

Essential chemistries for industrial water treatment

DOW

®



Dow has a broad range of chemistries, which are essential for the formulation of robust products that solve some highly important challenges of industrial water treatment across industries, such as scale, corrosion, fouling and foaming.

ACUMER™ Scale Inhibitors

Dow offers a wide range of polymers under the ACUMER™ brand name to address the needs of a variety of applications.

Scale control for cooling and boiler systems

Various industries use cooling circuits to remove heat by absorbing it with circulating water systems. Recirculating water can build up impurities that could lead to the precipitation of salts. The precipitation of salts and other particles can accumulate on equipment surfaces, resulting in reduced heat transfer efficiency, and higher operation and maintenance costs.

ACUMER™ polyacrylate water-soluble scale inhibitors can help prevent the formation of scale in recirculating cooling systems, boilers, and evaporators. ACUMER™ polymers can keep salts dispersed to prevent deposition and can modify the structure to make scale less tenacious and durable. ACUMER™ products

are effective on particulate matter containing calcium carbonate, calcium sulfate, calcium phosphate, silica and silicate, silt and iron, reducing their adhesion to heat transfer surfaces.



Table 1. ACUMER™ scale inhibition performance (product selection guide)

	Applicable for	Calcium carbonate inhibition	Calcium sulfate inhibition	Barium sulfate inhibition	(Poly) Phosphate inhibition	Silica/silicate inhibition	Silt dispersion	Iron fouling
ACUMER™ 1000	BW, CW, RO	●	○	●				
ACUMER™ 1100	BW, CW, RO	●	○	●				
ACUMER™ 1050	EV	●	○	●				
ACUMER™ 1051	EV	●	○	●				
ACUMER™ 1850	BW	●	○	○				
ACUMER™ 2000	BW, CW	○			●			○
ACUMER™ 2100	BW, CW	○			●	○	●	○
ACUMER™ 2200	CW, RO	○	●	●			○	
ACUMER™ 3100	BW, CW	○			●	○	●	●
ACUMER™ 4161	BW, CW, RO	●	●	●				
ACUMER™ 4200	BW, CW, RO	●	●	●				
ACUMER™ 4300	BW, CW, RO	●	●	●				
ACUMER™ 5000	BW, CW, RO	○			○	●	●	○
ACUMER™ 6600	BW, CW, RO	○	●				●	

BW: Boiler water
 CW: Cooling water
 RO: Reverse Osmosis Membranes

EV: Evaporators
 ● Highly recommended
 ○ Suitable

The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

Some of the polymers are compliant with the United States Food and Drug Administration (FDA) and Bundesinstitut für Risikobewertung (BfR). Additionally, some products are compliant with drinking water regulation. For more information about regulatory please contact your Dow Technical partner.

Scale control for reverse osmosis membranes

Fresh water purification, food liquids processing, desalination or wastewater recovery, and industrial water purification processes are increasingly based on the use of reverse osmosis (RO) membranes. Such important investments necessitate meticulous care to reduce operational issues, such as scale. Deposits on membranes can reduce permeate flow and increase pressure drop, significantly reducing permeate yield.

Feedwater can be from different sources, containing suspended solids and dissolved salts. Pretreatment focuses mainly on the removal of suspended solids, while in RO systems salts can precipitate out due to supersaturation. ACUMER™ scale inhibitors are used to decrease this precipitation, helping to enable the system to work at a higher recovery rate. Adding just a small concentration of ACUMER™ scale inhibitors to the feedwater increases the recovery due to multiple scale formation inhibiting mechanisms and aids by keeping the RO membranes cleaner and free of deposits. This, in turn, reduces water use, maintenance time and extends membrane life.

