BASF
The Chemical Company

® = Registered trademark of
BASF Aktiengesellschaft

Trilon® B types

Trilon BS
Trilon B Liquid
Trilon B Powder
Trilon BD
Trilon BX Liquid
Trilon BX Powder
Trilon B-A-T Liquid
Trilon BAQ
Trilon BVT

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

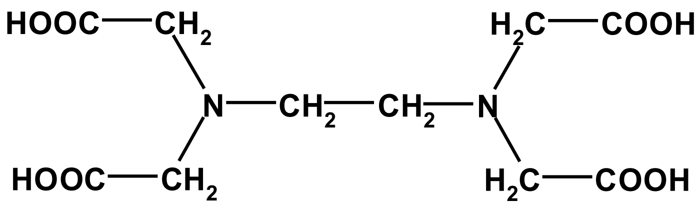
Contents

Properties

Chemical nature

The active ingredient contained in the Trilon B types is ethylenediaminetetraacetic acid (EDTA or EDTA-H_4) or its salts.

Ethylenediaminetetraacetic acid, $C_{10}H_{16}N_2O_8$, is an aminocarboxylic acid with six functional groups.



Trilon BS

Ethylenediaminetetraacetic acid (EDTA-H_4) in solid form
CAS No. 60-00-4

Trilon B Liquid

Aqueous solution of the tetrasodium salt of ethylenediaminetetraacetic acid (EDTA-Na_4)
CAS No. 64-02-8

Trilon B Powder

Tetrasodium salt of ethylenediaminetetraacetic acid (EDTA-Na_4) in solid form
CAS No. 64-02-8

Trilon BD

Disodium salt of ethylenediaminetetraacetic acid (EDTA-H_2Na_2) in solid form
CAS No. 139-33-3 (Trilon BD is a dihydrate and has therefore also been assigned CAS No. 6381-92-6)

Trilon BX Liquid

Aqueous solution of the tetrasodium salt of ethylenediaminetetraacetic acid (EDTA-Na_4), high purity grade
CAS No. 64-02-8

Trilon BX Powder

Tetrasodium salt of ethylenediaminetetraacetic acid (EDTA-Na_4) in solid form, high purity grade
CAS No. 64-02-8

Trilon B-A-T Liquid

Aqueous solution of the triammonium salt of ethylenediaminetetraacetic acid (EDTA-$H(NH_4)_3$)
CAS No. 15934-01-7

Trilon BAQ

Aqueous solution of the tetraammonium salt of ethylenediaminetetraacetic acid (EDTA-$(NH_4)_4$)
CAS No. 22473-78-5

Trilon BVT

Aqueous solution of the tetrasodium salt of ethylenediaminetetraacetic acid (EDTA-H_4) with added triethanolamine (TEA)
CAS No. 64-02-8/102-71-6

Chemical and physical data

	Unit	**Trilon BS**	**Trilon B Liquid**	**Trilon B Powder**
Physical form (visual)		White powder	Clear, yellowish liquid	Slightly yellowish powder
Molar mass (DIN 32625)	g/mol	292	380	380
Concentration (BASF method)* expressed as tetrasodium salt (EDTA-Na_4)	%	–	approx. 40	approx. 87
expressed as free acid (EDTA-H_4)	%	approx. 100	approx. 31	approx. 67
Density (DIN 51757, 20 °C, U-tube densitometer)	g/cm^3	–	approx. 1.30	–
pH (DIN 19268, 23 °C, 1% in water)		approx. 2.8 (slurry)	approx. 11.5	approx. 11.5
Bulk density (ISO 697, 40 mm diam.)	g/l	approx. 820	–	approx. 710
Hazen colour (DIN EN 1557)		–	max. 150	max. 150 (40 % in water)
Volatile NH_3 (BASF method)	ppm	–	max. 80	–
Calcium binding capacity (BASF method, pH 11)	mg $CaCO_3$/g t. q.	approx. 340	approx. 110	approx. 230
Water content (DIN EN 13268)	%	approx. 0.1	approx. 57	approx. 7
Viscosity (DIN 53018, 23 °C)	mPa · s	–	approx. 30	–
Freezing point (ISO 3013)	°C	–	< –30	–
Melting point (ISO 3146)	°C	approx. 245	–	> 300 (decomposes)
Solubility in water (BASF method)				
at 25 °C	g/l	approx. 1	Miscible in all proportions	approx. 600
at 80 °C	g/l	approx. 2		approx. 670

