Trilon® M Liquid

Technical Information

January 2016
Supersedes 08_0806103 dated December 2013

08_151102e-00/Page 1 of 7
WF-No. 7505

Organic chelating agent used to control the concentration of metal ions in aqueous systems.

BASF
The Chemical Company

Introduction

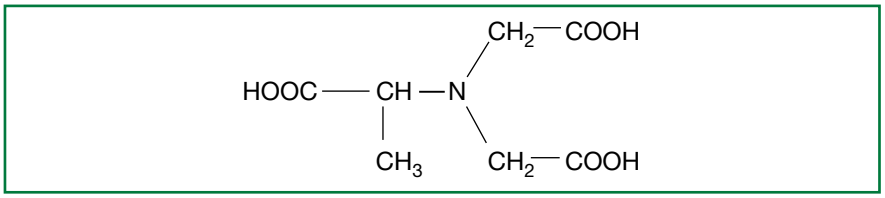
In addition to the strong, sustainable, and readily biodegradable chelating agents of the Trilon® M product line (MGDA, methylglycinediacetic acid), BASF offers an assortment of traditional products such as the Trilon® A brands (NTA, nitrilotriacetic acid), Trilon® B brands (EDTA, ethylenediaminetetraacetic acid), Trilon® C brands (DTPA, diethylenetriaminepentaacetic acid), and Trilon® D Liquid (HEDTA, hydroxyethyl ethylenediaminetriacetic acid).

Due to their higher performance, Trilon® M brands offer the customer better value than weak chelating agents such as citrates, for example. The excellent ecological and toxicological profile of Trilon® M Liquid has been verified in various repeated studies. BASF thus recommends Trilon® M Liquid as a substitute for other, less ecologically compatible chelating agents. Phosphonates, for example, contribute to the eutrophication of aquatic environments. Our team of application experts will be happy to help customize formulations.

Chemical nature

The active ingredient contained in Trilon® M Liquid is the trisodium salt of methyl glycinediacetic acid (MGDA-Na_3). Methylglycinediacetic acid is also referred to as alpha-alaninediacetic acid.

Methylglycinediacetic acid, $C_7H_{11}NO_6$, is an aminocarboxylic acid with four functional groups.



PRD-No.*

30043459

* BASF's commercial product numbers.

Appearance

At 23 °C, Trilon® M Liquid has a yellowish to yellow color and odor.

Handling and Storage

Handling

a) Trilon® M Liquid should not be stored at temperatures below 0 °C, precipitation can cause.
b) Precipitations can be reconstituted by heating Trilon® M Liquid briefly to 40 – 50 °C and stirring. Please mix sufficiently during heating.
c) 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 1.4541 – AISI 321 stainless steel (X6 CrNiTi 1810)
b) Stainless steel 1.4571 – AISI 316 Ti stainless steel (X6 CrNiMoTi 17122)
c) Stainless steel 1.4306 – AISI 321 L stainless steel (X2 CrNi 1911)
d) High-density polyethylene (HDPE)
e) Low-density polyethylene (LDPE)

Shelf life

Provided it is stored properly and drums are kept tightly sealed, Trilon® M Liquid has a shelf life of at least two years 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).

Trilon® M Liquid	**Unit**	**Value**
Physical form (23 °C)		liquid
Molecular Weight (M.W.)	g/mol	271
Concentration (pot. Titration with $FeCl_3$-solution) calculated as trisodium salt (MGDA-Na_3) calculated as free acid (MGDA-H_3)	 % %	 approx. 40 approx. 30
Density (DIN 51757, method 3, 20 °C)	g/cm³	approx. 1.31
pH value (DIN 19268, 1% in dist. water, 23 °C)		approx. 11.0
APHA color (DIN EN 1557, 23 °C)		max. 350
Viscosity (DIN EN 12092) 23 °C 5 °C 0 °C	 mPa·s mPa·s mPa·s	 approx. 20 approx. 65 approx. 90
Volatile NH_3 (BASF method)	ppm	max. 80
Calcium binding capacity (BASF method, pH 11)	mg $CaCO_3$/g t.q.	approx. 160
Water content (DIN EN 13267, Karl Fischer)	%	approx. 56
Pour point (DIN 3016)	°C	below -20
Solubility in water (25 °C)		Miscible in all proportions

Complex formation

The most important property of Trilon® M Liquid is its ability to form watersoluble complexes with polyvalent ions (e.g. calcium, magnesium, lead, copper, zinc, cadmium, mercury, manganese, iron) over a wide pH range from 2 to 13.5. MGDA usually forms 1 : 1 complexes, i. e. 1 mol of MGDA chelates binds to 1 mol of metal ions. These complexes remain stable, especially in alkaline media and even at temperatures of up to 100 °C.

