Technical Information

Lupasol® FG

Fields of application:
adhesives, complexing, coatings and paints,
pigment manufacture, protein immobilization.

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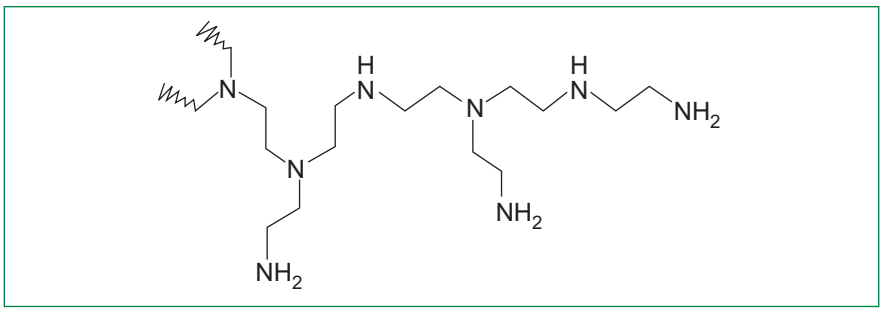
Chemical nature

Lupasol® FG is a multifunctional cationic polyethyleneimine (PEI) with a branched polymer structure.



Its composition is expressed by the following general molecular formula:

$– (CH_2 – CH_2 – NH)_n –$
$10 < n < 10^5$

The nitrogen to carbon ratio in polyethyleneimines is 1:2, so that they have the largest possible amino group density of all known commercial polyamines. Polyethyleneimines have a definite ratio of primary, secondary and tertiary amino groups.

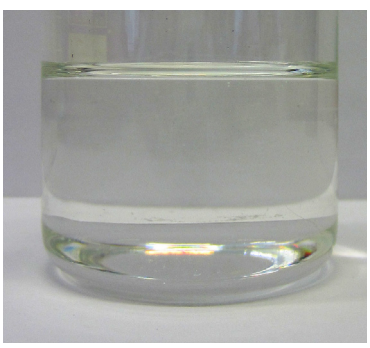
PRD-No.*

30552322

* BASF's commercial product numbers.

Appearance

Lupasol® FG is a clear, colorless till rarely yellowish liquid at room temperature and tends to form sediment in the coldness.



Handling and Storage

Handling ONLY packaged goods

a) Lupasol® FG should be stored in a dry place in its original sealed packaging. Lupasol® FG is hygroscopic, which means it can absorb moisture very quickly. Drums and IBCs must be resealed after each time they are opened.
b) Lupasol® FG can slighty separate during the storage time. The product must be homogenized before it is processed. It must be mixed sufficiently prior to use.
c) The storage temperature must be between min. +5 °C and max. +50 °C. Storage temperatures above +50 °C will cause an increase of the color number. At low temperatures (approx. <+5 °C) Lupasol® FG could forms crystals and becomes solid. Drums or IBCs containing solidified product or liquid that have begun to precipitate or separate should be reconstituted by gentle heating, preferably in a heating cabinet. Warming up to max. +50 °C allows the product to become liquid again. It must be mixed sufficiently prior to use. 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 can cause.
d) Lupasol® FG must be protected from sunlight and high temperatures (> +50 °C) to avoid discoloration and the formation of surface films.
e) Lupasol® FG must be blanketed with nitrogen if it is stored to prevent air contact. Air contact can cause discoloration.
f) Please refer to the latest Safety Data Sheet for detailed information on product safety.

Handling ONLY bulk containers

a) The storage temperature for bulk product must be between min. +10 °C and max. +70 °C. Storage temperatures above +50 °C cause an increase of the color number. At low temperatures (approx. <+5 °C) Lupasol® FG forms crystals and becomes solid.
b) Lupasol® FG can slighty separate during the storage time. The product must be homogenized before it is processed. It must be mixed sufficiently prior to use.
c) Lupasol® FG must be protected from high temperatures (> +50 °C) to avoid discoloration and the formation of surface films.
d) Lupasol® FG must be blanketed with nitrogen if it is stored in heated tanks (at max. +70 °C) to prevent air contact. Air contact can cause discoloration. Constant, gentle stirring helps to prevent it being discolored as a result of prolonged contact with electrical elements or external heating coils.
e) Please refer to the latest Safety Data Sheet for detailed information on product safety.

Materials

The following materials can be used for tanks and drums:

a) Stainless steel 1.4306 – AISI 304 L (X2 CrNi 19-11)
b) Stainless steel 1.4541 – AISI 321 (X6 CrNiTi 18-10)
c) Stainless steel 1.4571 – AISI 316 Ti (X6 CrNiMoTi 17-12-2)
d) HDPE – high density polyethylene
e) LDPE – low density polyethylene

Containers of low alloy steel, copper or copper alloys cause discoloration and are therefore unsuitable.