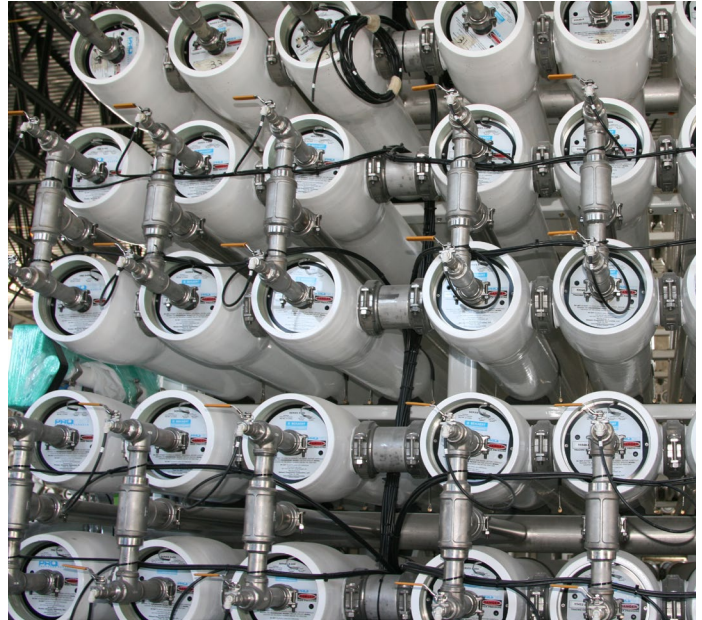


Table 2. ACUMER™ specialized products for membrane scale control

	Calcium carbonate inhibition	Calcium sulfate inhibition	Barium sulfate inhibition	(Poly) Phosphate inhibition	Magnesium silicate inhibition	Silt dispersion	Iron fouling	Phosphorus-free	NSF/ANSI 60 approval*	RO software available
ACUMER™ 4035	●	○	●					●	●	Yes
ACUMER™ 4450	○			●	○	●	●	●	●	Yes

● Highly recommended
○ Suitable

*Should you like to know more about other drinking water regulation, please contact your technical representative. The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

ACUMER™ Evaluator RO Software

ACUMER™ Evaluator can be used to:

- Develop an overall profile of scale potential for common scalants over the entire range of critical parameters anticipated.
- Evaluate the impact of acid feed on scale potential and scale inhibitor requirements.
- Evaluate the impact of % recovery on acid and/or inhibitor requirements.

Compatibility with RO membranes

Most of the ACUMER™ products recommended for membranes scale control are compatible with standard RO membranes. Please contact your Dow representative for more information.

Dow surfactants: a broad range of anionic and nonionic products

Dow surfactants include some of the most familiar anionic and nonionic products in the industry recognized for their excellent emulsification, dispersion, cleaning, wetting, and foam control properties. These surfactants can be used for industrial water treatment, oil & gas, pulp & paper manufacturing, industrial cleaning formulations as well as process chemicals in the food and feed industry.

Foam control agents

Dow offers a wide range of chemistries for foam control, including products with several regulatory compliances*, like FDA clearances for its use at food processing facilities, as well as readily biodegradable products, as defined in OECD Guidelines for the Testing of Chemicals, Section 3 (Rev. 23 March 2006). Within our offering you can select polyglycols to use them as pure products, as formulation ingredient or further reacted.

Polyglycol P series

Polyglycol P series are cost-efficient foam control agents widely used in many industrial applications, including wastewater, boiler water and process water treatment. These products are known for their low toxicity and easy manipulation. Most of them have extensive FDA clearances for indirect food contact, as boiler

water additives (21 CFR173.310), components of paper and paperboard (21 CFR176.170 and .180), and/or foam control agents in paper manufacturing (21 CFR176.210).

As molecular weight increases, viscosity and solubility in organic liquids also increases, while the solubility in water decreases, changing its cloud point. In consequence, product selection should be based on the operating temperature of the specific application. To achieve optimal results, the use of these products should be planned 10 to 15°C above their cloud point temperature.

*FDA 21 CFR, Commission Regulation (EC) No 10/2011, BfR XXXVI Recommendations, Swiss ordinance 817.023.21, French Arrêté 2011-509 and French Arrêté 8-9-99 compliance is possible for defined products. Consult your Dow representative or visit Dow.com for additional guidance.