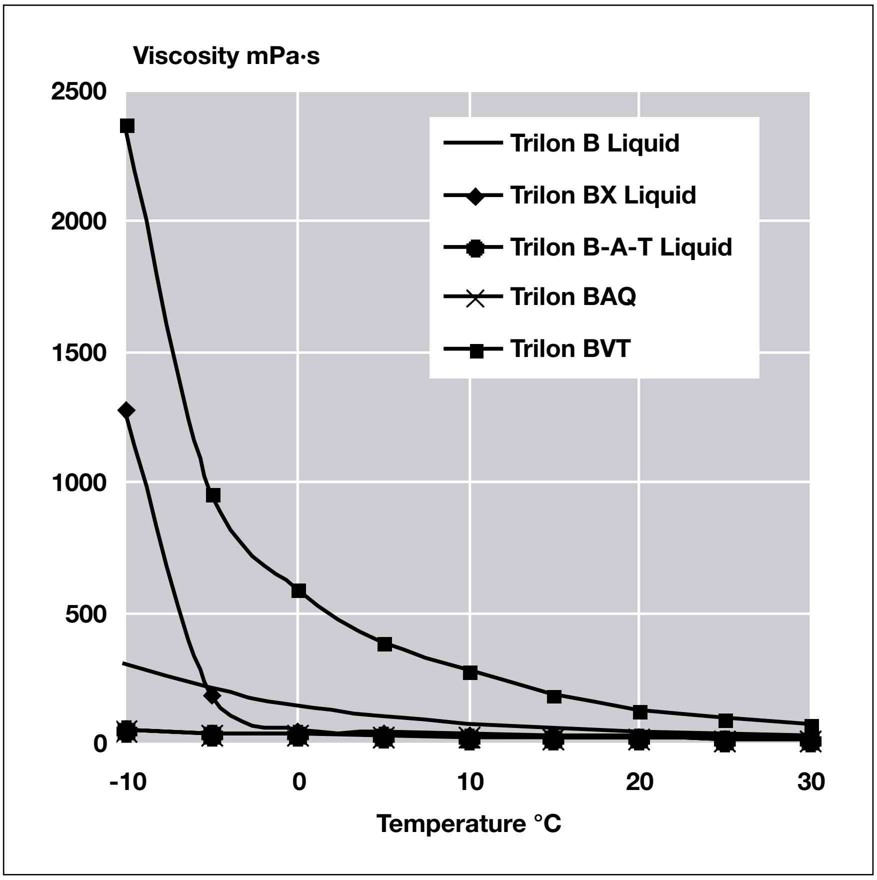
The above information is correct at the time of going to press. It does not necessarily form part of the product specification.

**Determined by potentiometric titration against iron(III)chloride.*

Trilon BD	Trilon BX Liquid	Trilon BX Powder	Trilon B-A-T	Trilon BAQ	Trilon BVT
White powder	Clear, yellowish liquid	White, crystalline powder	Clear, colourless or yellow liquid	Clear, yellowish liquid	Clear, yellowish liquid
336	380	380	343	360	–
approx. 90	approx. 40	approx. 84.5	–	–	approx. 21.5
approx. 78	approx. 31	approx. 65	approx. 43**	approx. 37***	approx. 17
–	approx. 1.28	–	approx. 1.20	approx. 1.18	approx. 1.23
approx. 4.5	approx. 11.5	approx. 11.2	approx. 7.5 (10 % in water)	approx. 9.3	approx. 11.0
approx. 950	–	approx. 780	–	–	–
–	max. 150	max. 20 (40 % in water)	–	max. 200	approx. 100
–	max. 80	–	–	–	–
approx. 270	approx. 110	approx. 230	approx. 150	approx. 140	approx. 65
approx. 10	approx. 60	approx. 16	approx. 50	approx. 50	approx. 35
–	approx. 20	–	approx. 20	approx. 20	approx. 150
–	< −20	–	< −20	–	below 0
approx. 245	–	> 300 (decomposes)	–	–	–
approx. 100 approx. 220	Miscible in all proportions	approx. 600 approx. 710	Miscible in all proportions	Miscible in all proportions	Miscible in all proportions

A detailed product specification is available from your local BASF representative.

