Metalworking Chemicals
Delivering proven and sustainable metalworking fluids
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.
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

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Equivalent Weight</th>
<th>Appearance @ 25°C</th>
<th>Max. Color Pt-Co</th>
<th>pH, 5% Aqueous Solution @ 20°C</th>
<th>Viscosity Cst @ 25°C</th>
<th>Flash Point PMCC, °C</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEA</td>
<td>Monoethanolamine</td>
<td>61</td>
<td>Clear liquid</td>
<td>15</td>
<td>11.8</td>
<td>-</td>
<td>96</td>
<td>1-10%</td>
<td>• Reserve alkalinity source&lt;br&gt;• Acid neutralizer&lt;br&gt;• Common intermediate for amides</td>
</tr>
<tr>
<td>DEA</td>
<td>Diethanolamine</td>
<td>105</td>
<td>Clear liquid</td>
<td>15</td>
<td>11.5</td>
<td>3212</td>
<td>176</td>
<td>1-10%</td>
<td>• Common intermediate for amides</td>
</tr>
<tr>
<td>TEA</td>
<td>Triethanolamine</td>
<td>149</td>
<td>Clear liquid</td>
<td>40</td>
<td>11</td>
<td>527</td>
<td>202</td>
<td>1-15%</td>
<td>• pH adjuster&lt;br&gt;• Enhances pH stability as a pH buffer</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Equivalent Weight</th>
<th>Appearance @ 30°C</th>
<th>Max. Color Pt-Co</th>
<th>pH, 5% Aqueous Solution @ 20°C</th>
<th>Viscosity Cst @ 40°C</th>
<th>Flash Point PMCC, °C</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFONIC® T-5 surfactant</td>
<td>Tallow amine ethoxylate</td>
<td>-</td>
<td>Amber liquid</td>
<td>9 (HLB)</td>
<td>9.0-10.5</td>
<td>71</td>
<td>374</td>
<td>5-10%</td>
<td>• Wetting agent&lt;br&gt;• Emulsifier in soluble oil and semi-synthetic fluids</td>
</tr>
<tr>
<td>SURFONIC® T-10 surfactant</td>
<td>Tallow amine ethoxylate</td>
<td>-</td>
<td>Clear to turbid amber liquid</td>
<td>12.4 (HLB)</td>
<td>9.4 (1%)</td>
<td>69</td>
<td>350</td>
<td>5-10%</td>
<td>• Wetting agent&lt;br&gt;• Emulsifier in soluble oil and semi-synthetic fluids</td>
</tr>
</tbody>
</table>

1. Properties are for reference only. Please approach Indorama for actual specifications. Only selected products have been showcased in this brochure.
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

