Technical Information

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Korantin® LUB

Low-foaming lubricant additive and corrosion inhibitor for use in aqueous metalworking fluids and hydraulic fluids

Low-foaming corrosion inhibitor for ferrous metals and aluminium in neutral and alkaline media

Specialty Chemicals

BASF

Korantin LUB

Labelling

Classification according to German chemicals legislation and European Union Directive 67/548/EEC.
(10) = Irritant
Further details are given on Page 6.

Chemical nature

Acidic ester of phosphoric acid and a polyether.

Properties

Korantin LUB is a clear, brown liquid.

Product data

Active content	ca. 100 %	
Phosphorus content	ca. 3.5 %	
Density (20 °C)	ca. 1.06 g/cm^3	DIN 51757
pH (1 % in water)	ca. 1.5	
Pour point	ca. –16 °C	ISO 3016
Viscosity (50 °C)	ca. 2000 mm^2/s	DIN 51562
Acid number	ca. 130 mg KOH/g	DIN 53402
Flash point	ca. 178 °C	ISO 2502

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

Solubility in water (10 % at 23 °C)

Suspensions of the free acid of Korantin LUB can be prepared in water. Salts of Korantin LUB, such as its sodium and triethanolamine salts, form clear or slightly cloudy solutions in water.

Solubility in alcohols (10 % at 23 °C)

The free acid and the salts of Korantin LUB form clear solutions in alcohols.

Solubility in mineral oils and hydrocarbons (10 % at 23 °C)

The free acid and the salts of Korantin LUB are only very sparingly soluble in oils. Their solubility can be increased by neutralizing them with certain alkalis such as fatty amines.

Storage

Korantin LUB should be stored in a dry place.

Drums should be tightly resealed each time material is taken from them.

Korantin LUB should not be stored at temperatures below 20 °C, because its viscosity makes drums difficult to empty.

Liquid that has solidified or that shows signs of precipitation should be heated to 30 – 40 °C and homogenised before use. This also applies if drums are heated by external electrical elements.

Internal electrical elements should not be used because of the localised anomalies in temperature that they cause.

Shelf life

Provided it is stored properly, Korantin LUB has a shelf life of at least one year if it is stored in its unopened, original packaging.

Processing

Neutralization

The best method to prepare salts of Korantin LUB is to slowly stir it into the alkaline formulation, and to continue stirring until it is completely dissolved. Alkaline formulations may contain alkalis such as sodium hydroxide, potassium hydroxide, monoethanolamine, triethanolamine or other amines, and the type of alkali they contain is unimportant. The rate

at which Korantin LUB dissolves can be increased by heating the formulation, usually to 50 – 60 °C, but it is important to bear in mind that the neutralization reaction is exothermic.

Korantin LUB should not be dissolved in pure water or in neutral or acidic aqueous solutions, because this can give rise to turbidity which cannot be dissipated by increasing the pH.

Monoethanolamine and triethanolamine salts can also be prepared by direct neutralization. They can be prepared by mixing Korantin LUB with the undiluted amine and stirring it until it is has been completely neutralized. Salts of this type that contain an excess of amine can separate out if they are left to stand for a long time. They should therefore be consumed as soon as possible, preferably while they are still warm.

It is usually the case that solutions of salts are required to have a pH of 8 – 9 after they have been diluted down to the desired concentration with water. Solutions of this type can be prepared as follows (w/w).

ca. 40 % Korantin LUB
ca. 60 % Triethanolamine
(e. g. Triethanolamine T 98 supplied by BASF)

Similar methods can be used to prepare other salts. The amount of alkali required to prepare a neutral salt can be calculated from the acid number. The optimum ratio of acid to alkali required to prepare slightly alkaline solutions has to be determined in laboratory trials.

We would recommend diluting the monoethanolamine with water when preparing monoethanolamine salts of Korantin LUB. For instance, a 50 % aqueous solution of monoethanolamine can be prepared first of all and the Korantin LUB can then be stirred in. It is virtually impossible to prepare concentrated sodium, potassium calcium or zinc salts from Korantin LUB, but they can be prepared by adding Korantin LUB to dilute formulations. Salts of this type should always be prepared by diluting the alkali in the formulation and then stirring in Korantin LUB.

Applications

Aqueous solutions and emulsions of the salts of Korantin LUB prepared with sodium hydroxide, monoethanolamine or triethanolamine, etc., have the following characteristic properties.

1. They can be used as lubricants, extreme-pressure additives for lubricants, and mould release agents.
2. They inhibit corrosion to ferrous metals and aluminium.
3. They are low-foaming.