** *Concentration expressed as EDTA-H$(NH_4)_3$ approx. 50 %*
*** *Concentration expressed as EDTA-$(NH_4)_4$ approx. 48 %*



Viscosity as a function of temperature

Complex formation

The most important property of the Trilon B types is their ability to form water-soluble complexes with polyvalent ions (eg. calcium, magnesium, lead, copper, zinc, cadmium, mercury, manganese, iron, aluminium) over a wide pH range from 2 to 13.5. EDTA usually forms 1 : 1 complexes, i. e. 1 mol of EDTA chelates binds to 1 mol of metal ions. The metal ion is completely enclosed by the ligand. These complexes remain stable, especially in alkali media and even at temperatures of up to 100 °C.

EDTA has six donor groups and it can form octahedral complexes.

From the law of mass action, the equation for the stability constant K 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 EDTA
K	is the stability constant for the chelate.

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

Metal ion	log K
Co^{3+}	41.0
Fe^{3+}	25.1
Hg^{2+}	21.8
Cu^{2+}	18.8
Ni^{2+}	18.6
Pb^{2+}	18.0
Cd^{2+}	16.5
Zn^{2+}	16.5
Co^{2+}	16.3
Al^{3+}	16.1
Fe^{2+}	14.3
Mn^{2+}	13.8
Ca^{2+}	10.6
Mg^{2+}	8.7
Ba^{2+}	7.9
Ag^{+}	7.3

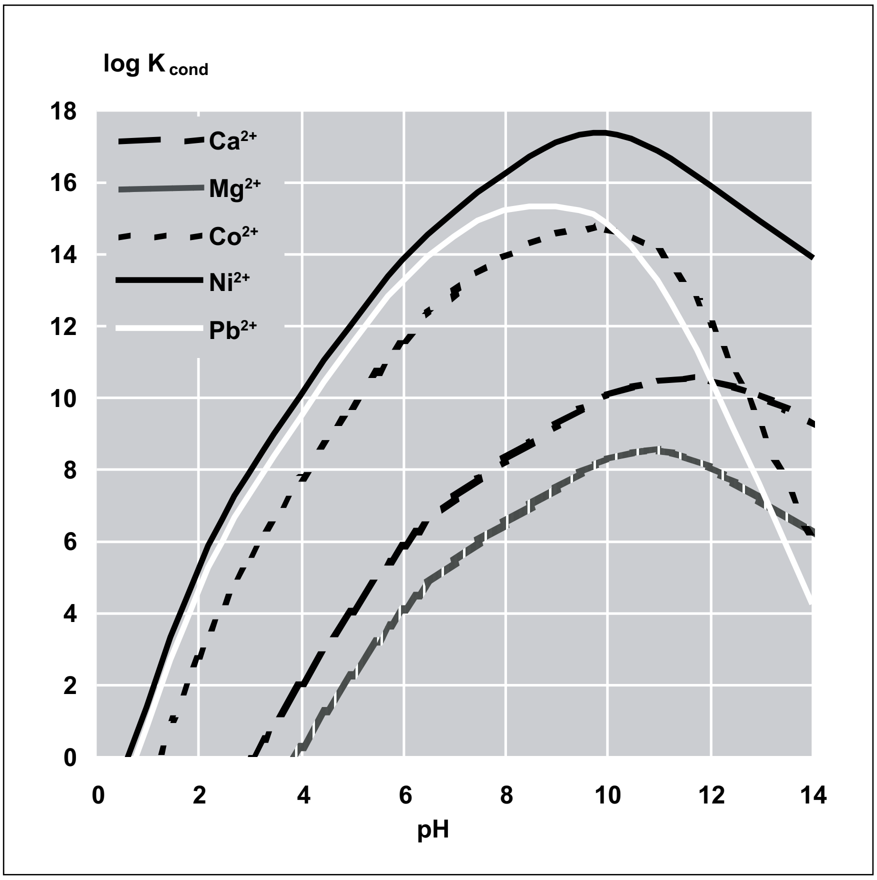
EDTA-H_4 is a tetrabasic acid that dissociates in four steps. The acid dissociation constants pK_a are as follows.

