

METSS CORPORATION



Products Derived From Soy

METSS Corporation
300 Westdale Ave.
Westerville, OH 43082

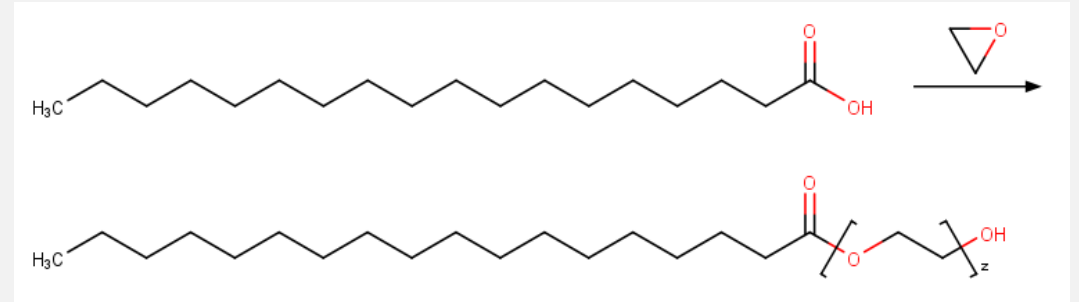
www.metss.com

Soy Fatty Acid Ethoxylates - Summary

Product: X-210-Z

- Reactants
 - Fatty acid - byproduct of soybean oil hydrolysis
 - Vary moles of ethylene oxide (EO)
 - X-210-4.5
 - Low foaming, cosmetics, adjuvants
 - X-210-6
 - low foaming, adjuvants, o/w emulsions
 - X-210-8
 - high foaming, personal care, o/w emulsions
 - X-210-10
 - high foaming, down hole lubricants, o/w emulsions
 - X-210-15
 - high foaming, detergents, down hole lubricants
 - X-210-20
 - low foaming, solubilizing agent, helper surfactant

Chemistry

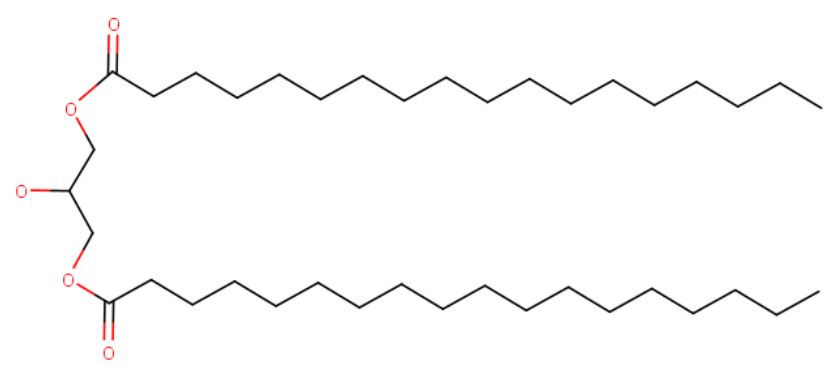


Other Soy Derivatives - Summary

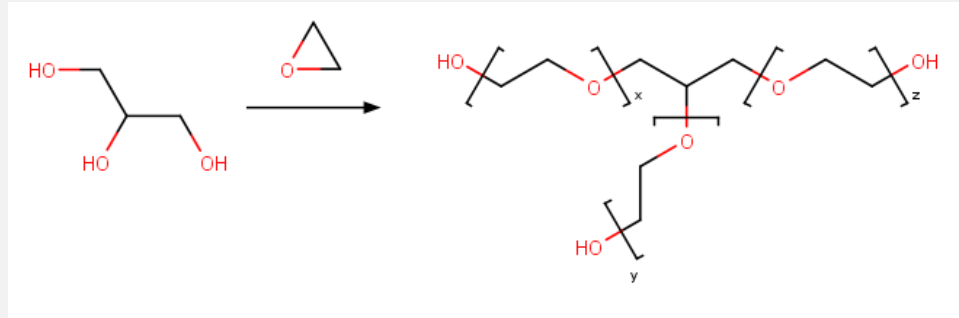
Other Products

- Soy Fatty Acid Ethoxylates
- Non-ionic Gemini Surfactant
- Ethoxylated Glycerols
- Carboxy Betaine
- Phosphate Ester Ethoxylate
- Soy Diethanolamine
- Amine Oxide
- Soy DMAPA
- Soy Quaternary Amine Carbonate
- Soy Quaternary Amine Silane
- Cationic Gemini Surfactant