Shelf life

Lupasol® FG has a shelf life of at least 24 months in its original packaging.

Properties

Some physical properties are listed in the table below. These are typical values only and not all of them are monitored on a regular basis. They are correct at the time of publication and do not necessarily form part of the product specification. A detailed product specification is available on request or via BASF's WorldAccount: https://worldaccount.basf.com (registered access).

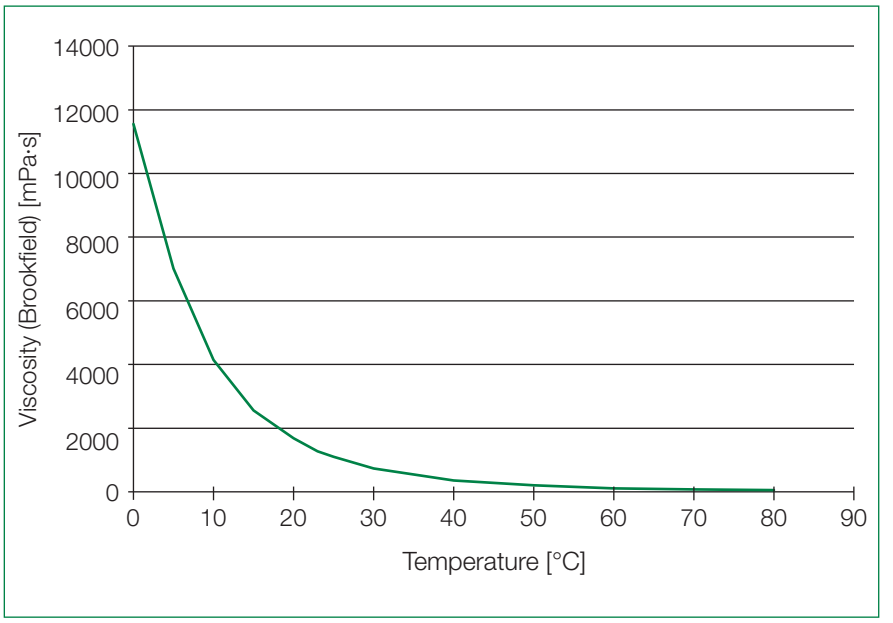
Lupasol® FG is an anhydrous polyethyleneimine and is miscible with water in all proportions.

Lupasol® FG	**Unit**	**Value**
Physical form (25 °C)		liquid
Average molar mass (GPC, BASF method)	g/mol	approx. 800
Viscosity (EN 12092, Brookfield, as is)		
20 °C	mPa·s	approx. 1680
50 °C	mPa·s	approx. 360
Concentration (= 100%-water content)	%	min. 98.5
Water content (ISO 760, K. Fischer)	%	max. 1.5
Refractive index (DIN 51423, 20 °C)		approx. 1.523
pH value (DIN 19268, 1% dry substance in dist. H_2O)		approx. 11
Density (DIN 51757, method 3)		
20 °C	g/cm³	approx. 1.03
50 °C	g/cm³	approx. 1.01
Charge density (cationic)[1)]	meq/g DS	16
Monomeric Ethyleneimine (BASF method)	ppm	< 0.1
Pour point (ISO 3016)	°C	approx. -25 °C
Ratio of prim./sec./tert. amine (BASF method, ^{13}C NMR)		approx. 1/0.9/0.5
Amine value (BASF method)	mmol/g DS	approx. 20

