# Technical Information

# Trilon® M Liquid

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







BASF

We create chemistry

## Introduction

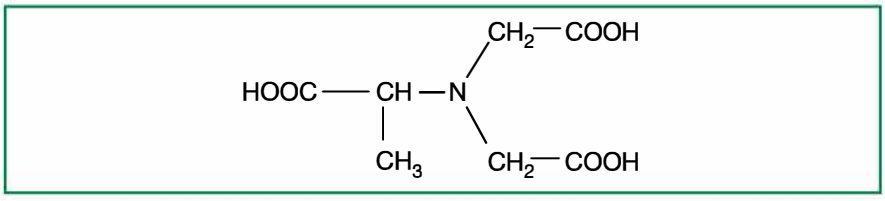
In addition to the strong, sustainable, and readily biodegradable chelating agents of the Trilon® M product line (MGDA, methylglycinediacetic acid), BASF offers an assortment of traditional products such as the Trilon® B brands (EDTA, ethylenediaminetetraacetic acid), and Trilon® D Liquid (HEDTA, hydroxyethyl 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 25 °C, Trilon® M Liquid has a yellowish to yellow color and a slight 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 1.4301 – AISI 304 (X5 CrNi 18-10)
b) Stainless steel 1.4305 – AISI 303 (X10 CrNiS 18-9)
c) Stainless steel 1.4306 – AISI 304 L (X2 CrNi 19-11)
d) Stainless steel 1.4361 – X1 CrNiSi 18-15-4
e) Stainless steel 1.4401 – AISI 316 (X5 CrNiMo 17-12-2)
f) Stainless steel 1.4404 – AISI 316 L (X2 CrNiMo 17-13-2)
g) Stainless steel 1.4439 – AISI 217 LMN (X2 CrNiMoN 17-13-5)
h) Stainless steel 1.4539 – AISI 904 L (X1 NiCrMoCu 25-20-5)
i) Stainless steel 1.4541 – AISI 321 (X6 CrNiTi 18-10)
j) Stainless steel 1.4571 – AISI 316 Ti (X6 CrNiMoTi 17-12-2)
k) HDPE – high density polyethylene
l) LDPE – low density polyethylene

**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<br>(25 °C) | | liquid |
| Molecular Weight<br>(M.W.) | g/mol | 271 |
| Concentration<br>(pot. Titration with $FeCl_3$-solution)<br>calculated as trisodium salt (MGDA-$Na_3$)<br>calculated as free acid (MGDA-$H_3$) | <br><br>%<br>% | <br><br>approx. 40<br>approx. 30 |
| Density<br>(DIN 51757, method 3, 20 °C) | g/cm³ | approx. 1.30 |
| pH value<br>(DIN 19268, 1% in dist. water, 25 °C) | | approx. 11.0 |
| APHA color<br>(DIN EN 1557, 25 °C) | | max. 350 |
| Viscosity<br>(DIN EN 12092)<br>25 °C<br>5 °C<br>0 °C | <br><br>mPa·s<br>mPa·s<br>mPa·s | <br><br>< 20<br>approx. 60<br>approx. 90 |
| Calcium binding capacity<br>(BASF method, pH 11) | mg $CaCO_3$/g t.q. | approx. 160 |
| Water content<br>(DIN EN 13267, Karl Fischer) | % | approx. 56 |
| Pour point<br>(DIN 3016) | °C | below -30 |
| Solubility in water<br>(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.