Non-ionic Gemini

Product: X-FA-PEG	Chemistry	
<ul style="list-style-type: none"> Reactants <ul style="list-style-type: none"> Glycerol (byproduct of soybean oil hydrolysis) Soy fatty acid Non-ionic surfactant 		
Target Markets	Key Properties	
<ul style="list-style-type: none"> Enhanced oil recovery Patents filed by Rhodia <ul style="list-style-type: none"> Currently no listed products Not applicable to METSS's chemistry 	Form Appearance pH Foam height Emulsification Hydroxyl Value HLB	Liquid Amber 7.2 Very low (20/ <10) 40/30/10 N/A N/A

Ethoxylated Glycerols

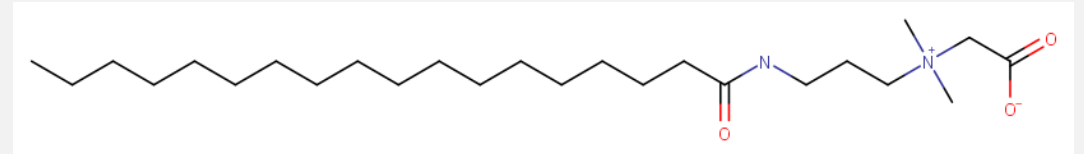
Product: X-TG-1218	Chemistry	
<ul style="list-style-type: none"> Reactants <ul style="list-style-type: none"> Glycerol - byproduct of soybean oil hydrolysis 6 moles of ethylene oxide (EO) High HLB non-ionic surfactant 	 <p style="text-align: right;">$X + Y + Z = 6$</p>	
Target Markets	Key Properties	
<ul style="list-style-type: none"> Cosmetics (humectant) Adhesives (humectant and tackifier) Oil/Water emulsions Competitive Product <ul style="list-style-type: none"> Glycereth-6 (Genapol X 060, Clariant) https://www.clariant.com/en/Solutions/Products/2014/09/23/16/22/Genapol-X-060 	<ul style="list-style-type: none"> Form Appearance pH Foam height Emulsification Hydroxyl Value HLB 	<ul style="list-style-type: none"> Liquid Slight yellow tint 5.8 Non-foaming 40/30/10 157 16

Carboxy Betaine

Product: X-210-CB

- Reactants
 - Soy fatty acid
 - Dimethylaminopropyl amine
 - Chloroacetic acid
- Coco variety is common in soaps and conditioners
- Zwitterionic (amphoteric) surfactant
- Actives 30% wt.

Chemistry



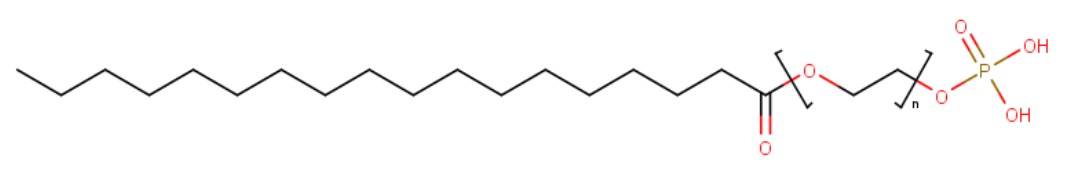
Target Markets

- Personal care
- Foam booster
- Effective in range of pH and dissolved solids (e.g., hard water)
- Competitive Product: Coco betaine
 - Amphosol CG (Stepan)
 - <https://www.steppan.com/products-markets/product/AMPHOSOLCG.html>