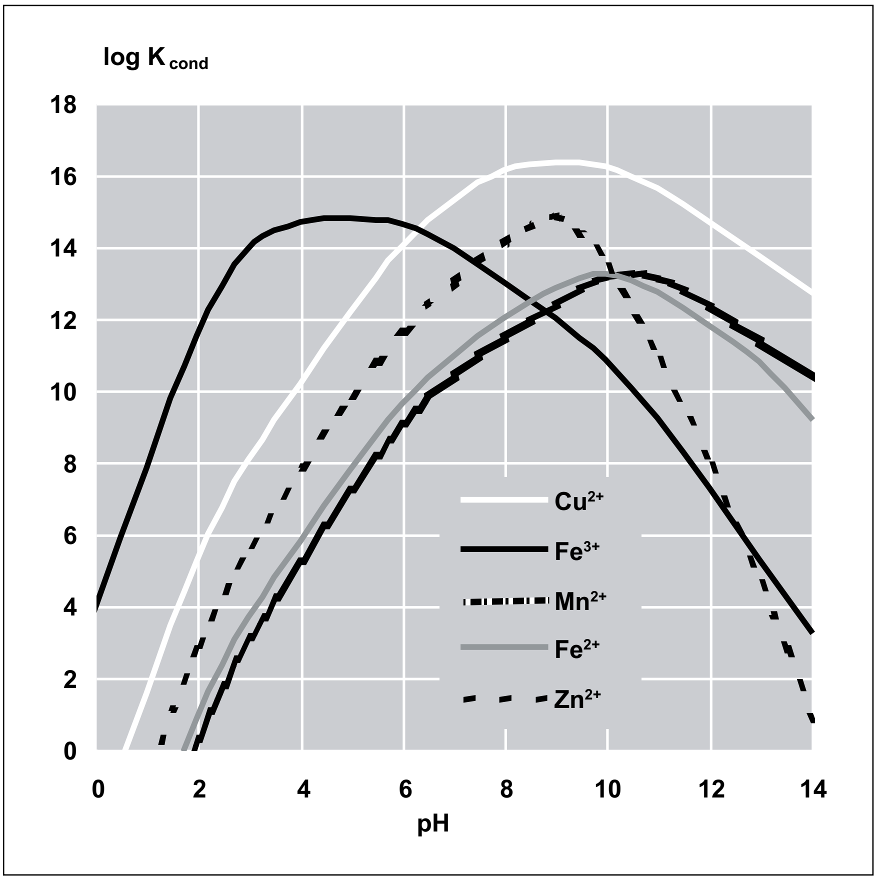
EDTA-H_4	pK_a1	2.0
EDTA-H_3^-	pK_a2	2.6
EDTA-H_2^{2-}	pK_a3	6.2
EDTA-H^{3-}	pK_a4	10.3

In aqueous solutions, EDTA 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}] take into account the stability constant K as well as the acid base dissociation equilibria.





Conditionalstability constants for selected EDTA chelates

The following table shows the amounts in grams of various different bases required to neutralize 100 g of Trilon BS.

Base	Degree of neutralization 1	2	3	4
Sodium hydroxide	13.7	27.4	41.1	54.8
Sodium hydroxide	18.5	37.0	55.5	74.0
Potassium hydroxide	19.2	38.4	57.6	76.8
Ammonia	11.6	23.2	34.8	–
Monoethanolamine (Molar mass 61)	20.8	41.6	62.4	–
Diethanolamine (Molar mass 105)	36.0	72.0	108.0	–
Triethanolamine (Molar mass 149)	51.2	102.4	–	–
N-Diethylethanolamine (Molar mass 117)	40.2	80.4	120.6	–
Oleylamine (Molar mass 267.5)	91.4	182.8	–	–

The table below shows the pH ranges in which EDTA forms complexes.

1 g of EDTA-Na_4 or 0.77 g of EDTA-H_4 are able to sequester the following amounts of metal ions, independently of temperature.

