



Dow Additives for Enhanced Fertilizer Applications



Dow Offers a Broad Portfolio for Enhanced Fertilizer Products

Growing crops safely, efficiently and economically has become an even greater priority with increasing demand and evolving regulations and trends. Dow's industry leading research capabilities, application and technical knowledge and collaborative approach to problem solving enables customers to deliver enhanced agrochemicals that meet these industry needs.



Dow provides a wide range of products for better performing agrochemical formulations, including:

Surfactants – Dow's portfolio includes both nonionic and anionic products with options that are readily biodegradable and offer low aquatic toxicity.

Oxygenated Solvents – Dow offers a wide selection of alcohols, esters, ketones, carboxylic acids, and glycol ethers to help compatibilize water-insoluble active ingredients.

Amines – Dow's product line includes monoethanolamine (MEA), diethanolamine (DEA) and triethanolamine (TEA), which offer the dual functionality of amines and alcohols in a single product. These can be used as buffer or stabilizer agents in fertilizer applications.

Chelating Agents – Dow provides materials for micronutrients which are crucial elements needed in small amounts to support plant growth. Chelating agents improve availability of micronutrients. Common chelated metals are copper, iron, manganese, molybdenum and zinc.

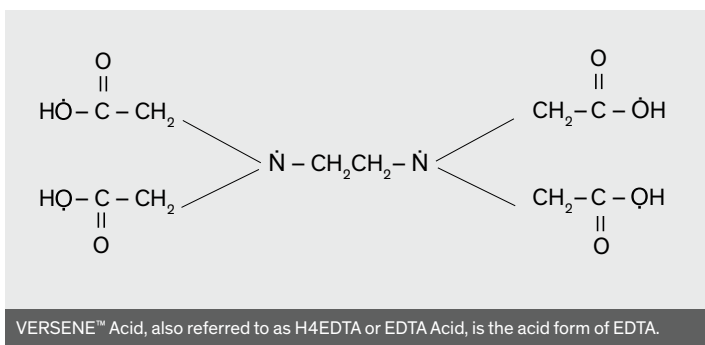
Type	Function	Suggested Products
Surfactants	Enhanced spreading Compatibility Spray pattern control	DOWFAX™ Surfactant Disulfonates TRITON™ H Surfactants ECOSURF™ EH Surfactants TERGITOL™ 15-S Surfactants TRITON™ CG and BG Surfactants
Solvents	Additives for fertilizer treatment Dissolve functional ingredients	POWERBLOX™ Solvents
Amines	Neutralizer Stabilizer	Alkanolamines
Rheology modifiers	Amendment suspensions	ACUSOL™ 830 Rheology Modifier
Dispersants	Amendment suspensions	ACUSOL™ 425 Rheology Modifier POWERBLOX™ SN Solvents
Chelants	Improved micronutrient solubility Enhanced water quality	VERSENE™ 100 Chelating Agents VERSENE™ Acid Chelating Agents VERSENOL™ Ag Fe 4.5% Chelating Agents
Polymers	Encapsulate fertilizer Spray pattern control Dust control	Polyurethane polyol and di-isocyanate, acrylics, styrenics Cellulosics
Anti-scales	Improved water quality	ACUSOL™ 425 Polymers ACUMER™ 4300, 2000 Polymers

Dow Chelants for Fertilizer Applications

Metal chelates are important in agriculture because they supply micronutrients (trace metals such as iron, zinc, manganese, and copper) which are vital in the metabolism of both plants and animals.

Plant problems previously ascribed to disease and drought are now recognized as possible symptoms of micronutrient deficiencies. Today these deficiencies are generally considered to be caused by:

- The use of higher analysis fertilizers containing fewer “impurities.” Soils which had been adequately supplied with trace metals from these “impurities” have now become deficient.
- Intensified cropping practices which place a severe demand on the soil to supply micronutrients; to maintain high yields, supplementary addition of trace metals is now necessary.
- High phosphorous fertilization, which tends to tie up metals in the soil in a form unavailable to the plant.
- The leveling of marginal land for cultivation, which often exposes subsoils deficient in micronutrients.



To aid in correcting micronutrient deficiencies, chelated micronutrients have distinct value when incorporated into liquid fertilizers. Because of their increased solubility, these metal chelates are more readily utilized by the plant than are the inorganic forms of metals. This is especially true in highly competitive ionic systems. As a result, less metal is required in the chelate form.

VERSENE™ Chelating Agents

Dow offers two products which are utilized in this application. **VERSENOL™ AG Fe 4.5% Chelating Agent**, a fully chelated micronutrient, is an aqueous solution of the iron disodium salt of N-(hydroxy-ethyl)-ethylenediaminetriacetic acid. **VERSENE™ Acid Chelating Agent** is the ethylenediaminetriacetic acid which customers utilize to form solutions of a variety of chelated metals.



Dow Surfactants for Fertilizer Applications

Agricultural spray solutions often contain a mix of pesticides, fertilizers and tank mix additives designed to provide benefits to the overall mix. These final mixes often contain high electrolyte content from fertilizers, micronutrients, and water conditioners. Stability can be an issue due to incompatibility in this environment. Understanding how well a surfactant tolerates fertilizers and other common electrolytes helps formulators address incompatibility issues. In some markets, surfactants can also be incorporated directly into liquid fertilizer solutions to help improve wetting.