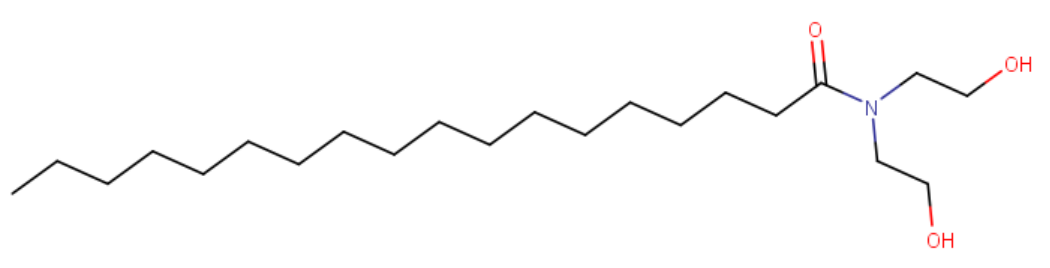
Key Properties

Form	Gel
Appearance	Pale brown
pH	7.7
Foam height	High (700/ <10)
Emulsification	0/0/80
Hydroxyl Value	N/A
HLB	N/A

Phosphate Ester Ethoxylate

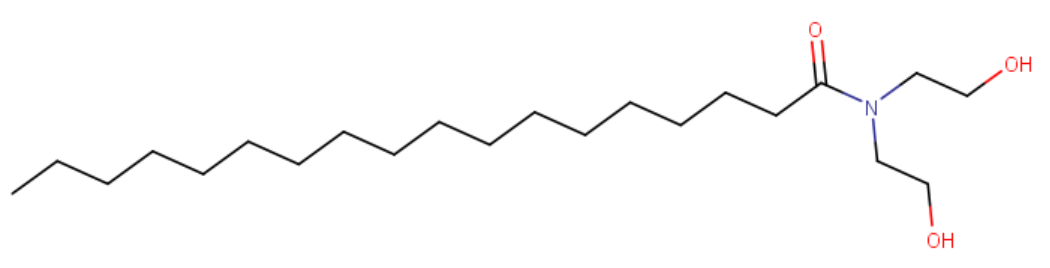
Product: X-210-4.5PE	Chemistry	
<ul style="list-style-type: none"> • Reactants <ul style="list-style-type: none"> • Soy fatty acid • 4.5 moles of ethylene oxide (EO) • Phosphorus pentoxide • Anionic surfactant 		
Target Markets	Key Properties	
<ul style="list-style-type: none"> • Metal lubricants • Corrosion inhibition • Lubricant modifier • Compatibilizer for agricultural use • Competitive Product <ul style="list-style-type: none"> • Stefac 8181 (Stepan) • https://www.stepan.com/ 	<p>Form</p> <p>Appearance</p> <p>pH</p> <p>Foam height</p> <p>Emulsification</p> <p>Hydroxyl Value</p> <p>HLB</p>	<p>Liquid</p> <p>Yellow</p> <p>4.1</p> <p>Very low (50/ <10)</p> <p>20/30/10</p> <p>N/A</p> <p>N/A</p>

Soy diethanolamine

Product: X-210-DEA	Chemistry
<ul style="list-style-type: none">Reactants<ul style="list-style-type: none">Soy fatty acidDiethylamineIonic (low pH) or non-ionic (high pH) surfactant	 <p>The image shows the chemical structure of Soy diethanolamine. It consists of a long, zigzag hydrocarbon chain representing a soy fatty acid, which is attached to a nitrogen atom. The nitrogen atom is also bonded to two ethyl chains, each ending in a hydroxyl group (-OH). The oxygen atoms in the hydroxyl groups are highlighted in red.</p>

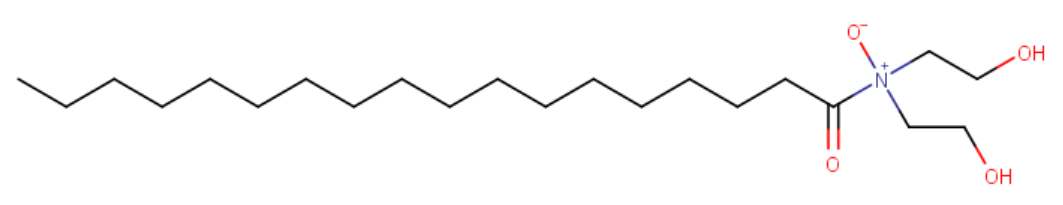
Target Markets	Key Properties	
<ul style="list-style-type: none">Personal careCosmeticsEmulsifierCompetitive Product<ul style="list-style-type: none">Cocamide C-11 (Independent Chemical)https://independentchemical.com/chemical-distributor/cocamide-c-11-supplier-2617.aspx	Form	Liquid
	Appearance	Dark amber
	pH	10.2
	Foam height	High (>800/100)
	Emulsification	0/0/80
	Hydroxyl Value	182
	HLB	N/A