mg	Metal ion	Oxidation number	pH range	Colour of complex
64	Magnesium	2	8.0 – 12.5	Colourless
105	Calcium	2	6.0 – 13.5	Colourless
230	Strontium	2	8.0 – 13.5	Colourless
361	Barium	2	10.0 – 13.0	Colourless
144	Manganese	2	5.0 – 11.0 5.0 – 13.0*	Colourless
147	Iron	2	1.0 – 12.5*	Colourless
154	Nickel	2	1.5 – 13.0	Blue
155	Cobalt	2	4.0 – 12.0 4.0 – 13.5	Red** Violet***
167	Copper	2	1.5 – 11.5 5.0 – 13.0*	Blue
172	Zinc	2	4.0 – 13.0	Colourless
296	Cadmium	2	3.5 – 13.0	Colourless
545	Lead	2	2.0 – 13.5	Colourless
71	Aluminium	3	2.5 – 13.5	Colourless
138	Chromium	3	1.5 – 5.0	Violet
147	Iron	3	1.0 – 5.5	Yellow
550	Bismuth	3	1.0 – 9.0	Colourless

* *In the presence of a reducing agent*
** *At room temperature*
*** *Appears when heated, persists on cooling*

Chemical stability

The Trilon B types are chemically very stable.

The Trilon B types have 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 (eg. phosphates) may hydrolyse at high temperatures, Trilon B types are stable – even when heated to 200 °C under pressure.

Trilon BS and Trilon BD melt at approx. 245 °C.

Trilon B Powder and Trilon BX gradually lose their water of crystallization at high temperatures and they begin to decompose at approx. 300 °C.

The Trilon B types are resistant to strong acids and 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 joint application. Nevertheless, we do not recommend combining Trilon B types and peroxides in liquid formulations.

Oxidizing agents impair the ability of Trilon BVT to form complexes.

Substances that release chlorine, such as sodium hypochlorite, have a highly detrimental effect on the performance of all of the Trilon B types, and some alkaline earth and heavy metal complexes are broken down.

Corrosion

The Trilon B types stabilize polyvalent metal ions, which means that they 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 is in the alkaline range and can be eliminated almost completely if oxygen and other oxidizing agents are excluded. With the exception of aluminium, metals that are cleaned with the Trilon B types in the slightly alkaline range, which is the optimum pH range for the Trilon B types, are much less prone to corrosion than if they are cleaned with acids.

The Trilon B types are capable of dissolving metal oxides such as magnetite, and great caution should be taken in cases in which resistance to corrosion depends the formation of a passive magnetite layer.

The only type of corrosion that has been observed with the Trilon B types is uniform corrosion: pitting or stress cracking have not been observed in media with a low chloride content. One of the advantages of the Trilon B types is that they can be supplied with a 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 materials and by the flow patterns of liquids. The compatibility of Trilon B types with different materials needs to be tested in each individual case.

Austenitic stainless steels such as AISI/SAE 321 are very effective for vessels used to store and transport the Trilon B types even at temperatures of 60 – 100 °C.

Ferritic carbon steels such as ASTM A201 Grade B (European Material No. P265GH) are resistant to Trilon BX Liquid at temperatures up to 60 °C if the liquid is blanketed with nitrogen. Unalloyed steel is not sufficiently resistant to corrosion by Trilon B-A-T Liquid and Trilon BAQ, which are less alkaline.

Copper and alloys such as brass and bronze must not be treated with Trilon B-A-T Liquid or Trilon BAQ, because they contain ammonium compounds. Here, corrosion is at least partly due to the release of ammonia, and corrosion can be caused by the gas phase above the metal surface. On the other hand, the use of Trilon BD for cleaning copper components in power stations has been documented in the literature and very little corrosion has been detected even at high temperatures [9].

Aluminium and aluminium alloys such as AL 7075 T6 (European Material No. 3.4365) are not resistant to the Trilon B types, because Trilon B Liquid is alkaline and aluminium is quickly corroded by strong bases. The rate of corrosion depends to a large extent on the pH. The neutral and slightly acidic products such as Trilon B-A-T Liquid and Trilon BD are much less corrosive to aluminium than the alkaline Trilon B types.

Silicon carbide and tungsten carbide are suitable materials for pump seals. Nickel-bound tungsten carbide seals are resistant to Trilon B liquid at temperatures of up to 100 °C.

Applications

The Trilon B types are used sequester free metal ions in aqueous systems. They are used to soften water and to remove traces of alkaline earth and heavy metals.

The Trilon B types are also used to stabilize bleach.

Stoichiometric amounts of Trilon B types are required to complex metal ions. Solutions are clear after they have been treated with chelating agents, and they do not need to be filtered or decanted.

The Trilon B types can be used to solubilize precipitated metal salts and hydroxides. Traces of free metal ions are always present in equilibrium with salts, even if these salts are very sparingly soluble. If the free ions are chelated, the equilibrium is gradually displaced in favour of the soluble chelates.