Table 3. Polyglycol P series summary

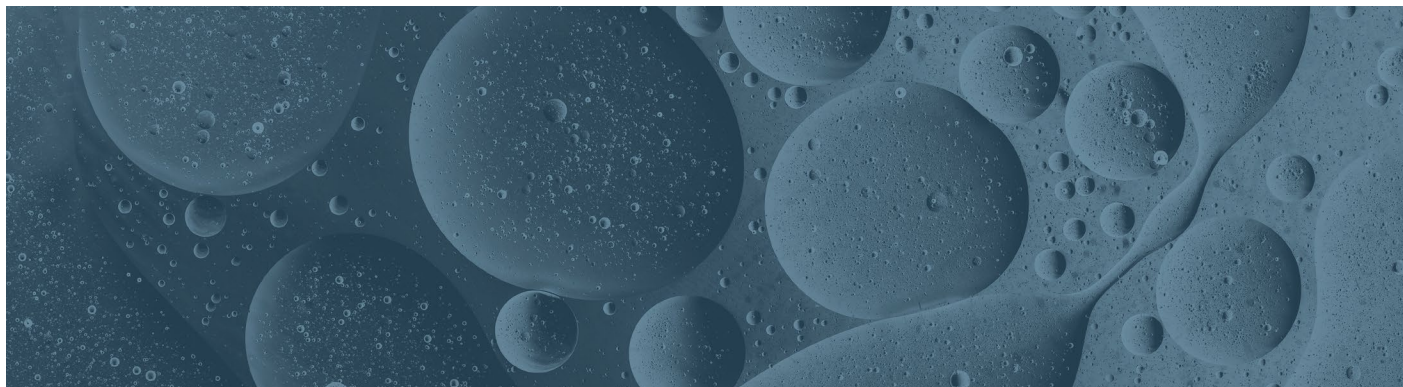
Product	Viscosity, 25°C (cSt) ¹	Viscosity, 40°C (cSt) ¹	Pour point, °C ²	Cloud point, 1% aqueous (°C) ³
Polyglycol P-400E	68	41	-49	>95
Polyglycol P-600	84	38	-47	65
Polyglycol P-1000E	143	71	-43	21
Polyglycol P-2000E	230	143	-31	15
Polyglycol P-4000E	1110	438	-20	9

¹Viscosity: ASTM 445/446

²Pour Point: ASTM D 97

³Cloud Point: ASTM D 2024

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DOWFAX™ N series copolymers

DOWFAX™ N series are nonionic surfactants for wetting, emulsifying, and foam control. Readily biodegradable, DOWFAX™ N series surfactants deliver low foam, excellent solvency, chemical stability and reliable formulation performance. The broad cloud point of DOWFAX™ N series products make them suitable for a wide range application temperature, finding use from wastewater to boiler foam control. DOWFAX™ N series products have extensive FDA clearances for use as defoaming agents in food processing (21 CFR 173.340) and paper manufacturing (21 CFR 176.210), as well as sanitizing options (21 CFR 178.1010) in food-processing facilities.

Table 4. DOWFAX™ N-Series – Core defoamers, linear block copolymers

Product	Viscosity, 25°C (cSt) ¹	Viscosity, 40°C (cSt) ¹	Pour point, °C ²	Cloud point, 1% aqueous (°C) ³
63N10	294	140	-35	23
63N13	300	160	<-20	24
63N30	441	215	-5	32
63N40	589	284	7	62
81N13	475	224	-27	20
100N15	630	392	-17	17

¹Viscosity: ASTM 445/446

²Pour Point: ASTM D 97

³Cloud Point: ASTM D 2024

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Beyond the products described above, we have a broad range of specialty defoamers based on alkoxylation chemistry, covering a wide operation temperature range and showing below features.

- Effective foam control at low concentrations (0.02~0.5wt%)
- Non toxic to the human body and microorganisms
- Function over a wide range of pH and temperature
- High active content
- Liquid product that can be injected automatically as required
- Effective above cloud points (best 10-15°C above)
- Perform well on protein-based foams
- Increased persistency through functionality increase.
- Can be used alone or formulated
- Can be esterified

Should you have specific foaming challenges, do not hesitate to contact us. Dow is open to provide further guidance on product selection or develop a tailor-made solution fitting your needs.

Cleaning surfactants

Some of Dow's low foam surfactants provide excellent detergency (ability of surfactants to aid in the removal of foreign material from a surface), wetting capacity (lower surface tension to increase surface cleaning capacity), as well as caustic and acid stability.

Generally, nonionic surfactants such as ECOSURF™ EH and TERGITOL™ 15-S product line tend to work better for oil and grease removal. Anionic surfactants, such as DOWFAX™ product line, are likely to work better on particulate soil (silt) cleaning.

These properties make them suitable for cleaning formulations for RO/UF membranes, ion exchange resins, and industrial equipment (boilers, heat exchangers, pipelines, etc.) during commissioning and programmed maintenance procedures. Other notable uses are paper processing and emulsion polymerization.