From the law of mass action, the equation for the stability constant K for 1 : 1 complexes can be written as follows.

$$K = \frac{[MeZ^{(m-n)-}]}{[Me^{n+}]\,[Z^{m-}]}$$

where

$[MeZ^{(m-n)-}]$ is the concentration of the chelate that is formed,

$[Me^{n+}]$ is the concentration of free, positively charged metal ions,

$[Z^{m-}]$ is the concentration of the ligand anion, in this case MGDA,

K is the stability constant for the chelate.

Logarithmic stability constants (log K) for complexes of MGDA and selected metal ions:

Metal ion	log K
Fe^{3+}	16.5
Cu^{2+}	13.9
Pb^{2+}	12.1
Ni^{2+}	12.0
Co^{2+}	11.1
Zn^{2+}	10.9
Cd^{2+}	10.6
Fe^{2+}	8.1
Mn^{2+}	8.4
Ca^{2+}	7.0
Mg^{2+}	5.8
Sr^{2+}	5.2
Ba^{2+}	4.9

A high value for log K indicates that the chelating agent has a high affinity for that particular metal ion, and it provides a preliminary indication of whether the chelating agent is suitable for the specific application.

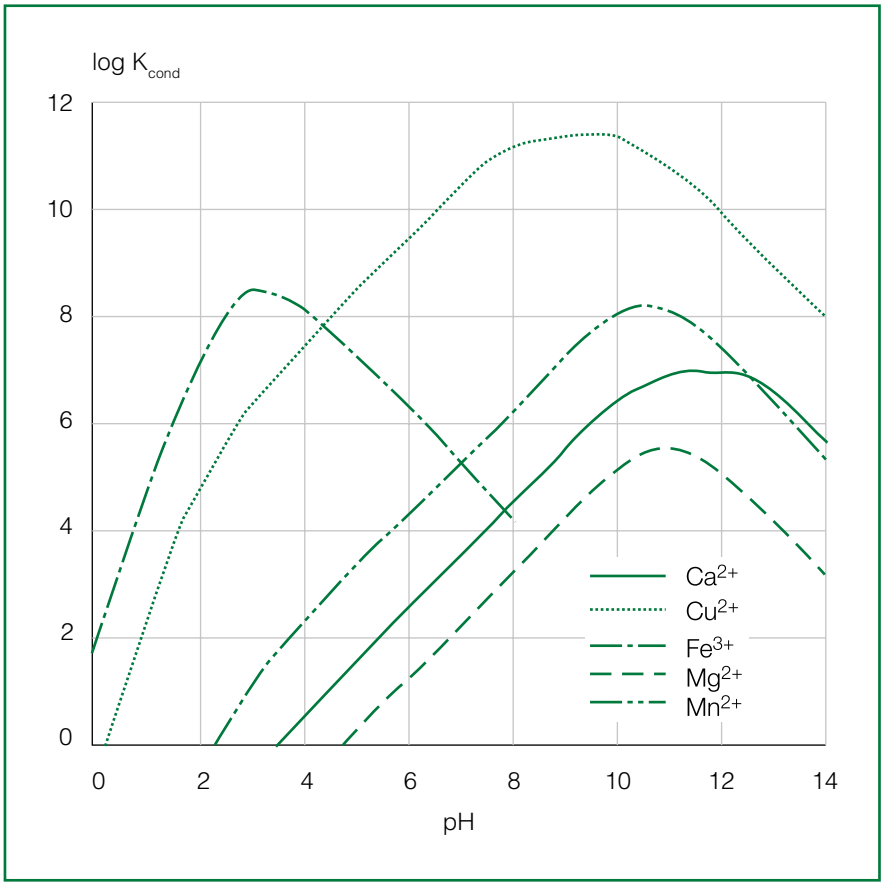
MGDA-H_3 is a tribasic acid that dissociates in three steps. The acid dissociation constants pK_a are as follows:

MGDA-H_3	pK_a1	1.6
MGDA-H_2^-	pK_a2	2.5
MGDA-H^{2-}	pK_a3	10.5

In aqueous solutions, MGDA competes for metal ions with other anions such as hydroxide, sulphate, sulphide, carbonate and oxalate that form sparingly soluble metal salts. The formation of chelates reduces the concentration of free metal ions $[Me^{n+}]$ to such an extent that the solubility products of many sparingly soluble metal salts are no longer exceeded. The result is that the salts no longer precipitate or may even redissolve.

The high stability of these complexes prevents metal ions from participating in typical chemical reactions. For instance, manganese, iron and copper are no longer able to catalyse the decomposition of peroxide bleach.

