

Emulan[®] types

Emulan A

Emulan OP 25

Emulan AF

Emulan OU

Emulan AT 9

Emulan P

Emulan EL

Emulan PO

Emulan ELP

Emulan TO 2080

Emulan NP 2080

Emulan TO 3070

Emulan OC

Emulan TO 4070

Emulan OG

Emulan TO 5070

Emulan OK 5

Nonionic emulsifiers for the chemical and allied industries

Emulan types

Chemical nature

Emulan A	Oleic acid ethoxylate
Emulan AF	Fatty alcohol ethoxylate
Emulan AT 9	Fatty alcohol ethoxylate
Emulan EL	Castor oil ethoxylate
Emulan ELP	Castor oil ethoxylate
Emulan NP 2080	Alkylphenol ethoxylate
Emulan OC	Fatty alcohol ethoxylate
Emulan OG	Fatty alcohol ethoxylate
Emulan OK 5	Fatty alcohol ethoxylate
Emulan OP 25	Alkylphenol ethoxylate
Emulan OU	Fatty alcohol ethoxylate
Emulan P	Fatty alcohol ethoxylate
Emulan PO	Alkylphenol ethoxylate
Emulan TO 2080	Fatty alcohol ethoxylate
Emulan TO 3070	Fatty alcohol ethoxylate
Emulan TO 4070	Fatty alcohol ethoxylate
Emulan TO 5070	Fatty alcohol ethoxylate

Properties

Emulan NP 2080, Emulan P, Emulan PO, Emulan TO 2080, Emulan TO 3070, Emulan TO 4070 and Emulan TO 5070 are all clear, colourless liquids.

Emulan OK 5 is a clear or cloudy, colourless liquid.

Emulan A and Emulan ELP are clear, yellowish liquids.

Emulan EL is a cloudy, yellowish liquid.

Emulan AF, Emulan AT 9, Emulan OC, Emulan OP 25 and Emulan OU are all colourless, waxy solids.

Emulan OG is supplied in the form of colourless, waxy, micronized beads.

The most important properties of the Emulan types are listed in the table overleaf.

Emulan		A	AF	AT 9	EL	ELP	NP 2080
Physical form		Liquid	Paste	Paste	Liquid	Liquid	Liquid
Concentration	%	ca. 100	ca. 100	ca. 100	ca. 97	ca. 100	ca. 80
Water content	%	–	–	–	ca. 3	–	ca. 20
Cloud point (DIN 53917)							
in BDG solution	°C	ca. 52	ca. 65	ca. 87	–	ca. 51	–
in water	°C	–	–	ca. 68	–	–	–
in saline solution	°C	–	–	ca. 55	ca. 71	–	ca. 85
pH (5% in water)		ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7
Density (23 °C)	g/cm ³	ca. 0.98	ca. 0.90 (60 °C)	ca. 0.95 (60 °C)	ca. 1.07	ca. 1.01	ca. 1.09
Bulk density	g/l	–	–	–	–	–	–
Dropping point	°C	< 5	ca. 43	ca. 33	ca. 16	< 5	ca. 5
Setting point	°C	< 5	ca. 38	ca. 31	ca. 8	< 5	< 5
Solidification point	°C	ca. –20	–	–	–	ca. –30	ca. –6
Melting point	°C	–	ca. 44	ca. 33	–	–	–
Viscosity (23 °C, Brookfield, LVT, 60 rpm)	mPa·s	ca. 70	ca. 15 (60 °C)	ca. 20 (60 °C)	ca. 1500	ca. 700	ca. 500
Acid number (DIN 53402)	mg KOH/g	ca. 0	ca. 0	ca. 0	ca. 1	ca. 1	ca. 0
Saponification number (DIN 53401)	mg KOH/g	ca. 110	ca. 0	ca. 0	ca. 60	ca. 100	ca. 0
Surface tension (DIN 53914, 1 g/l in distilled water, 23 °C, applying Harkins-Jordan correction)	mN/m	ca. 33	ca. 39	ca. 35	ca. 40	ca. 38	ca. 38
Hydrophilic-lipophilic balance (W. C. Griffin)		ca. 11	ca. 11	ca. 13	ca. 14	ca. 11	ca. 16