Soy diethanolamine

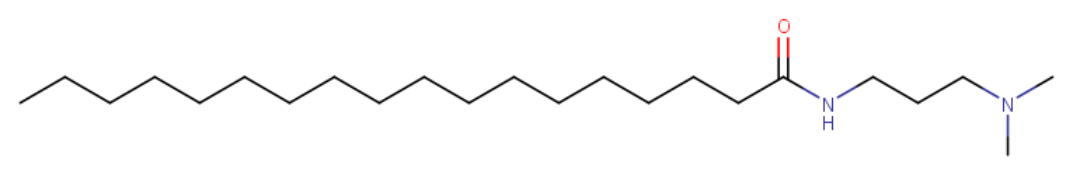
Product: X-210-DEA	Chemistry
<ul style="list-style-type: none">Reactants<ul style="list-style-type: none">Soy fatty acidDiethylamineIonic (low pH) or non-ionic (high pH) surfactant	 <p>The image shows the chemical structure of Soy diethanolamine. It consists of a long, zigzag hydrocarbon chain representing a soy fatty acid, which is attached to a nitrogen atom. The nitrogen atom is also bonded to two ethyl chains, each ending in a hydroxyl group (-OH). The oxygen atoms in the hydroxyl groups are highlighted in red.</p>

Target Markets	Key Properties	
<ul style="list-style-type: none">Personal careCosmeticsEmulsifierCompetitive Product<ul style="list-style-type: none">Cocamide C-11 (Independent Chemical)https://independentchemical.com/chemical-distributor/cocamide-c-11-supplier-2617.aspx	Form	Liquid
	Appearance	Dark amber
	pH	10.2
	Foam height	High (>800/100)
	Emulsification	0/0/80
	Hydroxyl Value	182
	HLB	N/A

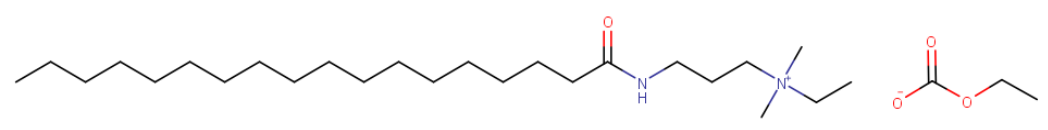
Amine Oxide

Product: X-210-DEAO	Chemistry	
<ul style="list-style-type: none"> Reactants <ul style="list-style-type: none"> Soy fatty acid Diethylamine Hydrogen peroxide Surfactant properties change with pH Actives 35% wt 		
Target Markets	Key Properties	
<ul style="list-style-type: none"> Disinfection Cleaning Food industry Personal care Detergents Competitive Product <ul style="list-style-type: none"> Genaminox 1216 (Global Amines) http://www.globalamines.com/our-products/ 	<ul style="list-style-type: none"> Form Appearance pH Foam height Emulsification Hydroxyl Value HLB 	<ul style="list-style-type: none"> Liquid Dark amber 5.4 Very low (30/0) 40/40/0 N/A N/A

