



# DYNAX C6 Fluorosurfactants

Multifunctional Paint and Coatings Additives



# DYNAX C6 FLUROSURFACTANTS

Multifunctional Paint and Coatings Additives

## Excellent Wetting/Leveling Properties and REACH conform

DYNAX Corporation is a major manufacturer of high-purity C6 fluorosurfactants. The DX4000-series fluorosurfactants from DYNAX are derived from high-purity C6 fluorotelomer intermediates. As such, they are not bioaccumulative or toxic and meet the REACH perfluorooctanoic acid (PFOA) regulation.

DX4000-series fluorosurfactants are designed to provide superior wetting, leveling and spreading performance to water-based coating systems, especially for low surface energy, hard-to-wet substrates.

## DX4000 Product Line

Each product of the DX4000-series is a tailor-made blend of differently designed fluorosurfactants, all derived from high-purity C6 fluorotelomers.

Product	Type	% Actives *
DX4000	Slightly cationic	35%
DX4005N	Anionic	46%
DX4010N	Slightly cationic	45%

\*Not for specification purposes

Beside, DX4000-series fluorosurfactants provide the following characteristics:

- ✓ Water-based
- ✓ VOC-free
- ✓ Non-flammable

## Highly Stable and Compatible

DX4000 fluorosurfactants are designed to show best performance under various conditions and convince with their robustness.

- ✓ Applicable in extreme pH ranges
- ✓ High thermal stability
- ✓ Compatible with alcohols
- ✓ UV stable

## Beneficial for Paints and Coatings

DX4000 fluorosurfactants are beneficial for paints and coatings from manufacturing stage up to long-lasting effects of the applied finished product.

### At manufacturing stage:

- ✓ Improved pigment dispersion
- ✓ Applicable in transparent and colored systems
- ✓ May not require additional defoamers

### During handling:

- ✓ Superior wetting and spreading even on low surface energy, difficult-to-wet substrates such as PE and PP
- ✓ Applicable on substrates contaminated with low surface tension compounds such as silicon oil
- ✓ Improved open-times
- ✓ Significant antiblocking and antistatic behavior
- ✓ Reduced surface tension-driven coating defects such as pinholes, orange peel or cratering

### Sustainable effects:

- ✓ Efficient water and oil repellency due to reorientation of the surfactant with the fluorinated part pointing away from the coated surface

## Other Areas of Application

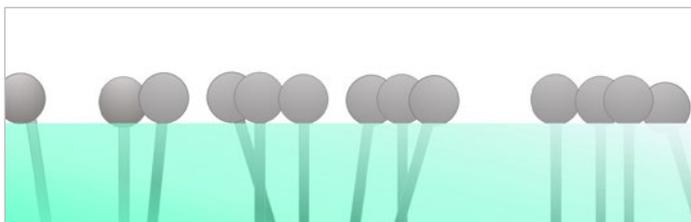
Based on the excellent wetting and levelling properties other potential areas of application are:

- ✓ Floor polishes
- ✓ Wood coatings

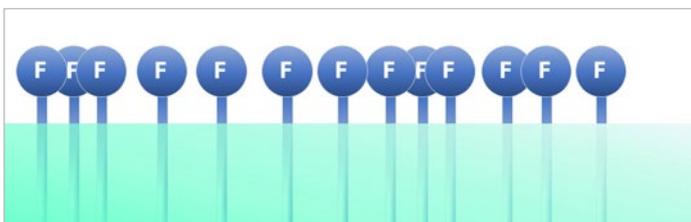


### Surfactants in Comparison

Hydrocarbon- and silicone-based surfactants, which are used in laundry or cleaning industries, consist of a hydrophilic head group and a hydrophobic carbon chain. The polar group provides water-solubility, while the unpolar chain interacts with organic residues.