OC	OG	OK 5	OP 25	OU	P	PO	TO 2080	TO 3070	TO 4070	TO 5070
Paste	Solid	Liquid	Paste	Paste	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
ca. 100	ca. 100	ca. 100	ca. 100	ca. 100	ca. 100	ca. 100	ca. 80	ca. 70	ca. 70	ca. 70
–	–	–	–	–	–	–	ca. 20	ca. 30	ca. 30	ca. 30
–	–	ca. 62	–	–	ca. 52	ca. 46	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
ca. 90	ca. 92	–	ca. 88	ca. 90	–	–	ca. 93	ca. 92	ca. 92	ca. 90
ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7	ca. 7
ca. 1.02 (60 °C)	–	ca. 0.96	ca. 1.06 (60 °C)	ca. 1.02 (60 °C)	ca. 0.92	ca. 1.03	ca. 1.07	ca. 1.08	ca. 1.09	ca. 1.09
–	ca. 600	–	–	–	–	–	–	–	–	–
ca. 50	ca. 52	ca. 6	ca. 37	ca. 50	ca. 5	< 5	ca. 12	ca. 12	ca. 15	ca. 16
ca. 35	ca. 34	< 5	ca. 26	ca. 35	< 5	< 5	< 5	< 5	ca. 7	ca. 7
–	–	–	–	–	ca. 6	ca. –20	ca. 3	ca. 0	ca. 2	ca. 4
ca. 52	ca. 50	–	ca. 37	ca. 52	–	–	–	–	–	–
ca. 60 (60 °C)	ca. 80 (60 °C)	ca. 60	ca. 100 (60 °C)	ca. 60 (60 °C)	ca. 30	ca. 300	ca. 400	ca. 1500	ca. 1400	ca. 2100
ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0
ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0	ca. 0
ca. 39	ca. 40	ca. 27	ca. 39	ca. 39	ca. 28	ca. 28	ca. 35	ca. 39	ca. 41	ca. 41
ca. 17	ca. 17	ca. 10	ca. 17	ca. 17	ca. 11	ca. 11	ca. 16	ca. 17	ca. 18	ca. 18

The above information is correct at the time of going to press. It does not necessarily form part of the product specification.

A detailed product specification is available from your local BASF representative.

Solubility of 10% solutions of Emulan at 23 °C

Emulan	A	AF	AT 9	EL	ELP	NP 2080	OC
- Distilled water	-	-	-	+	-	+	+
- Potable water	-	-	-	+	-	+	+
- Caustic soda, 5 %	-	-	-	+	-	+	+
- Hydrochloric acid, 5 %	-	-	-	+	-	+	+
- Saline solution, 5 %	-	-	-	+	-	+	+
- Petroleum oils	+	○	-	-/○	○	-	-
- Ethanol	+	+	+	+	+	+	○
- Aromatic hydrocarbons	+	+	+	○	+	-	+

The above table shows the solubility of 10% solutions of the various Emulan types at 23 °C.

- + = Clear solution
- = Cloudy solution
- = Insoluble

OG	OK 5	OP 25	OU	P	PO	TO 2080	TO 3070	TO 4070	TO 5070
+	-	+	+	-	-	+	+	+	+
+	-	+	+	-	-	+	+	+	+
+	-	+	+	-	-	+	+	+	+
+	-	+	+	-	-	+	+	+	+
+	-	+	+	-	-	+	+	+	+
-	+/ \emptyset	-/ \emptyset	-	+	+	-	-	-	-
-	+	+	\emptyset	+	+	+	+	+	+
+	\emptyset	+	+	\emptyset	+	-	-	-	-

The relationship between viscosity and temperature is always an important point to consider when Emulan types are to be stored or delivered. The following tables show the viscosity of the Emulan types as a function of temperature and concentration.

