



DOWFAX
Nonionic Surfactants

DOW POLYGLYCOLS

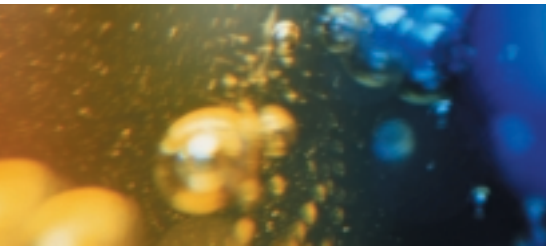


..... High-performance polyglycols for
demanding applications

DOW Polyglycols— Focused on Your Success

Dow strength in polyglycols brings customers many benefits

The Dow Chemical Company is a science and technology-based company and one of the world's largest producers of polyglycols. Our worldwide research, manufacturing, and distribution



include facilities in Europe, North America, Latin America, and Asia-Pacific.

With over 30 year's experience in polyglycol manufacturing, the industry's broadest product line, and a leadership position in new product development, Dow is uniquely positioned to meet the needs of a diverse global marketplace. This success results from expanding our customers' markets through a combined knowledge of their requirements and Dow's alkoxylation expertise in joint development applications. Together we focus these resources to help ensure success for our customers and their products.

Secure and reliable product supply

Dow's unique raw material position means that you can rely on consistent product quality and a secure supply of a full array of polyglycol products. Our position is one of strength

because Dow is the back-integrated manufacturer of all three alkylene oxides used to produce polyglycols, with manufacturing locations around the world.

Products tailored to customer needs

Dow's technical leadership in alkoxylation allows us to design unique polyglycol products to meet standard or exceptional formulation and process needs. We are experts at adjusting polyglycol physical properties to find the ideal polyglycol for your application or to produce a polyglycol to your specifications. Our research, pilot plants, and manufacturing flexibility enable us to rapidly develop and test new products, then quickly scale-up to deliver the performance qualities required for your tailor-made polyglycol. Whether you are looking to improve an existing product or to develop an innovative new product, there's a good chance that a DOW polyglycol already exists, or can be readily customized, that will help ensure your success.

Technical expertise when and where you need it

Dow experts on polyglycol products are regionally located to quickly respond to your needs. They are globally networked to take maximum advantage of years of combined experience. Whether your question involves products, applications, or regulations, Dow offers comprehensive customer service and technical assistance.



DOWFAX Nonionic Surfactants - high-performance polyglycols for demanding applications

DOWFAX* Nonionic Surfactants are high-performance products that feature excellent solvency, low foam characteristics, chemical stability, and a long list of other valuable performance properties. They serve as foam control agents, emulsifiers, wetting agents, and coupling agents in a wide range of applications. Cleaning products, industrial foam control agents, oil and gas production fluids, and industrial surfactants are just a few of the many uses for these versatile polyglycols.

DOWFAX Nonionic Surfactants are produced by polymerizing ethylene oxide (EO), propylene oxide (PO) and/or butylene oxide (BO) in the same molecule. The ratio and order of oxide addition, together with the choice of initiator, control the chemical and physical properties of the final polyglycol. The family of DOWFAX Nonionic Surfactants includes a diverse range of nonionic surfactants with traditional EO/PO blocks, reverse blocks, and random copolymerization onto mono-, di-, tri- or multifunctional initiators (See Table 1).

Unique combinations of properties expand your formulating options

DOWFAX Nonionic Surfactants expand your formulating possibilities by combining excellent surfactant properties with their polyether solvency and broad molecular weight range. DOWFAX Nonionic Surfactants offer low surface tension behavior, solid/liquid behavior, a wide viscosity range, hydrophobe polarity, good solubilization of “soils,” high chemical stability, and are viscous

liquids at room temperature. Other performance-oriented properties include excellent detergency, wetting, low foaming, solubilizing, rinsing, dispersing, and emulsifying behaviors.