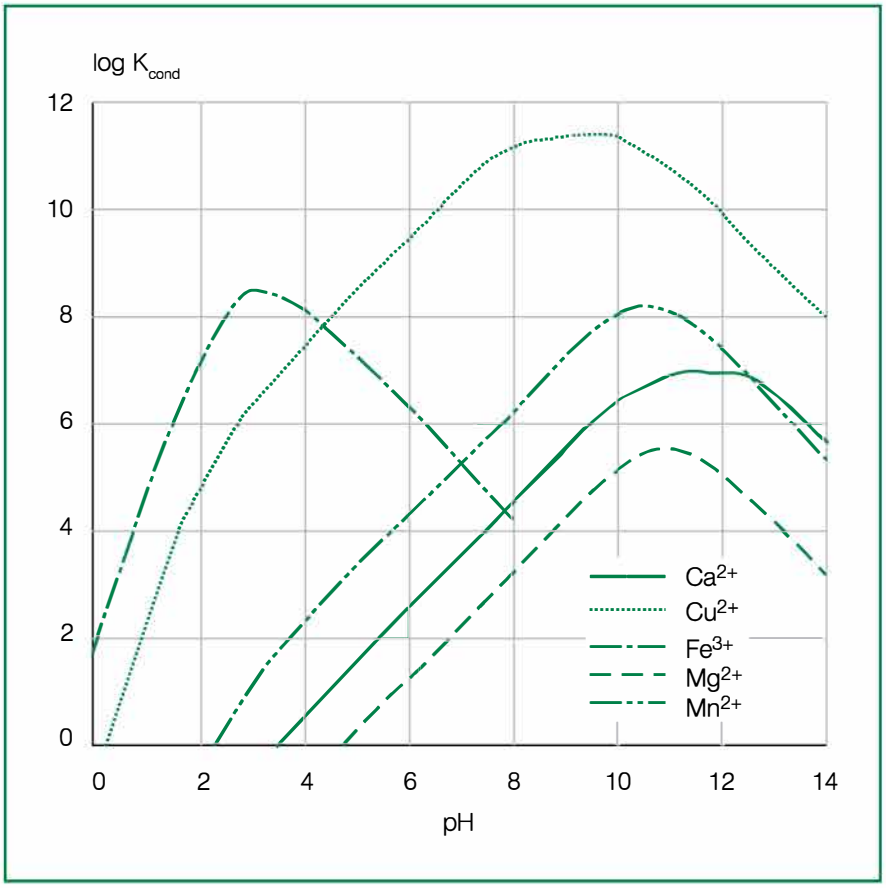
MGDA-$H_3$ is a tribasic acid that dissociates in three steps. The acid dissociation constants $pK_a$ are as follows:

| | | |
|---|---|---|
| MGDA-$H_3$ | $pK_a1$ | 1.6 |
| MGDA-$H_2^-$ | $pK_a2$ | 2.5 |
| MGDA-$H^{2-}$ | $pK_a3$ | 10.0 |

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

In the classification of corrosive substances according to class 8 according to the UN recommendations on Transport of dangerous goods, Trilon® M liquid is not classified in packing group III because the corrosion rate is less than 6.25 mm/year.

Trilon® M liquid generally stabilizes multivalent metal ions and might accelerate the dissolving behavior of metals through chelate formation. However, corrosion (with the exception of aluminum) always requires the presence of an oxidant such as air.

The following information on the corrosivity relate to the sales product and shall not relieve the customer of own corrosion tests in its formulations.

In ventilated media, nonalloyed steels are attacked by erosion. The corrosion is significantly reduced by alkaline pH values and more or less completely prevented by the elimination of oxygen and other oxidants.

Cleaning procedures under weak alkaline conditions that are optimal for Trilon® M liquid therefore damage steels (with the exception of aluminum) to a much lesser degree than cleaning procedures with acidic agents.

The corrosion observed with Trilon® M liquid is surface abrasion. Pitting or stress corrosion is usually not observed in low-chloride media. This is why it is particularly advantageous that Trilon® M liquid is supplied with minimal chloride level.

Since corrosion is characterized by many additional influences such as exposure to air, galvanic elements between different materials, or flow conditions, the following general information may only be applied to the use of Trilon® M liquid after a case-by-case review: Austenitic stainless steels (e.g., material no. AISI 304, AISI 321 or AISI 316 Ti are very well suited for the storage and transport of Trilon® M liquid.
Ferritic steels (e.g., boiler plate HII, material no. 1.0425) have only limited resistance of Trilon® M liquid.

At 50 °C, the corrosion rate in the absence of air was below 0.01 mm/a. Crevice corrosion of welded joints has been observed sporadically, however, so that longterm 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 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 readily 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 and Labelling**

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

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