Viscosity (mPa·s) as a function of temperature

Emulan	A	AF	AT 9	EL	ELP	NP 2080	OC
0 °C	ca. 290	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 7000	ca. 11000	> 10 ⁵
10 °C	ca. 160	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 1500	ca. 4500	> 10 ⁵
20 °C	ca. 100	> 10 ⁵	> 10 ⁵	ca. 5000	ca. 1000	ca. 1000	> 10 ⁵
30 °C	ca. 50	> 10 ⁵	ca. 3500	ca. 1000	ca. 350	ca. 250	> 10 ⁵
40 °C	ca. 30	3600	ca. 90	ca. 600	ca. 200	ca. 120	ca. 800
50 °C	ca. 25	ca. 20	ca. 40	ca. 200	ca. 150	ca. 50	ca. 100
60 °C	ca. 15	ca. 15	ca. 20	ca. 150	ca. 80	ca. 40	ca. 60

The rate at which the Emulan types dissolve can be increased by adding alcohols, glycols and other solubilizers.

Some of the Emulan types form a gel when they are diluted with water, as can be seen from the following table.

Viscosity (mPa·s) at 23 °C as a function of concentration

Emulan	A	AF	AT 9	EL	ELP	NP 2080	OC	
Water content	0%	ca. 70	> 10 ⁵	> 10 ⁵	ca. 1500	ca. 700	ca. 500	> 10 ⁵
	10%	ca. 110	> 10 ⁵	> 10 ⁵	ca. 1500	ca. 1000	ca. 450	> 10 ⁵
	20%	ca. 230	> 10 ⁵	> 10 ⁵	ca. 2100	ca. 1700	> 10 ⁵	> 10 ⁵
	30%	ca. 360	> 10 ⁵	> 10 ⁵	ca. 12000	ca. 2600	> 10 ⁵	> 10 ⁵
	40%	ca. 500	> 10 ⁵	> 10 ⁵	ca. 23000	ca. 2000	> 10 ⁵	> 10 ⁵
	50%	ca. 850	> 10 ⁵	> 10 ⁵	ca. 74000	ca. 1600	> 10 ⁵	> 10 ⁵
	60%	ca. 1900	> 10 ⁵	> 10 ⁵	ca. 12000	ca. 900	> 10 ⁵	ca. 1000
	70%	ca. 200	ca. 9000	> 10 ⁵	ca. 130	ca. 400	ca. 35	ca. 200
	80%	ca. 35	ca. 4000	ca. 1000	ca. 15	ca. 90	< 10	ca. 60
90%	ca. 20	ca. 1000	< 10	< 10	ca. 25	< 10	ca. 25	

OG	OK 5	OP 25	OU	P	PO	TO 2080	TO 3070	TO 4070	TO 5070
> 10 ⁵	ca. 5200	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 5000	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵
> 10 ⁵	ca. 600	> 10 ⁵	> 10 ⁵	ca. 140	ca. 950	ca. 8000	ca. 12000	ca. 23000	> 10 ⁵
> 10 ⁵	ca. 100	> 10 ⁵	> 10 ⁵	ca. 40	ca. 400	ca. 1100	ca. 3000	ca. 10000	ca. 16000
> 10 ⁵	ca. 40	> 10 ⁵	> 10 ⁵	ca. 25	ca. 120	ca. 240	ca. 1000	ca. 1000	ca. 1800
> 10 ⁵	ca. 30	ca. 300	ca. 800	ca. 20	ca. 70	ca. 130	ca. 500	ca. 600	ca. 1200
ca. 110	ca. 25	ca. 150	ca. 100	ca. 15	ca. 35	ca. 70	ca. 200	ca. 200	ca. 400
ca. 80	ca. 15	ca. 100	ca. 60	ca. 10	ca. 30	ca. 50	ca. 100	ca. 100	ca. 200