Conditional stability constants [log K_{cond}] can be used along with the log K values to help select the best complexing agent for a specific application. Conditional stability constants differ from the stability constants referred to above [log K] in that they also take the acid-base dissociation equilibria – i. e. the influence of the pH on the formation of complexes – into account.



Conditional stability constants for selected MGDA chelates.

Chemical stability

Trilon® M Liquid is chemically very stable.

Trilon® M Liquid has been shown to be very stable compared to other organic complexing agents such as citric acid, tartaric acid and gluconates, especially at high temperatures.

Whereas inorganic sequestring agents (e.g. phosphates) may hydrolyse at high temperatures, Trilon® M Liquid is stable – even when heated to 200 °C under pressure.

Trilon® M Liquid is resistant to strong acids and strong bases. They are gradually broken down by chromic acid, potassium permanganate and other strong oxidizing agents. Stability in the presence of hydrogen peroxide, percarbonate and perborate is sufficient for most application. Nevertheless, we do not recommend combining Trilon® M Liquid and peroxides in liquid formulations.

Sodium hypochlorite and other substances that release chlorine cause Trilon® M Liquid to decompose. Alkaline earth and heavy metal complexes are broken down.

Corrosion

Trilon® M Liquid stabilize polyvalent metal ions, which means that it can increase the rate at which metals dissolve. Nevertheless, with the exception of aluminium, an oxidizing agent (such as air) always has to be present for corrosion to take place.
Unalloyed steel is prone to corrosion in media that contain air, but corrosion can be reduced substantially if the pH value is in the alkaline range and can be eliminated almost completely if oxygen and other oxidizing agents are excluded. Steel cleaned with Trilon® M Liquid in the slightly alkaline range, which is the optimum pH range for Trilon® M Liquid, is much less prone to corrosion than if it is cleaned with acids.

Corrosion in connection with Trilon® M Liquid is limited to surface abrasion. Localized or stress corrosion is generally not observed in low-chloride media. It is therefore of particular advantage that Trilon® M Liquid can be supplied with very low chloride content (< 20 mg/kg).

The following information on materials is of a very general nature, because corrosion depends on many different factors such as exposure to air, galvanic corrosion caused by the presence of different metals and by the flow patterns of liquids. The compatibility of Trilon® M Liquid with different materials needs to be tested in each individual case.

Austenitic stainless steels such as AISI 321 L, 316 Ti and 321 are very effective for vessels used to store and transport Trilon® M Liquid.

Ferritic steels (e.g., boiler plate HII, material no. 1.0425) have only limited resistance to Trilon® M Liquid. At 50 °C, the corrosion rate in the absence of air was below 0.01 mm/yr. Crevice corrosion of welded joints has been observed sporadically, however, so that long-term storage in appliances made of nonalloyed carbon steel is not recommended. The corrosion rate can be slowed down by eliminating air from the system.

Aluminum is quickly corroded by strong bases. Aluminum and aluminum-based alloys (e.g., material 3.4365) are therefore not resistant to the alkaline Trilon® M Liquid. Preparations containing Trilon® M Liquid whose pH value is set to 5 – 7 are significantly less corrosive to aluminum.

Ecology and toxicology

Trilon® M Liquid has outstanding ecological (ecotoxicological) and toxicological properties. Trilon® M Liquid can therefore be used in various applications without limitation. The active ingredient in Trilon® M Liquid, MGDA, is classified as “slightly biodegradable” based on OECD standards. This means that MGDA, in such a test, for example, is degraded into water and its mineral components by the microorganisms present in wastewater treatment plants.

The products supplied by BASF conform to stringent standards with respect to their toxicological and ecotoxicological properties in order to provide protection of human and the environment. BASF has thoroughly tested the active ingredient MGDA and therefore also possesses extensive data on Trilon® M Liquid.

Safety

We are not aware of any ill effect that can result from using Trilon® M Liquid for the purpose for which it is intended and from processing it in accordance with current practices.

According to the experience that we have gained over many years and other information at our disposal, Trilon® M Liquid does not exert harmful effects on health, provided 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.

Labelling

Please consult the current Safety Data Sheets for information on the classification and labelling of our products and other information relevant to safety.

Disclaimer

This document, or any answers or information provided herein by BASF, does not constitute a legally binding obligation of BASF. While the descriptions, designs, data and information contained herein are presented in good faith and believed to be accurate, it is provided for your guidance only. Because many factors may affect processing or application/use, we recommend that you make tests to determine the suitability of a product for your particular purpose prior to use. It does not relieve our customers from the obligation to perform a full inspection of the products upon delivery or any other obligation. NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, DATA OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE.

January 2016