 17AN surfactant (N stands for 2 EO to 25 EO)	C16 - C18 (Cetyl - Oleyl) alcohol ethoxylates	• Extensively used as emulsifiers, cleaners, penetrants and wetting agents in metalworking formulations • Appearance (25°C) varies from clear liquids to white waxy solids, depending on the alcohol used and degree of ethoxylation
SURFONIC® TDA series surfactants	Iso-C13 (iso-Tridecanol) ethoxylates	
SURFONIC® L-24 series (2 EO to 22 EO)	C12 - C14 alcohol ethoxylates	
SURFONIC® CO series surfactants	Castor oil ethoxylates	• Emulsifiers and dispersing agents that can impart some lubricity in formulations

Low Foam Surfactant

Alcohol alkoxylates are ideally suited for metalworking operations. They tend to have low foam and excellent wetting characteristics. Some products can work as defoamers in water-based systems.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	HLB	Max. Color Pt-Co	pH, 5% Aqueous Solution	Viscosity Cst @ 25°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
TERIC® 168 surfactant	Alcohol alkoxylate	Clear to hazy liquid	11.1	250	6.0-8.0 1% aq.	70[2]	28-37	2-15%	• A low foaming surfactant with excellent wetting properties. It may be used in low foam metal cleaning formulations.
SURFONIC® JL-80X surfactant	Alcohol alkoxylate	Clear liquid	13.1	100	7.0	51	59	2-15%	• Used in metal cleaning operations • Special structure eliminates gel phase common to alcohol ethoxylates in aqueous solutions
SURFONIC® LF-17 surfactant	Alcohol alkoxylate	No more than a trace of turbidity	-	100	5.0-7.5 1% aq.	96	32-36	5-20%	• Wetting agent in acid cleaner formulations • LF-17/LF-18 may be used as an efficient low foam emulsifier in metalworking fluids • LF-37 has excellent wetting performance and a very low foaming tendency • Emulsifier and rinse aid for metal cleaning • Solubilizer / emulsifier for semi-synthetic formulations • Co-emulsifier for semi-synthetics • Rinse aid for cleaners • Emulsifier for semisynthetics
SURFONIC® LF-18 surfactant	Alcohol alkoxylate	Clear to slightly hazy liquid	11.9	100	5.5-7.5[3]	240	14-20	5-20%	
SURFONIC® LF-37 surfactant	Alcohol alkoxylate	Clear to slightly hazy liquid	3.0-6.0	200	5.5-7.0	96	15-19	5-20%	
SURFONIC® P1 surfactant	Alcohol alkoxylate	Clear liquid	7	100	6.0-7.0 1% aq.	90	24-26	2-15%	
SURFONIC® P3 surfactant	Alcohol alkoxylate	Clear colorless liquid	-	100	5.5-7.0	56	34-36	2-15%	
SURFONIC® P5 surfactant	Alcohol alkoxylate	Clear liquid	-	250	6.5-7.5	85	44-46	2-15%	

1. Properties are for reference only. Please approach Indorama for actual specifications. Only selected products have been showcased in this brochure.
2. Measured at 20°C
3. 1% in 10:6, IPA:H_20

Specialty Emulsifier

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	HLB	Pour Point °C	Density 25°C, g/mL	Viscosity Cst @ 40°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
SURFONIC® MW-100 emulsifier	Proprietary emulsifier	Slightly turbid liquid, substantially free of foreign matter	5-7	4	7 (pH 1%)	117	-	5-20%	• Inherently low foaming • Compatible with phosphate esters for extreme pressure • Able to formulate macro or micro emulsions that are very stable • Coupling agent • Low toxicity profile
SURFONIC® MW-103 polymeric emulsifier	Tall oil, polymer with polyethylene glycol and succinic anhydride monopolysiobutylene	Amber to brown viscous liquid	7-8	20	4.5-6.5 (pH 5%)	15000cP	-	5-20%	• Inherently low foaming • Solvent free product • Clean labeling and no VOC • Stable emulsions after shearing that are very stable • Low toxicity profile

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Extreme Pressure Additives - Phosphate Esters