OG	OK 5	OP 25	OU	P	PO	TO 2080	TO 3070	TO 4070	TO 5070
> 10 ⁵	ca. 60	ca. 100	> 10 ⁵	ca. 30	ca. 300	ca. 400	ca. 1500	ca. 1400	ca. 2100
> 10 ⁵	ca. 13000	ca. 30	> 10 ⁵	ca. 50	ca. 300	> 10 ⁵	> 10 ⁵	ca. 2300	ca. 4200
> 10 ⁵	> 10 ⁵	ca. 400	> 10 ⁵	ca. 200	ca. 9000	> 10 ⁵	> 10 ⁵	ca. 1800	ca. 2000
ca. 15000	> 10 ⁵	ca. 500	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 1500	ca. 2800
ca. 13000	> 10 ⁵	ca. 900	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 800	ca. 1000
ca. 2000	> 10 ⁵	> 10 ⁵	> 10 ⁵	> 10 ⁵	ca. 4000	> 10 ⁵	> 10 ⁵	ca. 400	ca. 400
ca. 250	> 10 ⁵	> 10 ⁵	ca. 1000	> 10 ⁵	ca. 450	> 10 ⁵	ca. 160	ca. 150	ca. 200
ca. 50	ca. 75000	ca. 100	ca. 200	> 10 ⁵	ca. 200	ca. 70	ca. 80	ca. 50	ca. 70
ca. 35	ca. 500	< 10	ca. 60	ca. 3000	ca. 80	ca. 20	ca. 20	ca. 20	ca. 20
ca. 10	< 10	< 10	ca. 25	ca. 60	ca. 25	ca. 10	ca. 10	< 10	ca. 10

Storage

- a) The Emulan types should be stored in their original packaging, which should be kept tightly sealed, in a dry place. Storerooms must not be overheated.
- b) The Emulan types are hygroscopic and soluble in water, with the result that they absorb moisture very quickly. Drums should be tightly resealed each time material is taken from them.
- c) The setting points of the Emulan types must be taken into consideration when determining the storage temperature.
- d) The Emulan types can become cloudy if they are stored at low temperatures, but this has no effect on their performance.

The cloudiness can be dissipated by heating them to 50 – 60 °C.

- e) Liquid that has solidified or that shows signs of precipitation should be heated to 50 – 70 °C* and homogenized before use.
- f) Drums that have solidified or that have begun to precipitate should be reconstituted by gentle heating, preferably in a heating cabinet. The temperature must not be allowed to exceed 50 – 70 °C*. This also applies if drums are heated by external electrical elements. Internal electrical elements should not be used because of the localized anomalies in temperature that they cause.
- g) The Emulan types must be blanketed with nitrogen if they are stored in heated tanks (at 50 – 70 °C*) to prevent them from coming into contact with air. Gentle, constant stirring helps to prevent them being discoloured as a result of prolonged contact with electrical elements or external heating coils.
- h) Emulan OG should be stored in a dry place at a temperature not exceeding 25 – 30 °C.

Materials

The Emulan types should be stored in tanks made from AISI 316 Ti or AISI 321 stainless steel.

Shelf life

The Emulan types have a shelf life of two years, provided they are stored in their original packaging and kept tightly sealed.

Applications

The Emulan types can be used to prepare oil-in-water and water-in-oil emulsions. Individual products can usually be classified as being oil-in-water or water-in-oil emulsifiers, but it is often difficult to allocate combinations of different emulsifiers to either of these categories. It is also difficult to categorize emulsions that deviate from the norm in that, for instance, they consist of more than two phases.

Some of the products in the Emulan range can also be used to disperse solids such as waxes, polymers or rubber latex in water, and to stabilize aqueous dispersions. Dispersions of this type are employed as impregnating resins, lubricants, polishes and protective coatings, and they can be used to dedust powders.

The choice of emulsifier plays a large part in determining the stability of emulsions. The nature of the hydrophilic and lipophilic components of the emulsifier molecule and the proportions of hydrophilic and lipophilic groups determine their performance and the applications open to them. Oil-in-water emulsions are usually obtained if the emulsifier molecule is predominantly hydrophilic, and water-in-oil emulsions are obtained if the emulsifier molecule is predominantly hydrophobic.