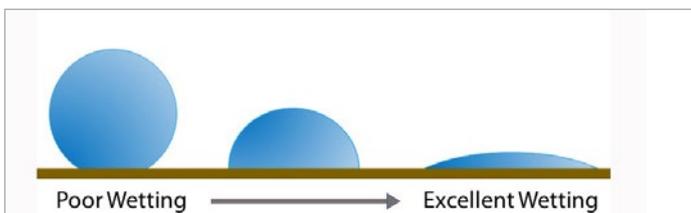
Contrary to that, fluorosurfactants feature a (per)-fluorinated carbon chain resulting in both hydrophobic and lipophobic properties. Besides, the fluorocarbon chain exhibits excellent chemical and thermal stability as well as a high tolerance to extreme pH ranges.



### Reduction of Surface Tension: Effective, Efficient and Fast

DYNAX fluorosurfactants are able to reduce the surface tension of aqueous media below 20 mN/m.

In a physical sense, a reduction of surface tension causes an optimization of the aqueous media-surface-interface resulting in an improved wetting of the surface. Furthermore, irregularities of the surface can be evened out.



DX4000 fluorosurfactants are both highly effective and efficient:

**Effectiveness** refers to the degree of lowering the surface tension at a given concentration, which can be regarded as the performance factor.

**Efficiency** is a measure of how much of a surfactant is needed to reach the desired level of surface tension. This can be considered as the cost factor.

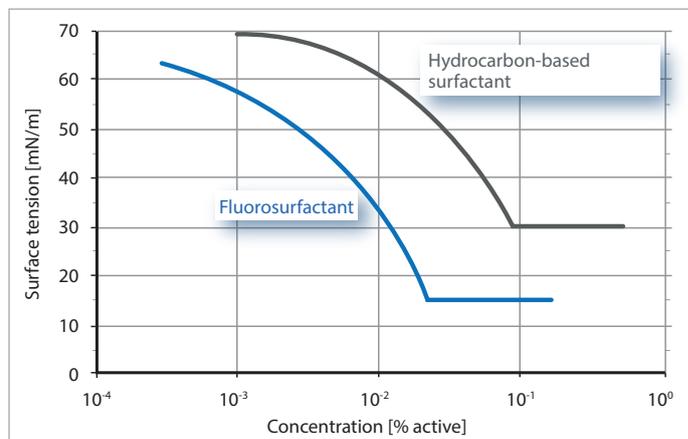


Figure 1: Concentration dependent reduction of the surface tension in aqueous media: fluorosurfactants (blue) vs. hydrocarbon-based surfactant (grey).

Figure 1 illustrates the high effectiveness and efficiency of fluorosurfactants compared to hydrocarbon-based surfactants over three orders of magnitude. Fluorosurfactants are in general more expensive compared to hydrocarbon- or silicon-based analogues, which can be compensated by their superior performance even at low dosage levels.

**Fast:** The DX4000 series was developed with a focus on the deepest attainable surface tension at short mixing times. A complete homogenization of the DX4000 fluorosurfactants in water yields a surface tension of  $\leq 16.9$  mN/m. Only after 5 seconds a surface tension as low as  $\leq 17.0$  mN/m can be obtained.

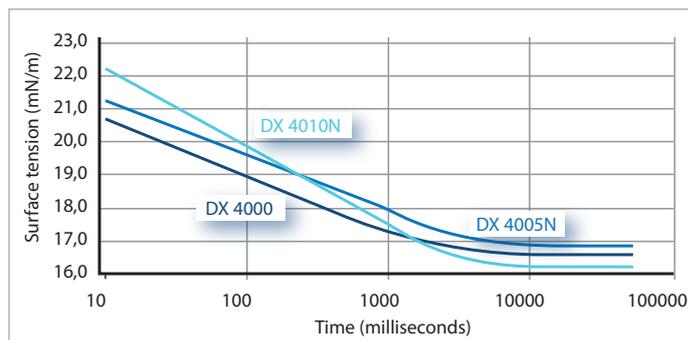


Figure 2: Dynamic surface tension of the DX 4000-series for 0.1% active in water.