In addition, DOWFAX Nonionic Surfactants exhibit inverse water solubility — they are more soluble in cold water than in hot water. The temperature at which a solution exhibits this solubility inversion is termed its cloud point. At the cloud point, the surfactant molecule undergoes micro-phase separation and the solution becomes turbid. DOWFAX Nonionic Surfactants make excellent foam control agents in aqueous systems due to their inverse water solubility. Since DOWFAX Nonionic Surfactants cover a wide temperature range in terms of cloud point and are reacted onto many different initiators, formulators are able to select the ideal DOWFAX Nonionic Surfactant for their foam control formulation.

While each DOWFAX Nonionic Surfactant product has unique properties useful in specific applications, all share the valuable properties listed in Table 2. Some of the many applications for DOWFAX Nonionic Surfactants are described in Table 3.



Table 1: The family of DOWFAX Nonionic Surfactants and Their Typical Properties¹

DOWFAX N-Series – Linear Block Copolymers

Linear EO/PO block copolymers are particularly effective as foam control agents. They are used in sugar production, pulp and paper processing, and in various types of fermentation, such as monosodium glutamate, lactic and citric acid, and some alcohols, to name a few. They are also used in water treatment, demulsification, and acid gas treatment.

Product	Concentration	Cloud Points ⁽²⁾			Surface Tension ⁽⁴⁾	Foam Height ⁽⁶⁾ (Ross Miles) Init/After 5 min.		Wetting Time ⁽⁶⁾		Viscosity ⁽⁷⁾			Pour Point ⁽⁸⁾	Specific Gravity ⁽⁹⁾	Average Molecular Weight ⁽¹⁰⁾
		1% aqueous	10% aqueous	10% solvent ⁽³⁾		mm/mm @25°C	mm/mm @70°C	sec @25°C	sec @70°C	cSt @25°C	cSt @40°C	cSt @100°C			
		°C	°C	°C											
63N10	100	23	18	39	35.5	10/0	0/0	>300	214	294	140	22	-35	1.105	1900
63N13	100	24	19	39	35.8	10/0	0/0	>300	75	300	160	29	<-20	1.018	2000
63N30	100	32	22	62	34.4	50/7	50/6	>300	45	441	215	30	-5	1.040	2250
63N40	100	62	26/63 ⁽¹¹⁾	72	38.6	60/8	80/10	>300	43	589	284	47	7	1.050	2700
81N13	100	20	14	41	34.9	2/0	0/0	117	>300	475	224	34	-27	1.017	2700
81N15	100	20	11	44	36.3	0/0	2/0	75	>300	513	244	ND	-20	1.018	2750
92N20	100	15	15	53	23.2	40/24	3/0	43	>300	850	386	63	-8	1.024	4050
100N15	100	17	13	46	32.6	10/0	0/0	115	>300	630	392	48	-17	1.025	3800

DOWFAX Fatty Alcohol Alkoxylates – Low Foam Surfactants

These surfactants are produced by alkoxylation of a variety of fatty alcohols. Due to their low-foaming characteristics, these polyglycols are often used in cleaning and rinsing formulations that are applied by high-pressure sprays — for example automatic dishwashing and metal cleaning products. They are also used in textile processing auxiliaries, household cleaners, window cleaners, metalworking fluids, water treatment, and as defoamers in food processing.

Product	Concentration	Cloud Points ⁽²⁾			Surface Tension ⁽⁴⁾	Foam Height ⁽⁶⁾ (Ross Miles) Init/After 5 min.		Wetting Time ⁽⁶⁾		Viscosity ⁽⁷⁾			Pour Point ⁽⁸⁾	Specific Gravity ⁽⁹⁾	Average Molecular Weight ⁽¹⁰⁾
		1% aqueous	10% aqueous	10% solvent ⁽³⁾		mm/mm @25°C	mm/mm @70°C	sec @25°C	sec @70°C	cSt @25°C	cSt @40°C	cSt @100°C			
		°C	°C	°C											
20A42	100	<4	<4	52	31.0	8/4	0/0	>300	>300	52	32	7	<-10	0.950	600
20A612	100	8	8	28	31.4	1/0	0/0	61	>300	120	61	12	-21	0.990	1170
20A64	100	30	28	51	29.4	72/8	0/0	24	80	63	34	ND	-10	0.973	685
20B102	95	32	31	44	30.9	50/5	0/0	34	60	78	40	8	-8	1.007	885
EM-51	100	<4	<4	60	26.8	70/30	⁽¹²⁾	27	⁽¹²⁾	46	24	5	-16	0.964	440

¹Typical properties, not to be construed as specifications.