Phosphate esters provide extreme pressure (EP) properties to water-based and synthetic formulations. Additionally, they provide lubricity and emulsification actives and may provide excellent corrosion resistance in different kinds of metalworking formulations.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	Acid Value	Pour Point °C	Density 25°C, g/mL	Viscosity Cst @ 40°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
SURFONIC® PE-1198LA surfactant	Alkylaryl ethoxylate complex phosphate in free acid form	Viscous yellow liquid	95-110 mgKOH/g, pH 2#	-9.4	1.12	1510	2.5 (5% pH)	0.5-3%	• Excellent aluminum protection • Good EP performance • Hard water tolerance
SURFONIC® PE-2852 surfactant	Aliphatic phosphate in free acid form	Clear liquid		-32	1.05	116	-	0.5-3%	• Good corrosion inhibition • Good EP performance

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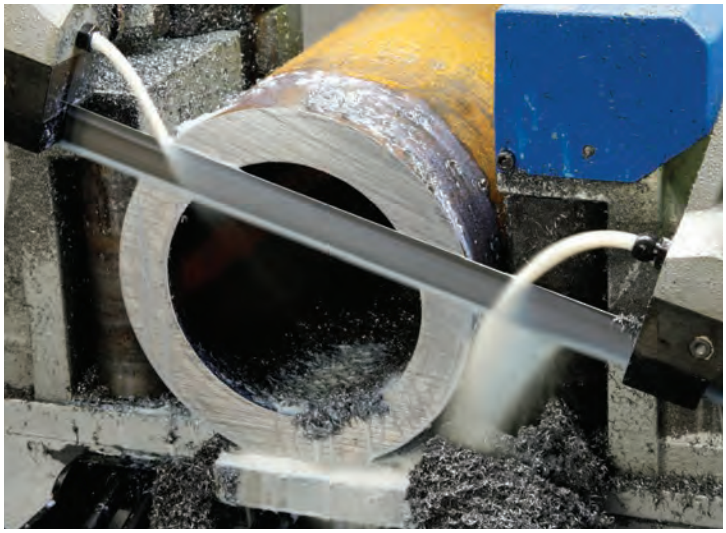

Lubricant In Synthetic Fluid

SURFONIC® POA block copolymers are very useful in a variety of metalworking operations. These products are made by the sequential addition of ethylene oxide and propylene oxide. The functional attributes of these products - defoaming, wetting, lubricity, solubilization, emulsification, thickening and dispersion - all depend on the ratio of ethylene oxide to propylene oxide, the molecular weight and blocking pattern of the molecule. **UNIMAX®** functional fluids are alkoxylates of mono-, di- or tri-functional starting materials. These versatile fluids have varying degrees of solubility in water and oil. The fluids possess many desirable properties of natural lubricants and have distinctive properties of their own. They are recommended for use in difficult applications such as drilling, quenching and as a gear oil component.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	HLB	Max Color Pt-Co	pH, 5% Aqueous Solution	Viscosity Cst @ 25°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
SURFONIC® POA-L101 surfactant	EO/PO block copolymers	Clear to hazy liquid, substantially free of foreign matter	1	150	5.5-7.5[2]	800	13-17	3-10%	• Emulsifier and dispersant • Solubilizer for semi-synthetics and synthetic fluids
SURFONIC® POA-17R2 surfactant	Reverse EO/PO block copolymers	Colorless to light yellow liquid	8	100	6.0-7.5	205 (38˚)	35	3-10%	• Prime surfactant in cleaners and wetting agent • Lubricant in synthetic fluids
SURFONIC® POA-17R4 surfactant	Reverse EO/PO block copolymers	Colorless to light yellow liquid	7-12	80	5.5-7.0	254 (38˚)	44-48	3-10%	• Reduces misting • Lubricant in synthetic fluids
SURFONIC® POA-25R2 surfactant	Reverse EO/PO block copolymers	Colorless to light yellow liquid	6.3	100	6.0-7.5	570	30	3-10%	• Lubricant in synthetic fluids • Solubilizer in semi-synthetic fluids
UNIMAX® WL-660 fluid	EO/PO block copolymers	Clear liquid	-	-	7.7	158 (38˚)	66	5-15%	• Exceptional lubrication, excellent finishes and longer tool life • High viscosity index used at a wide range temperatures
UNIMAX® WL-5000 fluid	EO/PO block copolymers	Clear amber liquid	-	200	-	1080 (38˚)	53	5-15%	