The rate at which precipitates dissolve depends on their crystal structure and age, and on the temperature. Increasing the temperature can help to increase the rate at which precipitated solids dissolve. Old, dried-on scale has to be treated with Trilon B types over a longer period, and we would recommend applying 1 g/l more than the stoichiometric amount in this case.

Laundry detergents

The Trilon B types can be used to stabilize perborate and percarbonate in powder detergents. Small amounts of complexing agents, as little as 0.5 – 1.0 % expressed as the active substance, can be added to prevent traces of heavy metals from catalyzing the decomposition of hydrogen peroxide and other types of bleach. These heavy metals, which mainly consist of iron, copper and manganese, originate from the walls of pipes, the soil contained in the laundry and the other ingredients of the detergent. Peroxide bleach can break down fluorescent whitening agents, cause coloured laundry to change shade and damage fabrics in the presence of heavy metal ions. The Trilon B types protect fabrics by sequestering heavy metals.

The Trilon B types play an active role in removing many types of soil and boost the detergency of laundry detergents.

Cleaners

The Trilon B types can be employed in all types of cleaner and degreaser formulations for industrial and institutional applications. They prevent hardness ions and heavy metal ions from precipitating. Inorganic solids of this type can form scale and deposits in tanks, pipes, and nozzles and on hard surfaces. The Trilon B types boost the performance of the surfactants contained in cleaner formulations and ensure that their performance remains undiminished during the whole cleaning process.

Scale that consists of calcium carbonate, calcium phosphate or calcium oxalate can be formed in pipes and heat exchangers at high temperatures in various industrial processes. The Trilon B types can be added to cleaner formulations remove this type of scale. The rate at which the scale dissolves can be increased by increasing the cleaning temperature.

Turbidity and precipitation is often a problem when highly concentrated cleaners such as floor cleaners, metal cleaners and bottle-washing formulations are prepared with hard water. This problem can be overcome in most cases by adding Trilon B types. The excellent solubility of the Trilon B types enables them to be used to replace some or all of the phosphates contained in many formulations. This prevents highly concentrated liquid formulations from precipitating and demixing at low temperatures.

The Trilon B types can be used to protect lubricants, cleaners and polishes in emulsion form from the damaging effects of hard water and salts of polyvalent metal ions.

Soap

The Trilon B types can be added to curd soap, toilet soap and shaving soap at rates of between 0.3 % and 2 % to prevent it becoming rancid and discoloured. The heavy metals responsible for this are usually contained in the tallow, fatty acids and other raw materials, but soap can also be contaminated with metallic particles during drying, milling, plodding or stamping.

They can also be added at higher rates (1 – 10 %) to prevent lime soaps from being formed, to boost the detergency of the soap and to promote foaming.

Textile processing

The Trilon B types are employed in the textile industry in pretreatment, after-treatment and dyeing processes to prevent insoluble substances such as boiler scale and lime soaps from precipitating. They ensure that the treatment process remains effective over the whole working life of the bath.

The Trilon B types prevent hydroxides of heavy metals and alkaline earth metals from precipitating when cotton, wool and blended fabrics are boiled off with caustic soda.

In bleaching processes, the disruptive heavy metal ions that are washed out of cotton, wool and blended fabrics have to be sequestered with Trilon B types to prevent them from catalysing the decomposition of peroxide bleach. The bleach would otherwise decompose very quickly. The Trilon B types enable bleaching costs to be reduced substantially.

The Trilon B types can also be used to stabilize dyes. They protect fabrics from incrustation and prevent dyes from being precipitated by calcium or magnesium salts.

The Trilon B types can be used to suppress turbidity when textiles are washed in hard water after they have been printed. The Trilon B types prevent hard water salts from being deposited on fabrics, which endures a brilliant shade and high fastness. The Trilon B types can be used to soften the water in order to enhance the whiteness of fabrics when textiles are treated with fluorescent whitening agents.

Leather

The Trilon B types are employed in the production of leather before and during tanning and in dyeing processes. They prevent solids from being precipitated and staining the leather.

Pulp and paper

The Trilon B types are used to stabilize peroxide and hydrosulphite bleach by sequestering disruptive metal ions, especially Fe^{3+}, Mn^{2+} and Cu^{2+}. These metals are washed out of the pulp in the form of their complexes.