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Function / Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERIC® 17AN surfactant (N stands for 2 EO to 25 EO)</td>
<td>C16 - C18 (Cetyl - Oleyl) alcohol ethoxylates</td>
<td>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.</td>
</tr>
<tr>
<td>SURFONIC® TDA series surfactants</td>
<td>Iso-C13 (iso-Tridecanol) ethoxylates</td>
<td></td>
</tr>
<tr>
<td>SURFONIC® L-24 series (2 EO to 22 EO)</td>
<td>C12 - C14 alcohol ethoxylates</td>
<td></td>
</tr>
<tr>
<td>SURFONIC® CO series surfactants</td>
<td>Castor oil ethoxylates</td>
<td>Emulsifiers and dispersing agents that can impart some lubricity in formulations.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Appearance @ 25°C</th>
<th>Max. Color Pt-Co</th>
<th>pH, 5% Aqueous Solution</th>
<th>Viscosity Cst @ 25°C</th>
<th>Cloud Point °C (1% Aqueous)</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERIC® 168 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear to hazy liquid</td>
<td>11.1</td>
<td>250</td>
<td>6.0-8.0 1% aq.</td>
<td>70²</td>
<td>28-37</td>
<td>2-15%</td>
</tr>
<tr>
<td>SURFONIC® JL-80X surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear liquid</td>
<td>13.1</td>
<td>100</td>
<td>7.0</td>
<td>51</td>
<td>59</td>
<td>2-15%</td>
</tr>
<tr>
<td>SURFONIC® LF-17 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>No more than a trace of turbidity</td>
<td>-</td>
<td>100</td>
<td>5.0-7.5 1% aq.</td>
<td>96</td>
<td>32-36</td>
<td>5-20%</td>
</tr>
<tr>
<td>SURFONIC® LF-18 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear to slightly hazy liquid</td>
<td>11.9</td>
<td>100</td>
<td>5.5-7.5³</td>
<td>240</td>
<td>14-20</td>
<td>5-20%</td>
</tr>
<tr>
<td>SURFONIC® LF-37 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear to slightly hazy liquid</td>
<td>3.0-6.0</td>
<td>200</td>
<td>5.5-7.0</td>
<td>96</td>
<td>15-19</td>
<td>5-20%</td>
</tr>
<tr>
<td>SURFONIC® P1 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear liquid</td>
<td>7</td>
<td>100</td>
<td>6.0-7.0 1% aq.</td>
<td>90</td>
<td>24-26</td>
<td>2-15%</td>
</tr>
<tr>
<td>SURFONIC® P3 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear colorless liquid</td>
<td>-</td>
<td>100</td>
<td>5.5-7.0</td>
<td>56</td>
<td>34-36</td>
<td>2-15%</td>
</tr>
<tr>
<td>SURFONIC® P5 surfactant</td>
<td>Alcohol alkoxylate</td>
<td>Clear liquid</td>
<td>-</td>
<td>250</td>
<td>6.5-7.5</td>
<td>85</td>
<td>44-46</td>
<td>2-15%</td>
</tr>
</tbody>
</table>

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:H₂O
**Specialty Emulsifier**

**Properties**

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Appearance @ 25°C</th>
<th>HLB</th>
<th>Pour Point °C</th>
<th>Density 25°C, g/mL</th>
<th>Viscosity Cst @ 40°C</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
</table>
| 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 monoplatebutylene | 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**

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Appearance @ 25°C</th>
<th>Acid Value</th>
<th>Pour Point °C</th>
<th>Density 25°C, g/mL</th>
<th>Viscosity Cst @ 40°C</th>
<th>Cloud Point °C (1% Aqueous)</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
</table>
| 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

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

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2. 5% in 10:6, IPA:H₂O
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

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

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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 sulphonates in metalworking fluids.

Properties

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Appearance @ 25°C</th>
<th>HLB</th>
<th>Pour Point °C</th>
<th>Density 25°C, g/mL</th>
<th>Viscosity Cst @ 20°C</th>
<th>Cloud Point °C (1% Aqueous)</th>
<th>Suggested Dosage</th>
<th>Function / Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFONIC® SM-60 HBH surfactant</td>
<td>Synthetic sodium sulphonate</td>
<td>Clear brown liquid</td>
<td>-</td>
<td>510</td>
<td>avg. MW</td>
<td>60% active content</td>
<td>1500</td>
<td>-</td>
<td>5-15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Wetting agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Emulsifier in soluble oil and semi-synthetic fluids</td>
</tr>
<tr>
<td>SURFONIC® SM-60 HBA surfactant</td>
<td>Synthetic sodium sulphonate</td>
<td>Clear brown liquid</td>
<td>-</td>
<td>510</td>
<td>avg. MW</td>
<td>78% active content</td>
<td>1700 (50°C)</td>
<td>-</td>
<td>5-15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Wetting agent</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Emulsifier in soluble oil and semi-synthetic fluids</td>
</tr>
<tr>
<td>SURFONIC® SM-60 MXA surfactant</td>
<td>Synthetic sodium sulphonate</td>
<td>Clear brown liquid</td>
<td>-</td>
<td>497</td>
<td>avg. MW</td>
<td>50% active content</td>
<td>3500 (50°C)</td>
<td>-</td>
<td>5-15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Wetting agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Emulsifier in soluble oil and semi-synthetic fluids</td>
</tr>
</tbody>
</table>

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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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