* The temperature depends on the melting point or setting point.

The ratio between the two parts of the molecule is expressed by the hydrophilic lipophilic balance (HLB), as defined by W.C. Griffin (Journ Soc. Cosm. Chemists, **1** [1949], 311; **5** [1954], 249). The hydrophilic lipophilic balance is a useful practical guide to the applications open to different emulsifiers, but the final choice of emulsifier always depends on the results of practical tests in the laboratory.

The usual method is to use a combination of two or more emulsifiers, because this approach offers greater scope. The Emulan types have the advantage that they are compatible with each other, with cationic and anionic emulsifiers, and with many other substances. Emulsions prepared with emulsifiers from the Emulan range are largely insensitive to variations in temperature. They are largely unaffected by the presence of soil and, to a lesser extent, electrolytes.

As with all other nonionic emulsifiers, the performance of the Emulan types can be affected by tannins, other substances of a phenolic nature, and complex acids such as phosphotungstic acid and its salts.

Emulan A

Oil phase (o/w)	Mainly used to emulsify petroleum oils, fatty oils and mixtures thereof. Can also be used in combination with other emulsifiers to emulsify solid fats, aromatic compounds, chlorinated hydrocarbons, silicone oils and similar substances of a polar nature.
Main applications	Drilling oils, rolling oils, drawing oils, release agents for concrete formwork, spinning oils, cleaners, metal polishes and buffing compounds.
Level of addition	5–15 %, expressed as a proportion of the substance to be emulsified.

Emulan AF

Oil phase (o/w)	Paraffin wax, paraffin oils and petroleum oils. Can also be used in combination with other emulsifiers to emulsify vegetable oils, solid fats, ester waxes, beeswax, chlorinated hydrocarbons, silicone oils and aromatic compounds.
Main applications	Petroleum oil emulsions and paraffin wax emulsions.
Level of addition	5–20 %, expressed as a proportion of the substance to be emulsified.

Emulan AT 9

Oil phase (o/w)	Paraffin wax.
Main applications	Highly concentrated paraffin wax emulsions.
Level of addition	5–20 %, expressed as a proportion of the paraffin wax.

Emulan EL

Oil phase (o/w)	Mainly used to emulsify fatty acids, fatty oils, solid fats, ester waxes, many different organic solvents and solutions of polymers, etc., in organic solvents. Solubilizer for cyclic compounds and dyes.
Main applications	All types of emulsions prepared from fatty acids, fatty oils, organic solvents and substances dissolved in them, such as polymers, resins, dyes, etc. Can be used in combination with calcium dodecylbenzenesulfonate in emulsifiable pesticide concentrates.
Level of addition	5–15 %, expressed as a proportion of the substance to be emulsified.

Emulan ELP

Oil phase (o/w)	Mainly used to emulsify vegetable oils.
Main applications	All types of emulsions prepared from vegetable oils and substances dissolved in them, e.g. in emulsifiable pesticide concentrates.
Level of addition	5–15 %, expressed as a proportion of the substance to be emulsified.

Emulan NP 2080, Emulan OP 25

Oil phase (o/w)	Mainly used to emulsify acrylic esters, styrene and vinyl monomers. Also used to emulsify ester waxes and fatty acids.
Main applications	<p>Polymer dispersions. Can be used alone or in combination with anionic emulsifiers such as Emulphor® OPS 25 or cationic emulsifiers in emulsion polymerization processes for many different types of monomer, such as acrylic esters, styrene and vinyl compounds.</p> <p>Also used to emulsify ester waxes and fatty acids.</p> <p>Can be used to stabilize emulsions, suspensions and latices.</p>
Level of addition	5–15 %, expressed as a proportion of the substance to be emulsified.