Bleaching mechanical pulp
The Trilon B types enable substantial savings in the consumption of hydrogen peroxide and hydrosulphite bleach to be made. Complexing heavy metal ions improves the efficiency of the bleaching process. The Trilon B types make it possible for sodium silicate to be largely dispensed with in peroxide bleaching processes.

In reductive bleaching processes with sodium dithionite, the Trilon B types are used to sequester Fe^{3+} ions that would otherwise react with phenolic compounds to form strongly coloured complexes.

The Trilon B types have also been shown to perform well in two-stage bleaching processes with peroxide and hydrosulphite or peroxide and peroxide.

Bleaching chemical pulp
Trilon BX types or Trilon C types are often used for bleaching chemical pulp. They prevent disruptive heavy metal ions from catalyzing the decomposition of oxidative bleach such as hydrogen peroxide by complexing them. The Trilon BX types are very pure grades of EDTA, and they allow consumption to be reduced by 10 % compared to standard grades of EDTA or DTPA.

Technological advances in the field of paper production have had the effect that paper machine white water circuits are operated at a higher degree of closure. This has resulted in the increased formation of scale and deposits in pipes and evaporators, etc., and on the pulp itself. The Trilon B types offer a simple means of softening the water. The Trilon B types, especially the Trilon BX types, are also capable of dissolving scale that consists of calcium carbonate, calcium sulphate or calcium oxalate in the 9 – 12 pH range.

Water treatment

Trilon B types are very effective for treating water to prevent scale and deposits of calcium carbonate, calcium sulphate and calcium phosphate from forming in boilers, evaporators, reverse osmosis membranes, heat exchangers and filters, etc. They can also be used to remove scale.

The Trilon B types are every effective for cleaning equipment of this type, because they are less corrosive than other cleaners. They have the advantage over acids that no potentially disruptive CO_2 is formed when calcium carbonate is dissolved.

The following table shows the amounts of Trilon B required to soften 1 litre of water containing 1 mmol of Ca^{2+} ions/l at 20 °C*.

	1 mmol Ca^{2+} ions/l (DIN 53910, Part 1)
Trilon BS	approx. 295 mg
Trilon B Liquid	approx. 955 mg
Trilon B Powder	approx. 450 mg
Trilon BD	approx. 370 mg

** The standard unit of water hardness in Germany according to DIN 53910, Part 1, is mmol of Ca ions per litre of water, but other units are still in use internationally.*

1 mmol/l of Ca ions = 5.6° German hardness = 10.0° French hardness = 7.0° English hardness (° Clark) = 100 ppm $CaCO_3$

1° Clark (English hardness) corresponds to 0.01 g $CaCO_3$/0.7 l water (= 0.143 mmol Ca ions/l)

1° German hardness corresponds to 0.01 g CaO/l water (= 0.178 mmol Ca ions/l)

1° French hardness corresponds to 0.01 g $CaCO_3$/l water) (= 0.1 mmol Ca ions/l)

In the United States, water hardness is sometimes expressed in ppm. 1 ppm $CaCO_3$ = 0.001 g $CaCO_3$/l water = 0.01 mmol Ca ions/l.

Example *The amount of Trilon B Powder required to soften 100 l of water with a hardness of 2 mmol Ca ions/l (= 200 ppm $CaCO_3$ = approx. 14° Clark) is 450 x 2 x 100 x 0.001 g = 90 g Trilon B Powder.*

Cleaning heat exchangers

Trilon B-A-T Liquid is particularly effective for removing magnetite scale. Magnetite scale can be formed in the heat exchangers of power stations or in heating circuits if air is allowed to enter. Trilon B-A-T Liquid causes little corrosion to alloyed and unalloyed steels, and it is much superior to the sodium salt in this respect. Scale can be removed most efficiently at elevated temperatures. Magnetite is formed from a mixture of Fe(II) and Fe(III) ions. Fe(II) forms complexes at a pH of approx. 9, but the pH needs to be in the acid range ($pH < 5$) for Fe(III) to be complexed. Adding hydrazine to the cleaning solution can prevent Fe(III) ions from being formed and can reduce these to Fe(II). This makes it easier to remove magnetite scale in the alkaline pH range, and prevents iron(III) hydroxide sludge from being formed. It is recommended to remove magnetite scale at a pH of approx. 9 [7].