Test Methods:

(2) Cloud Points: ASTM D 2024

(3) 10% surfactant in a solution of 25% diethylene glycol butyl ether in water

(4) Surface Tension: ASTM D 1331; Temperature 20°C, 1% surfactant in water

(5) Ross-Miles Test: ASTM D 1173; 0.1% surfactant in water

(6) Wetting Test: DIN 53901

(7) Viscosity: ASTM 445/446

(8) Pour Point: ASTM D 97

(9) Specific Gravity: ASTM D 892

(10) Molecular Weight: Calculated from the molecular weight of the initiator and oxide units in the molecule.

(11) Two cloud points were measured.

(12) Results could not be determined due to the product being insoluble at the high temperature.

ND = not determined

Table 1: The family of DOWFAX Nonionic Surfactants and Their Typical Properties¹ - *continued*

DOWFAX DF-Series – High Performance Defoamers

These products are designed for high-performance foam control formulations. They are used in vegetable washing, fermentation, paper processing, sugar production, and construction material deaeration.

Product	Concentration	Cloud Points ⁽²⁾			Surface Tension ⁽⁴⁾	Foam Height ⁽⁵⁾ (Ross Miles) Init/After 5 min.		Wetting Time ⁽⁶⁾		Viscosity ⁽⁷⁾			Pour Point ⁽⁸⁾	Specific Gravity ⁽⁹⁾	Average Molecular Weight ⁽¹⁰⁾
		1% aqueous	10% aqueous	10% solvent ⁽³⁾		mm/mm @25°C	mm/mm @70°C	sec @25°C	sec @70°C	cSt @25°C	cSt @40°C	cSt @100°C			
Units	%	°C	°C	°C	mN/m	mm/mm @25°C	mm/mm @70°C	sec @25°C	sec @70°C	cSt @25°C	cSt @40°C	cSt @100°C	°C	g/cm ³ @25°C/25°C	
DF-101	100	20	8	30	34.4	1/0	0/0	58	>300	490	232	37	<-20	1.017	2760
DF-111	100	20	15	26	34.2	1/0	0/0	184	>300	790	372	54	<-20	1.020	3550
DF-112	100	49	20	48	34.8	22/1	0/0	>300	45	680	286	54	-13	1.050	3150
DF-114	100	40	8	42	36.9	1/0	0/0	>300	85	810	321	51	<-20	1.040	3720
DF-117	100	10	8	35	33.1	1/0	0/0	122	>300	710	313	46	<-20	1.020	4100
DF-151	100	42	<40	44	26.0	40/5	20/0	11	36	660	24	5	<-20	1.047	4050
50C15	100	20	14	45	33.4	1/0	0/0	67	>300	833	392	50	-20	1.020	4850

¹Typical properties, not to be construed as specifications.

Test Methods:

(2) Cloud Points: ASTM D 2024

(3) 10% surfactant in a solution of 25% diethylene glycol butyl ether in water

(4) Surface Tension: ASTM D 1331; Temperature 20°C, 1% surfactant in water

(5) Ross-Miles Test: ASTM D 1173; 0.1% surfactant in water

(6) Wetting Test: DIN 53901

(7) Viscosity: ASTM 445/446

(8) Pour Point: ASTM D 97

(9) Specific Gravity: ASTM D 892

(10) Molecular Weight: Calculated from the molecular weight of the initiator and oxide units in the molecule.