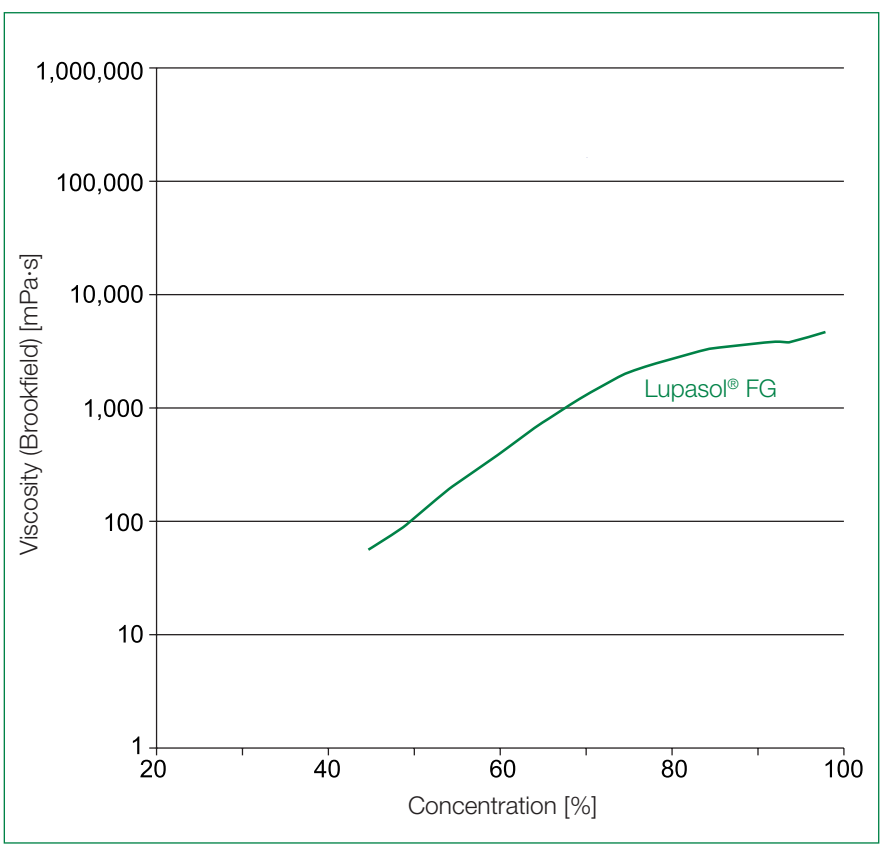
[1)] BASF method, 100% dry substance at pH 4.5.

Viscosity

It is important for the transport, storage and processing of Lupasol® FG to know how its viscosity changes with temperature and concentration. The graph below shows the viscosity of Lupasol® FG as a function of temperature.



The following graph shows how the viscosity of Lupasol® FG depends on the water content.



Solubility

Lupasol® FG is soluble in water and polar solvents.

The following solubility data are of a general nature only and can vary according to the amount of Lupasol® FG to be dissolved. Aldehydes, ketones and chlorinated hydrocarbons are unsuitable as solvents, since they are likely to react with Lupasol® FG. With acids, typical neutralization reactions occur.

Distilled water	+
Methanol ethanol, n-propanol isopropanol	+
n-Hexane	–
Ethyl acetate	O
Toluol Xylol	O

+ = *soluble*
– = *insoluble*
O = *partially soluble*

Compatibility

Lupasol® FG is compatible with cationic and nonionic systems. In anionic systems, the addition of Lupasol® FG can result in incompatibilities (gelatinization, precipitation). The compatibility can generally be improved by selecting the appropriate molecular weight or by adding ammonia.

Lupasol® FG may change the coloristic properties of dyes and pigments.

Application

Because of its high charge density, Lupasol® FG adsorbs strongly on negatively charged surfaces such as cellulose, polyester, polyolefins, polyamides and metals. It is therefore used as adhesion promoter for bonding different materials. The usual application rate for these applications is very low, in the 50 – 150 mg/m^2 range.

In addition, owing to the large number of peripheral amino groups, Lupasol® FG can act as physical or chemical crosslinking agent in coatings, paints and adhesives.

Adhesives

In combination with polyvinyl alcohol, polyvinylbutyral, polyvinyl acetate and styrene copolymers, Lupasol® FG can be used as adhesion promoter in adhesives. The application concentration is usually in the 0.1 – 5% range (percent active substance).

Because of its crosslinking action, the use of low-molecular Lupasol® FG in dispersion-based label adhesives results in significantly increased cohesion for the same level of adhesion.

Low-molecular anhydrous Lupasol® FG can also act as crosslinker and hardener in epoxy resin and polyurethane adhesives. The amounts used depend on the epoxide or isocyanate component and the desired product properties.

Complex formation

Lupasol® FG can form reversible complexes with heavy-metal ions. It has a high cation-binding capacity similar to that of EDTA. Complexing is preferably carried out in an alkaline medium. Lupasol® FG exhibits outstanding binding capacities towards divalent metal ions (Zn^{2+}, Hg^{2+}, Cu^{2+}, Pb^{2+}, Ni^{2+}, Cd^{2+}).

Coatings and paints

Lupasol® FG is used as primer in coating applications, where it improves adhesion to the substrate.

Low-molecular, anhydrous Lupasol® FG can also be used as a crosslinking polyamine component in epoxy resin and polyurethane coatings.

Lupasol® FG improves the early rain resistance of stucco finishes.

Pigment manufacture

Pigments dispersed with Lupasol® FG-based compounds are easier to process and exhibit higher color strength.

Protein immobilization

Lupasol® FG can be used to immobilize proteins on inorganic materials. The proteins are usually bound to the Lupasol® FG using dialdehydes (e. g. glutaraldehyde).

Safety and Labelling

Please refer to the safety data sheet for information on classification & labeling, safe use, handling and transport.

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