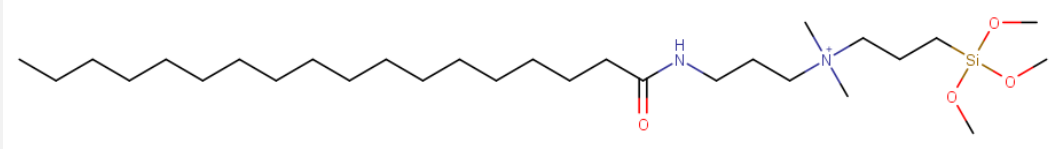
Soy DMAPA

Product: X-210-DMAPA	Chemistry	
<ul style="list-style-type: none">Reactants<ul style="list-style-type: none">Soy fatty acidDimethylaminopropyl amineReactive intermediateCationic at low pH	 <chem>CCCCCCCCCCCCCCCCCCCC(=O)NCCCN(C)C</chem>	
Target Markets	Key Properties	
<ul style="list-style-type: none">Chelatoro/w emulsifier (pH 3.4 – 4.4)LubricantCompetitive Product<ul style="list-style-type: none">Schercodine I (Lubrizol)https://www.lubrizol.com/Personal-Care/Products/Product-Finder/Products-Data/Schercodine-I-amido-amine	<p>Form</p> <p>Appearance</p> <p>pH</p> <p>Foam height</p> <p>Emulsification</p> <p>Hydroxyl Value</p> <p>HLB</p>	<p>Waxy solid</p> <p>Brown</p> <p>9.4</p> <p>Non-foaming</p> <p>40/40/0</p> <p>N/A</p> <p>N/A</p>

Soy Quaternary Amine Carbonate

Product: X-210-QAC	Chemistry	
<ul style="list-style-type: none"> • Reactants <ul style="list-style-type: none"> • Soy fatty acid • Dimethylaminopropyl amine • Diethyl carbonate • Quaternary amine with novel counterion • Applications where dissolved chloride is undesirable 		
Target Markets	Key Properties	
<ul style="list-style-type: none"> • Fabric softener • Antimicrobial • Green alternative • Competitive Product <ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> Form Appearance pH Foam height Emulsification Hydroxyl Value HLB 	<ul style="list-style-type: none"> Solid Dark brown 9.6 Low (200/0) 40/40/0 N/A N/A

Soy Quaternary Amine Silane

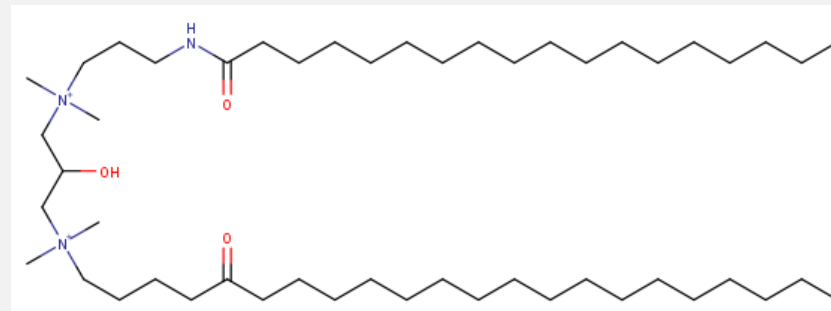
Product: Soyasil 210	Chemistry	
<ul style="list-style-type: none"> • Reactants <ul style="list-style-type: none"> • Soy fatty acid • Dimethylaminopropyl amine • 3-chloropropyl trimethoxysilane • Quaternary amine functionality combined with silane chemistry • Long-term modification of high traffic surfaces 		
Target Markets	Key Properties	
<ul style="list-style-type: none"> • Durable antimicrobial coatings • Car care • Competitive Product <ul style="list-style-type: none"> • SiQAC (SiShield) • https://www.sishield.com/technology/ 	Form Appearance pH Foam height Emulsification Hydroxyl Value HLB	Liquid Dark brown 7.7 Moderate (530/150) 56/32/10 N/A N/A

Cationic Gemini

Product: X-FA-EPI

- Reactants
 - Soy fatty acid
 - Dimethyl aminopropylamine
 - Epichlorohydrin
- High activity per unit mass
- Low CMC
- Actives 20% wt.