The high levels of performance achieved by Korantin LUB are unmatched by all other known ether phosphates in these respects.

Korantin LUB is particularly appropriate for use in:

1. Water-soluble metalworking fluids and emulsifiable metalworking fluids with a low oil content;
2. Water-based hydraulic fluids.

Lubrication

The salts of Korantin LUB have a pronounced lubricating action in aqueous solutions, in emulsions and in oils. This is illustrated by the results of performance tests employing a Reichert balance. A 3.3 % aqueous solution of a triethanolamine salt of Korantin LUB was prepared by mixing 7 parts of triethanolamine with 3 parts of Korantin LUB (w/w), i. e. the concentration of Korantin LUB was 1 %. The solution was prepared with potable water with a hardness of 1.8 mmol Ca ions/l (12.5 °Clark), and it was tested at a load of 1.5 kg. The total distance travelled was 100 m.

The abraded surface area was 11 – 14 mm^2 (which corresponds to a pressure of 200 – 270 bar), and the distance travelled before the initial noise abated was 10 – 20 m.

The high degree of lubrication provided by Korantin LUB has also been documented in practice. It has been shown to prolong the life of machine tools many times over in formulations such as those outlined below.

Corrosion inhibition

The main function of the salts of Korantin LUB is to protect iron, steel and aluminium surfaces from corrosion by water, aqueous solutions or emulsions. The salts of Korantin LUB have to be dissolved before they can take effect.

The following results were obtained for a mixture of 2 parts of Korantin LUB and 3 parts of triethanolamine in a test derived from DIN 51360, Part 1 (Herbert test) on mild steel and cast iron in the following media.

Distilled water	ca. 1.5 %
Potable water with a hardness of 1.8 mmol Ca ions/l (12.5 °Clark)	ca. 2 – 3 %

The corresponding figures for the test described in DIN 51360, Part 2 (cast iron-filter paper test) are as follows.

Distilled water	ca. 1 %
Potable water with a hardness of 1.8 mmol Ca ions/l (12.5 °Clark)	ca. 1.3 %
Potable water with a hardness of 4.1 mmol Ca ions/l (28 °Clark)	ca. 2.5 – 3 %
Artificially hardened water according to DIN 51360, 3.6 mmol Ca ions/l (25 °Clark)	ca. 3 %

Like the salts of many other phosphoric esters, the salts of Korantin LUB are also effective corrosion inhibitors for aluminium.

Synergistic effects with other corrosion inhibitors

Korantin LUB mostly display synergistic effects on ferrous metals in combination with corrosion inhibitors other than phosphoric esters when it is used as a lubricating additive in cutting fluids or hydraulic fluids. Synergistic effects can be obtained in combination with Korantin MAT, Korantin PAT, fatty acid alkanolamides and with the salts of branched, aliphatic monocarboxylic acids with a chain length of C_6 – C_{11} (e. g. isononanoic acid) and dicarboxylic acids with a corrosion-inhibiting action (e. g. azelaic acid and sebacic acid).

Foaming

Korantin LUB can only unfurl its full lubricating and corrosion-inhibiting action in the absence of foam. Korantin LUB differs from nearly all the acidic phosphoric esters synthesized so far in that dilute aqueous solutions of the salts of Korantin LUB form little foam. It is sufficiently low-foaming to meet the demands posed by most applications, and no defoamers need to be added.

Behaviour in hard water

Like the salts of all other acidic phosphoric esters, salts of Korantin LUB are sensitive to hard water. They begin to precipitate even in fairly soft water, but this can easily be prevented by adding Sokalan® CP 10. The formulations below all contain Sokalan CP 10, which prevents problems from being caused by hard water.

Sticky deposits

It has been observed in some cases that metalworking fluids formulated with salts of Korantin LUB have formed viscid deposits on machinery. Nevertheless, these deposits always remain fairly greasy, and they do not congeal to form a sticky gum.

Suggested formulations

The following BASF products are employed in the formulations below.

Product	Chemical nature	Function
Emulan® PO	Alkylphenol ethoxylate	Emulsifier
Korantin MAT	Nitrogenous, organic acid, triethanolamine salt	Corrosion inhibitor
Korantin PAT		
Pluronic® PE 6100	Propylene oxide-ethylene oxide block copolymer	Low-foaming, non-ionic surfactant
Sokalan® CP 10	Substituted sodium polyacrylate	Dispersing agent for hard water salts

Synthetic, water-soluble hydraulic fluid and cutting fluid

The following formulation is a concentrated, oil-free formulation which can be employed as a fire-resistant HFA-grade hydraulic fluid or as a metalworking fluid for cutting screw threads.