Dow offers a wide range of surfactants for fertilizer applications. Compatibility of select Dow nonionic and anionic surfactants with common electrolytes is illustrated in the table here. Observations were made by visual inspection of samples at room temperature 24 hours after mixing.

Fertilizers/Micronutrients	Key
50 wt% 28-0-0	A
50 wt% 10-34-0	B
50 wt% 12-0-0 26S	C
50 wt% 8-0-0 10Zn	D
50 wt% 6-0-0 3S/5Mn	E
50 wt% 10B	F
50 wt% 7.5Cu EDTA	G
Buffers/Salts	
12.5 wt% Ammonium Sulfate	H
12.5 wt% Citric Acid Monohydrate	I
12.5 wt% Calcium Nitrate Tetrahydrate	J
12.5 wt% Copper (II) Sulfate Pentahydrate	K
12.5 wt% Magnesium Sulfate Heptahydrate	L
12.5 wt% Manganese (II) Sulfate Monohydrate	M
12.5 wt% Potassium Carbonate	N
12.5 wt% Potassium Hydrogencarbonate	O
12.5 wt% Potassium Pyrophosphate	P
12.5 wt% Zinc Sulfate Heptahydrate	Q

Dow Surfactant Compatibility																		
Product Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
10 wt% DOWFAX™ 2A1	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% DOWFAX™ 3B2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% DOWFAX™ C6L	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% DOWFAX™ C10L	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% DOWFAX™ 30599	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% DOWFAX™ 8390	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	
Alkyl Polyglycoside																		
10 wt% TRITON™ CG-50	○	○	○	○	○	○	○	○	○	●	●	●	●	○	○	○	●	
10 wt% TRITON™ CG-110	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
10 wt% TRITON™ CG-600	●	○	○	●	○	○	○	○	○	●	●	●	●	●	○	○	●	
10 wt% TRITON™ CG-650	○	○	○	○	○	○	○	○	○	○	○	●	●	○	○	○	●	
10 wt% TRITON™ BG-10	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Phosphate Esters																		
10 wt% TRITON™ H-55	○	○	●	○	○	○	○	○	●	●	●	●	●	○	○	○	●	
10 wt% TRITON™ H-66	○	○	○	○	○	○	○	○	○	●	●	○	●	○	○	○	●	
Alcohol alkoxyate																		
10 wt% ECOSURF™ EH-6	○	●	●	●	●	●	●	●	○	○	●	●	●	●	●	●	●	
10 wt% ECOSURF™ EH-9 (90%)	○	●	●	○	●	●	●	●	○	○	○	●	●	○	●	○		
10 wt% ECOSURF™ EH-14 (90%)	○	●	●	○	●	●	●	●	○	○	○	○	●	●	○	●	○	
10 wt% TERGITOL™ 15-S-7	○	●	●	●	●	●	●	●	○	○	●	●	●	●	●	●	●	
10 wt% TERGITOL™ 15-S-9	○	●	●	○	●	●	●	●	○	○	○	●	●	●	○	●	○	
10 wt% TERGITOL™ 15-S-15 (90%)	○	●	●	○	●	●	○	●	○	○	○	○	●	●	○	●	○	
10 wt% TERGITOL™ 15-S-20 (80%)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○	



Dow Solvents for Fertilizer Applications

Dow offers a wide selection of alcohols, esters, ketones, carboxylic acids, and glycol ethers to help compatibilize water-insoluble active ingredients in agriculture applications.

POWERBLOX™ EF-25 Solvent is a solvent designed for use with the urease inhibitor N-(n-butyl) thiophosphoric triamide (NBPT). POWERBLOX EF-25 has excellent handling properties for fertilizer treatment applications, such as:

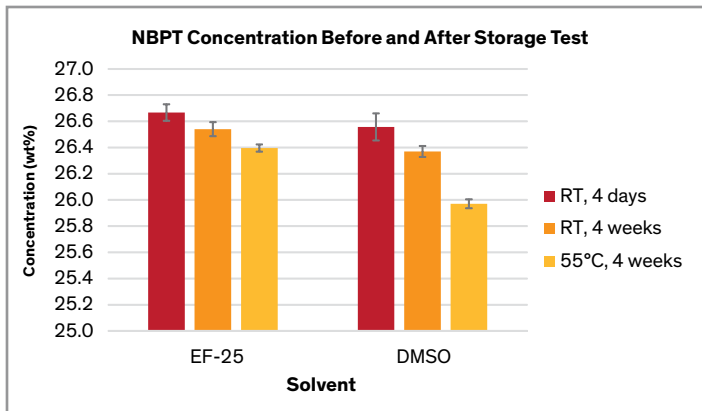
- High flash point
- Low odor
- Water soluble
- UAN compatible
- Dye compatible

Property	Typical Value*
Flash Point	> 200° F
Density at 25° C	9.35 lb/gal
Solubility in water	Miscible
Compatibility in 28-0-0 UAN	Compatible at 1 wt%
NBPT solubility at 25° C	> 40 wt%
Dye compatibility	Compatible with fertilizer dyes Examples: 3% D93287X Chromatint® Red 3% D11025X Chromatint® Yellow GS 3% D15003 Chromatint® Blue AZ



*These are typical properties, not to be construed as specifications

NBPT has been observed to exhibit minimal degradation when solubilized in POWERBLOX™ EF-25 Solvent in accelerated aging testing.



NBPT Concentration determined using European Standard EN 15688
The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

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Product Stewardship Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

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