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2. 5% in 10:6, IPA:H_20

NPE Replacements

Alkyl poly(alkylene oxide) derivatives based on a synthetic linear primary alcohol. Due to their low viscosities, the surfactants are easily handled.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	HLB	Pour Point °C	Density 25°C, g/mL	Viscosity Cst @ 20°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
HYDRAPOL® RP40 surfactant	Alkyl poly (alkylene oxide) derivative based on a synthetic linear primary alcohol	Clear to slightly turbid liquid	7.8	-10	0.949	28.5	45	0.5-6%	• Soft gel structures lead to easy dispersal and dissolution
HYDRAPOL® RP50 surfactant	Alkyl poly (alkylene oxide) derivative based on a synthetic linear primary alcohol	Clear to slightly turbid liquid	10.2	0	0.964	38	56	0.5-6%	• Minimal surface tensions and highly surface active • Powerful wetting agent
HYDRAPOL® RP90 surfactant	Alkyl poly (alkylene oxide) derivative based on a synthetic linear primary alcohol	Clear to slightly turbid liquid	13	16	0.993	156	71	0.5-6%	• Low contact angles • Low foam surfactant and NPE replacement

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Synthetic Sodium Sulphonate

Indorama is a major manufacturer of alkyl benzenes with an existing and developing range of higher molecular weight materials. Our **SURFONIC® SM** products are synthetic sodium sulphonates that offer excellent emulsification and corrosion inhibition. These products are used as primary emulsifiers in soluble oil and semi-synthetic fluids, and can be used to replace natural sodium sulfonates in metalworking fluids.

Properties

Product	Description	Properties[1]							Function / Characteristic
		Appearance @ 25°C	HLB	Pour Point °C	Density 25°C, g/mL	Viscosity Cst @ 25°C	Cloud Point °C (1% Aqueous)	Suggested Dosage	
SURFONIC® SM-60 HBH surfactant	Synthetic sodium sulphonate	Clear brown liquid	-	510 avg. MW	60% active content	1500	-	5-15%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids
SURFONIC® SM-60 HBH surfactant	Synthetic sodium sulphonate	Clear brown liquid	-	510 avg. MW	78% active content	1700 (50°C)	-	5-15%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids
SURFONIC® SM-60 HBA surfactant	Synthetic sodium sulphonate	Clear brown liquid	-	497 avg. MW	50% active content	3500 (50°C)	-	5-15%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids
SURFONIC® SM-60 MXA surfactant	Synthetic sodium sulphonate	Clear brown liquid	-	425 avg. MW	60% active content	3000	-	5-15%	• Wetting agent • Emulsifier in soluble oil and semi-synthetic fluids

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INDORAMA VENTURES

Integrated Oxides & Derivatives

About Indorama

Indorama Ventures is a world-class chemical company and a global integrated leader in PET and fibers serving major customers in diversified end-use markets. Following our core strategies, we develop innovative products for customer needs and to make great products for society. Headquartered in Bangkok, Thailand, Indorama Ventures has operating sites in 31 countries on five continents – in Africa, Americas, Asia, Europe & Eurasia.

Integrated Oxides & Derivatives

Headquartered in The Woodlands, Texas, Indorama Ventures Integrated Oxides & Derivatives is a leading chemical intermediates and surfactants producer with a diverse range of products in growth markets such as home & personal care, agrochemicals, oilfield technologies, fuel & lube additives and more.

In January 2020, Indorama Ventures Public Company Limited completed its acquisition of Huntsman's world-class integrated oxides and derivative business, including:

- **Surfactants:** Integrated producer of a wide range of products for home and personal care, oilfield technologies, agriculture and process industries.
- **Ethylene and Derivatives:** Highly integrated manufacturer of ethylene, ethylene oxide, ethylene glycol, ethanolamines and other derivatives.
- **Propylene Oxide & Derivatives:** Highly competitive technology offerings in propylene glycol, methyl tertiary butyl ether (MTBE) and other derivatives.

Our operating sites include a large flagship site on the US Gulf Coast (USGC) at Port Neches, as well as Chocolate Bayou, Dayton and Clear Lake in Texas, Lake Charles, Louisiana, Ankleshwar, India and Botany, Australia.

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