10 Potable water
14 Triethanolamine
38 Korantin MAT
21 Korantin LUB (stir until dissolved)
13 Pluronic PE 6100
4 Sokalan CP 10

It performs effectively and economically at a concentration of 2% at normal water hardness, but its concentration can be increased to 3% in order to overcome the detrimental effects of high water hardness or high concentrations of salts in the water used to make up the fluid. In soft water, it affords sufficient protection against corrosion at concentrations as low as 1%. We would recommend using it at a concentration of 5–7% in order to take full advantage of its lubricating properties, and it should be used at even higher concentrations if it is used as a cutting fluid for use at low speeds or if it is to be used for cutting screw threads.

The ability of this formulation to inhibit corrosion on ferrous metals is the result of the interaction between Korantin MAT and Korantin LUB in the form of their triethanolamine salts. Adding Pluronic PE 6100 ensures that any residue that forms owing to evaporation remains liquid, and Sokalan CP 10 disperses precipitated hard water salts. Dilute aqueous solutions of this very versatile formulation have a pH of less than 8.5.

All of the ingredients of this formulation are biodegradable. We would therefore recommend adding a biocide, because dilute solutions can be broken down by microbial action.

Dilute solutions of this formulation are low-foaming, but it can be advisable to add a defoamer if large amounts of air are entrained in the liquid owing to intense mechanical action.

Semi-synthetic, water-miscible cutting fluid with a low oil content (semi-transparent emulsion)

10 (50) Potable water
13 (7) Triethanolamine
20 (11) Korantin MAT
25 (14) Fatty acid alkanolamide
5 (3) Korantin LUB (stir until dissolved)
8 (4) Pluronic PE 10100
10 (6) Spindle oil
3 (2) Sokalan CP 10
6 (3) Emulan PO

The above formulation is for a concentrated passivating fluid which affords temporary protection against corrosion.

The combination of Korantin MAT, fatty acid alkanolamide and the triethanolamine salt of Korantin LUB is responsible for the corrosion-inhibiting effect of this formulation. The pronounced lubricating effect is the result of the combination of Korantin LUB, Pluronic PE 10100 and spindle oil contained in the formulation. Pluronic PE 10100 also acts as a coemulsifier, and Sokalan CP 10 disperses precipitated hard water salts.

The concentrated formulation, which has a concentration of 90 %, is normally employed at a concentration of 2 – 5 %, depending on the water hardness and the levels of corrosion inhibition and lubrication required. It forms an opalescent emulsion, even in very hard water.

The principal emulsifier contained in this formulation causes dilute solutions to foam to some extent. A separate defoamer generally needs to be added and, as in the previous example, a biocide needs to be added.

Cutting fluids free of sulphur and boron can also be formulated along the following lines. Korantin PAT protects them from attack by fungi.

24 Korantin PAT
14 Triethanolamine
20 Fatty acid alkanolamide
5 Korantin LUB
4 Sokalan CP 10
6 Oleic acid
9 Tallow fatty acid
18 Spindle oil

This formulation needs to be diluted down to a concentration of ca. 3 % before use.

Cutting fluids formulated along the lines of this formulation have a pronounced lubricating effect and afford a high level of protection against corrosion on ferrous metals. They are protected from attack by fungi. They form high-quality, finely divided emulsions, even in very hard water and, because they are free of sulphur, they do not give off any unpleasant odours when they are broken down by bacteria.

Safety

We know of no ill effects that could have resulted from using Korantin LUB for the purpose for which it is intended and from processing it in accordance with current practice.

According to the experience we have gained over many years and other information at our disposal, Korantin LUB does not exert any harmful effects on health, provided that it is 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.

Handling

Korantin LUB is acidic, and it irritates the skin and mucous membranes in its concentrated form. All contact with the eyes and prolonged contact with the skin must be avoided. Safety glasses must be worn when handling this product in its concentrated form.

Further details are given in our safety data sheet.

Ecology

Biodegradability

More than 70 % of the Korantin LUB present was removed in the static Zahn-Wellens Test (OECD 302 B/ISO 9888/EEC 88/302 C), expressed as chemical oxygen demand (COD).

Hazard labelling

According to European and German legislation, Korantin LUB has to be labelled as follows.

Hazard labelling

Xi = Irritant
R 36 = Irritating to eyes

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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