Chelating agents

Chelating agents in industrial water treatment formulations help remove scale in boilers, evaporators, heat exchangers, and other utility equipment, improving efficiency and reducing downtime. Chelating agents (also known as sequestering agents) can also inhibit undesirable metal-catalyzed reactions by forming complexes with these metal ions (calcium, magnesium, iron, etc.). Using Dow chelating agents in industrial water applications, already formed scale can be dissolved during operation and/or through offline chemical cleaning procedures. Dow chelating agents produce stable complexes with metal ions and generally provide effective control of metal ion problems. Dow offers aminopolycarboxylic acids – VERSENE™ EDTA, VERSENL™ HEDTA, and VERSENE™ DTPA. Distinct advantages of Dow chelating agents include predictable performance, high thermal stability, chemical stability, pH stability, and resistance to bacterial or mold breakdown.

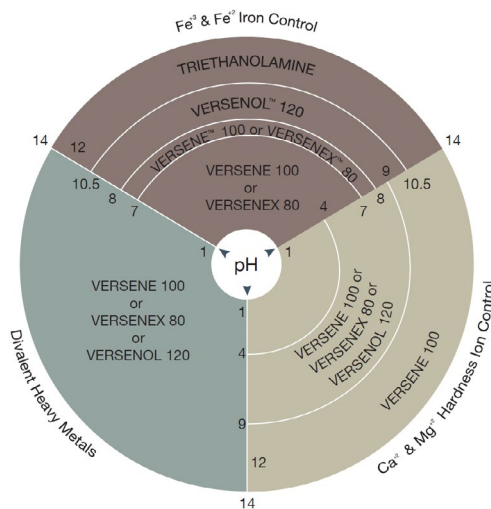


Table 5. Chelants - main features

Name	Type	Physical form	Chelation value	pH	FDA 21 CFR* Clearance available
VERSENE™ 100	EDTA	Liquid	102	11 - 12	Yes
VERSENE™ 220 Crystals	EDTA	Solid	119	10.5 - 11.5	No
VERSENE™ ACID	EDTA	Solid	339	2.5 - 3.0	No
VERSENE™ NA2 Crystals	EDTA	Solid	267	4.3 - 4.7	No
VERSENE™ 80	DTPA	Liquid	80	10.0 - 11.8	Yes
VERSENL™ 120	HEDTA	Liquid	120	11 - 11.8	No

*Additional regulatory compliances: Commission Regulation (EC) No 10/2011, BfR XXXVI Recommendations, Swiss ordinance 817.023.21, French Arrêté 2011-509 and French Arrêté 8-9-99 compliance is possible for defined products. Consult your Dow representative or visit Dow.com for additional guidance. The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

Oxygenated solvents

Dow offers a wide range of solvents, including alcohols, esters, ketones, ethylene and propylene glycol ethers and acetates, which can be used as solvents and co-solvents for multifunctional industrial water treatment formulations, such as one-drum options for corrosion and scale control.

The following solvents are all 100% water soluble and can be used in water-based formulations:

E-Series Glycol Ethers	Methyl CARBITOL™ Solvent, Methoxy Triglycol (MTG), CARBITOL™ Solvent, Butyl CELLOSOLVE™ Solvent, Butyl CARBITOL™ Solvent, Butoxy Triglycol (BTG)
P-Series Glycol Ethers	DOWANOL™ PM Glycol Ether
Performance Glycol Ether	DOWANOL™ PnP Glycol Ether

DOWANOL™ P series glycol ethers are less harmful to humans and the environment than many other solvents. DOWANOL™ DPM and DOWANOL™ TPM are readily biodegradable (≥60% biodegradation within 28 days according to OECD 301F).

Amines

Dow ethanolamines, such as MEA, DEA, and TEA (mono-, di-, and triethanolamine) can be used alone or in conjunction with other specialty amines (amine blends) as corrosion inhibitors for condensate circuits in medium- and high-pressure boilers. The amines raise the pH by neutralizing carbonic acid present in the condensate. The optimal amine blend will depend upon the neutralization capacity, basicity, and liquid-vapor distribution ratio needed for each system. Dow ethanolamines MEA and TEA are readily biodegradable according to OECD 301A (≥70% biodegradation within 28 days). The ethanolamine DEA is readily biodegradable according to OECD301F (≥ 60% biodegradation within 28 days).



Formulating with Dow Chemistries

Dow has supported water treatment service companies for the past 40 years as they develop specialized formulations using our wide range of chemistries. Dow offers references, lab testing and collaboration on new innovations to advance the field of water treatment science. Contact your Dow technical representative today for deep chemistry expertise and formulation guides.

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