Custom-manufactured products also available

Through our alkoxylation expertise and unique raw material supply, Dow can provide customized solutions, which significantly expand your formulation options. We can offer custom-manufactured polyglycols to meet your exact specifications or we can suggest derivatives based on your performance requirements. We have the flexibility to produce polyglycols to a wide range of molecular weights, viscosities, biodegradability, cloud points, or solubilities in water and oil. Customized DOW polyglycols have provided many opportunities for customers to create or enhance their products and expand their markets. For instance, DOWFAX DM-Series Surfactants are custom manufactured surfactants used as demulsifiers and drilling fluid additives in oil and gas production.



Table 2: Valuable properties shared by all DOWFAX Nonionic Surfactants

Toxicological and eco-toxicological profiles – Polyglycols exhibit a low order of acute toxicity by ingestion or skin exposure. Aquatic toxicity is typically low and many of the products are biodegradable. Consult the Safety Data Sheet for more specific information.

Inert, stable – DOWFAX Nonionic Surfactants do not hydrolyze or become rancid in storage. They are pH-stable and non-corrosive. Recommended shelf life is two years.

High performance/cost ratio – In addition to being effective at low use levels, DOWFAX Nonionic Surfactants often perform multiple functions in a formulation (e.g., providing foam control as well as emulsification), further improving its economy.

Excellent solvency – Polyglycols dissolve or are miscible in various organic liquids. They are also compatible with a wide variety of performance additives.

A wide range of cloud points – DOWFAX Nonionic Surfactants offer a wide temperature range of cloud points.

Nonionic – The surface-active portion of this family of DOW polyglycols bears no apparent ionic charge.

Table 3: Typical applications for DOWFAX Nonionic Surfactants

The applications described here represent just a few of the many proven uses for DOWFAX Nonionic Surfactants.

Foam control agents

DOWFAX Nonionic Surfactants are widely used in a range of foam control applications, either as neat products or as components of foam-control formulations. Typical applications include fermentation, food processing, paper processing, chemical processing, acid gas treatment, mining, oil drilling, and textile processing.

Detergents and cleaners

The low foaming characteristics of DOWFAX Nonionic Surfactants, coupled with their excellent surfactancy, chemical stability, and solvency make them ideal candidates for many household and institutional cleaning formulations. Household applications include hard surface cleaners, laundry detergents, and rinse aids.

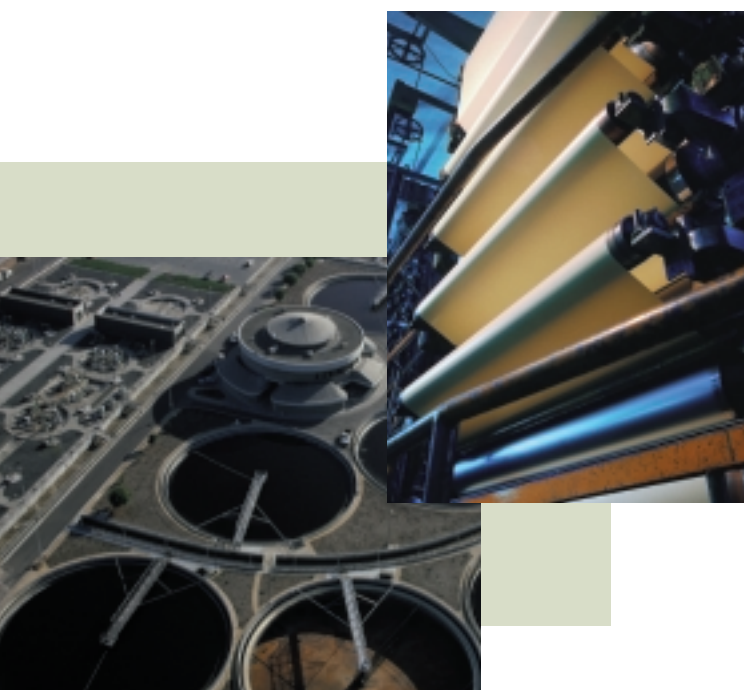
When used in household automatic dishwashing detergents and rinse aids, DOWFAX Nonionic Surfactants reduce excessive foaming and minimize the spotting of glassware. Other institutional applications include cleaning products used in restaurants, hospitals, schools, hotels, and other hospitality establishments. DOWFAX Nonionic Surfactants are also ideal in high-temperature, machine-ware dishwashing formulations.