Product	Dynamic surface tension 0.1% active in water [mN/m]	
	After 5 seconds	Complete homogenization
DX4000	16.6	16.6
DX4005N	17.0	16.9
DX4010N	16.3	16.2

A fast migration of surfactant molecules is essential for time-critical applications in order to still obtain a low surface tension.



### Manufacturing Process

Fluorochemicals can be manufactured via two different procedures:

**Electrochemical fluorination (ECF)** or the so-called Simon's procedure is based on the perfluorination of straight-chain hydrocarbon surfactants usually with a chain length of eight carbon atoms (C8). Electrolysis is used to replace the hydrogen by the fluorine atoms. Although many byproducts are formed and the yield is only about 30-45%, this process is regarded as cost-effective.

**Manufacturing by telomerization** is a polymerization-based process, in which short-chain perfluorinated intermediates are elongated. This elongation occurs in a step-wise manner, which allows an extremely controlled preparation of C6 fluorochemicals with highest-purity. The accurate telomerization is a comparably expensive procedure, but in return byproducts as well as waste can be massively reduced.

Fluorosurfactants produced via telomerization do not contain or degrade into C8-based perfluorooctane-sulfonic acid (PFOS). However, trace levels of unintended impurities of PFOA and its precursors cannot be avoided.

### Concerns About PFOA and PFOS

For the so-called long-chain C8 fluorosurfactants, the current situation is very alarming. According to the German Federal Institute for Risk Assessment (BfR, Statement 0004/2009 of September 11 2008), the acute toxicity of PFOA and PFOS is indeed very low. It is the long-term persistency in the human organism, which was evaluated as highly critically. Besides, the fluorochemicals PFOA and PFOS are suspected as carcinogenic, classified as toxic for reproduction and hazardous to health with unknown long-term effects. Moreover, they are meeting the definition for Substance of Very High Concern (SVHC).

It is a known fact that the potential of bioaccumulation of fluorinated surfactants drops with decreasing length of perfluorinated alkyl chain. This environmental requirement was taken into account throughout the research and development of the DYNAX C6 fluorosurfactants, which are non-bioaccumulative.

### PFOA- and PFOS-Related Restrictions

In 2013, PFOA was added to the list of substances causing particular concern according to REACH (Registration, Evaluation, Authorization and Restriction of Chemicals), a regulation of the EU. In the USA manufactures were compelled to reduce the content of PFOA in their final products by 2015.

In 2017, the EU published a REACH measure to regulate PFOA and its derivatives. The REACH Regulation "Commission Regulation (EU) 2017/1000 of June 13 2017" will be valid from 2020 onwards. An exemption to this regulation is PFOS and its derivatives. However, the production and use of PFOS has been restricted by Stockholm Convention on Persistent Organic Pollutants in 2009.

### DYNAX is Ready for REACH 2017/1000

From 4th of July 2020 onwards, it is against law to use PFOA- and PFOA-related substances in the production of fluorochemicals or to place these fluorochemicals onto the market.

From day one, DYNAX relied on the controlled and high-yielding telomerization process for the synthesis of the C6 fluorosurfactants. Thus, DYNAX C6 fluorosurfactants meet the regulation of the maximum impurity level for PFOA- and PFOA-related substances:

	PFOA impurity	PFOA-related impurities
DX4000-series	<12.5 ppb	<500 ppb
REACH EU regulation	<25.0 ppb	<1000 ppb

#### About DYNAX

DYNAX Corporation was founded in the USA in 1991 focusing on the production of C6 fluorosurfactants.



Today, DYNAX is one of the world's leading manufacturer of C6 fluorosurfactants of highest purity. From day one, DYNAX has been banking on C6 fluorotechnology and anticipating in current environmental requirements.

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