Emulan OC

Oil phase (o/w)	Mainly used to emulsify waxes, especially montanic ester waxes and carnauba wax, fatty acids, many different organic solvents and substances dissolved in organic solvents.
Main applications	Dry-bright wax polishes. Emulan OC can be used to emulsify montanic ester wax and blends of montanic ester wax with paraffin wax, microcrystalline wax, oxidized microcrystalline wax, emulsifiable polyethylene wax (Luwax® OA Pastilles), and Fischer-Tropsch wax.
Level of addition	5–15 %, expressed as a proportion of the wax to be emulsified, depending on the type of wax.

Emulan OG, Emulan OU

Oil phase (o/w)	For waxes, especially montanic ester waxes and carnauba wax, fatty acids, and many organic solvents and dissolved organic substances such as polymers, etc.
Main applications	<p>Dispersing solids formed by chemical reaction, precipitation or coagulation. Dispersing pigments and dyes during grinding, either dry, in water or in aqueous mixtures of organic solvents. Can be used in combination with protective colloids.</p> <p>Can also be used to stabilize emulsions and suspensions. Examples include stabilizing concentrated hydraulic fluids and corrosion inhibitors before they are diluted with very hard water. They prevent polymer dispersions from precipitating when pigments, fillers or other additives are added, and they can be used to stabilize dispersions that are exposed to heat or contaminated with soil.</p>
Level of addition	<p>As an emulsifier 5–15 %, expressed as a proportion of the substance to be emulsified.</p> <p>As a stabilizer 1–10 %, expressed as a proportion of the substance to be dispersed.</p>

Emulan OK 5

Oil phase (o/w)	Mainly used to emulsify petroleum oils and organic solvents. Compatible with other emulsifiers such as Emulan A, Emulan P, Emulan PO, Korantin® SH, Lutensol® AP 7, sulfonated oils and soaps.
Main applications	Solvent-based cleaners, drilling oils and release agents for concrete formwork.
Level of addition	5–15 %, expressed as a proportion of the substance to be emulsified.

Emulan P

Oil phase (o/w)	<p>Mainly used to emulsify paraffin oils and other petroleum oils such as kerosene, spindle oil and mineral spirits.</p> <p>Can also be used to emulsify fatty oils and aromatic solvents in combination with other emulsifiers.</p>
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Main applications All types of emulsions prepared from light petroleum fractions such as paraffin oils and spin finishes for textiles, and for spinning oils and cleaners that contain solvents.

Level of addition 5–10%, expressed as a proportion of the substance to be emulsified.

Emulan PO

Oil phase (o/w) Mainly used in combination with other emulsifiers to emulsify petroleum oils and organic solvents. Compatible with emulsifiers such as Emulan A, Emulan P, Korantin SH, Lutensol AP 7, sulfonated oils and soaps.

Main applications Solvent-based cleaners, drilling oils and release agents for concrete formwork.

Level of addition 5–15%, expressed as a proportion of the substance to be emulsified.

Emulan TO types

Oil phase (o/w) Mainly used to emulsify acrylic esters, styrene and vinyl monomers.

Main applications Polymer dispersions. Can be used alone or in combination with anionic surfactants in emulsion polymerization processes for many different types of monomer, such as acrylic esters, styrene and vinyl compounds.

Substitutes for highly ethoxylated alkylphenol ethoxylates.

Level of addition In polymerization processes 1–5%, expressed as a proportion of the monomers to be emulsified.

Safety

We know of no ill effects that could have resulted from using the Emulan types for the purpose for which they are intended and from processing them in accordance with current practice.

According to the experience we have gained over many years and other information at our disposal, the Emulan types do not exert any harmful effects on health, provided that they are used properly, due attention is given to the precautions necessary for handling chemicals, and the information and advice given in our safety data sheets are observed.

Ecology

Most of the Emulan types are at least 90% biodegradable and satisfy the requirements of German surfactants legislation. The only exception is Emulan OP 25.

Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application, these data do not relieve processors of the responsibility of carrying out their own tests and experiments; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

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