Industrial surfactants

The versatility of DOWFAX Nonionic Surfactants enables them to be used in a multitude of industrial applications. These include wetting agents in agricultural formulations, emulsifiers for water treatment, dispersing aids for formulated defoamers, and coupling agents for incompatible components.

Other applications

Other applications that benefit from the performance of DOWFAX Nonionic Surfactants are adhesives, ceramics, chemical processing, acid gas treatment, and textile manufacturing.



Application overview for Dow polyglycols

Industry/Application	SYNALOX Lubricants	DOWFAX Nonionic Surfactants	Polyethylene Glycols (PEGs)	Polypropylene Glycols (PPGs)	Methoxy-polyethylene Glycols (MPEGs)	Custom Polyglycols
Foam Control Agents DOWFAX Nonionic Surfactants and polypropylene glycols are nonionic and are used in a wide range of foam control applications, as neat products or components of foam-control formulations.	●	●	●	●	●	●
Synthetic Lubricants SYNALOX* Lubricants feature excellent lubricity, low pour points, low volatility, and high thermal conductivity. They are non-varnishing, low foaming, compatible with common lubricant additives, and used in a wide variety of lubrication formulations.	●	●	●	●	●	●
Oil and Gas Applications DOWFAX DM-Series Nonionic Surfactants are high-performance drilling fluid additives and performance chemicals.	●	●	●	●		●
Detergents/Cleaning DOWFAX Nonionic Surfactants are high-performance nonionic polyglycols used in environments where low foaming and excellent surfactancy are required.		●	●		●	●
Industrial Surfactants DOWFAX Nonionic Surfactants are versatile enough to be used in a multitude of industrial applications including emulsifiers, rinse aids, and wetting agents.		●	●		●	●
Chemical Intermediates Polyglycols have terminal hydroxyl groups that can be reacted to modify the properties of a final product. Their versatility is demonstrated by the reaction of DOW polyglycols with fatty acids to make esters, a common commercial practice. Alternatively, polybutylene glycols are an excellent choice when a highly hydrophobic product is required.	●	●	●	●	●	●
Cosmetics and Personal Care Products In cosmetic and personal care formulations, polyglycols provide lubricity and compatibility with other ingredients, as well as function as thickeners, bases, and carriers.			●	●	●	●
Other Applications Adhesives, agricultural formulations, ceramics, electronics, emulsion polymerization, food processing, inks, leather, paint and coatings, paint balls, paper processing, petroleum chemicals, pharmaceuticals, rubber and plastics, silica cutting, solder assist fluids, textile, and wood preservation.	●	●	●	●	●	●

This table lists a few of the many applications for DOW polyglycols, along with the products types typically used. Contact your Dow representative for more information on specific polyglycol applications.

Safe use and Handling

DOW polyglycol products are easy to store and handle. Safety Data Sheets should be consulted prior to the use of DOW polyglycols. For specific safe use and handling information, or to obtain a Dow polyglycol Safety Data Sheet, contact your local Dow representative.

Product stewardship

Dow encourages its customers and potential users of DOW polyglycols to review their applications for such products from the standpoint of human health and environmental quality. To help ensure that DOW polyglycols are not used in ways for which they were not intended or tested, Dow personnel will assist customers in dealing with environmental and product safety considerations.

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Call today and let us focus on your success

To find out more about how DOW polyglycol products and services can help ensure the success of your product or formulation, call the number for your area listed below or contact us via the Internet at www.dow.com. We'll make sure you get the information you need and put you in touch with a Dow representative in your area.

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