Chemistry



Target Markets

- Antimicrobial
- Enhanced oil recovery
- Cleaners
- Personal care
- Competitive Product
 - US6358914B1 (Rhodia Operations SAS, Expired) – no active products found

Key Properties

Form	Liquid
Appearance	Light amber
pH	6.31
Foam height	High (>800/500)
Emulsification	35/10/35
Hydroxyl Value	N/A
HLB	N/A

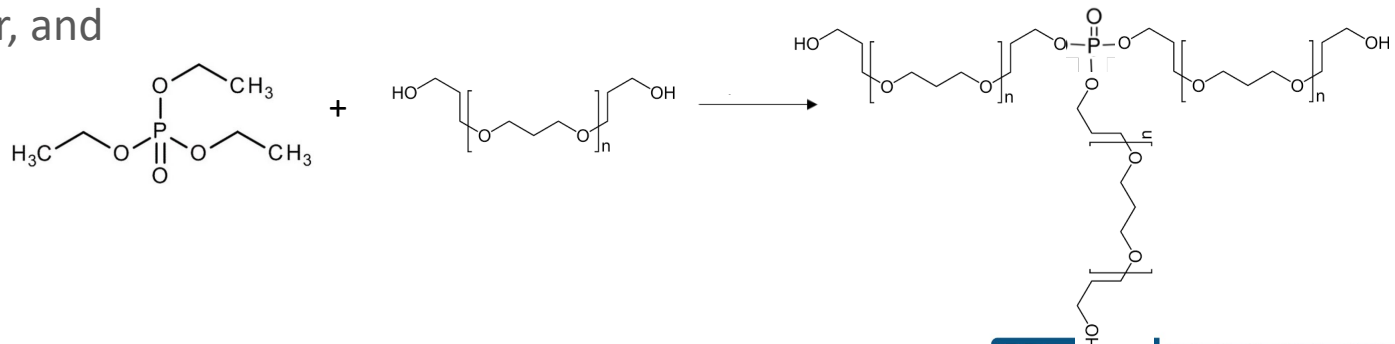
Halogen-free Flame Retardants

□ Flame Retardants (FRs)

- Added to materials to slow or prevent fire
- Used ubiquitously across a vast array of products to improve consume safety
- Environmental and direct contact exposure istoxic to humans

Chlorinated organophosphate FRs

- TCPP - Tris(2-chloroisopropyl)phosphate and TDCPP - Tris(1,3-dichloroisopropyl)phosphate
- Widely used in automotive, consumer, and industrial foams and fabrics
- 50 MM lb/year usage rate



TEP (triethyl phosphate)

- TEP has demonstrated efficacy in (PU) foams
- Addition of TEP as a tertiary additive to PU foam formulations is not cost effective

METSS Solution

- Incorporate TEP into the backbone of the polyol used in the production of PU foams
- ✓ Retain 2-part PU production chemistry
- ✓ Ensure uniform dispersion of TEP to improve FR performance
- ✓ Prevent FR migration and associated human contact hazard

Brine-tolerant Downhole Lubricant

- METSS DHL-BT is a high-performance lubricant that has been specifically formulated to provide superior downhole drilling performance in high brine environments.
 - Can be used at fractional amounts compared to other products.
 - METSS DHL-BT is formulated using renewable materials that are sustainable and safe for the environment.
 - Readily mixes with high brine solutions to form a stable, low foam, lubricating emulsion that can be used 24 to 48 hours after mixing.

Typical Physical Properties	
Appearance	Light Amber Liquid
Viscosity (20 °C)	7.0 mm ² /s (cSt)
Specific Gravity	0.89 g/cm ³
Flash Point	> 350 °F / 177 °C
Pour Point	10 °F / -12 °C

METSS DHL-BT Brine Compatibility

Brine	Conc. (ppg)	Initial Emulsion	Foaming Tendency	Emulsion Stability	Mineral Oil Addition	
					Oil Emulsion	Precipitation
NaCl	10.04	Very Opaque	Slight	Very Good	Good	None
CaCl ₂	9.60	Very Opaque	Slight	Excellent	Excellent	None
CaBr ₂	11.00	Opaque	Min	Very Good	Very Good	None
KCl	8.87	Very Opaque	Slight	Excellent	Excellent	None

- Testing conducted by Oilfield Testing and Consulting
 - 90% reduction in torque in a 4% CaCl₂ brine at a product use rate of 0.2%;
 - Measured coefficient of friction (COF) values ranged from 0.04 to 0.07.
 - Torque reduction performance and COF values were maintained after 16 hours of hot rolling at 400 °F.



Contact Information

Kenneth Heater
METSS Corporation
300 Westdale Avenue
Westerville, Ohio 43082
kheater@metss.com
Tel – 614.797-.2200, 111