The rate at which the scale dissolves depends to a large extent on the thickness of the scale, its composition and morphology, and the flow of liquid through the equipment to be descaled. Practical experience has shown that the rate at which scale is removed can be speeded up by increasing the concentration of Trilon B-A-T Liquid, the temperature and the rate of flow through the system.

Adding Trilon B-A-T Liquid to the feed water in low concentrations has the advantage that the protective layer of scale that is formed on the bare metal is of a much higher quality than the layer formed in the absence of complexing agents. The protective layer acts as a patina, protecting the underlying metal from corrosion. The layer formed in the presence of Trilon B-A-T Liquid is very resistant to corrosion, especially static corrosion when the plant is shut down [6].

Radioactive decontamination

The Trilon B types can be employed in radioactive decontamination processes. They can be used to dissolved the insoluble oxides or radioactive elements. Complexes can then be easily removed form hard surfaces or the skin. Formulations are more effective if they contain a surfactant such as our Lutensol® types.

Electroplating

Trilon B Powder and Trilon BX Powder can be used to stabilise phosphonates in neutral and alkaline derusting and descaling baths. The Trilon B types also prevent lime soaps from precipitating, which prolongs the working life of baths.

Trilon BVT can be added to alkaline degreasing baths that contain polyphosphates to reduce the hydrolysis of polyphosphates in the presence of metal ions, especially alkaline earth and heavy metal ions. Adding Trilon BVT to degreasing baths helps to inhibit the formation of orthophosphates. This reduces the danger of the phosphates precipitating, which impairs the complexing power of the bath and its ability to disperse soil and emulsify grease. Trilon BVT boosts the detergency of degreasing baths and prevents non-ferrous metals from tarnishing.

Trilon BVT can be added to passivation and neutralization baths after the metal has been pickled with acid in order to completely remove insoluble iron oxide hydrates from the water and acid.

Trilon BVT is able to sequester iron(II) and iron(III) in neutral and alkaline media, and especially in highly alkaline solutions, irrespective of the hardness of the water.

Under normal conditions, i. e. in 3 – 10 % caustic soda, 100 g of Trilon BVT sequesters 8.0 – 9.0 g iron ions, 2.15 g calcium ions or 1.3 g of magnesium ions.

Complexing power of Trilon BVT as a function of pH

pH	1 g of Trilon BVT sequesters Fe (mg) at 25 °C
5	approx. 33
6	approx. 33
7	approx. 33
8	approx. 33
9	approx. 46
10	approx. 63
11	approx. 78
12	approx. 100
13	approx. 140

Trilon BS is employed as a complexing agent in electroplating and electroless plating baths and it is used to regenerate baths by sequestering impurities.

Trilon BS consists of the free acid of EDTA, and it has the advantage that it can be neutralized with a wide variety of different bases, such as sodium hydroxide, potassium hydroxide or organic amines. This enables the solubility of the complexing agent to be controlled. The degree of neutralization can also be varied within wide limits.

Trilon BS and the Trilon BX types can be used in applications that demand high standards of purity.

The Trilon BX types are employed in electroplating and electroless plating baths on account of their high purity.

Electroless copper plating baths are extremely sensitive to organic impurities and heavy metals. These substances have a very detrimental effect on the effectiveness and stability of the formulation. Baths based on the Trilon BX types remain stable. The high concentration of metal enables the copper to be applied very evenly. Baths based on the Trilon BX types are distinguished by their long working life and the high quality of the copper deposits.

The Trilon B types make it easier to separate metals that are difficult to isolate, such as rare earths.

Polymerisation

The Trilon B types, especially the Trilon BX types, are used in the production of rubber as a complexing agent for iron(II) catalysts. The latex can be washed with Trilon B types to remove traces of heavy metals, especially copper and manganese, that originate from the bark of trees. This prevents the rubber from ageing prematurely.

All products that come into contact with rubber have to be free of heavy metal ions. Articles that are intended to be treated, coated, or impregnated with rubber can be washed by boiling them for 1 – 2 hours in water that contains 1 – 2 g Trilon BX Powder per litre.

Printing inks

Trilon BD prevents lithographic inks from scumming and piling. It sequesters the polyvalent metal ions in the fountain solution and prevents them from forming salts. Depending on the hardness of the water and the type of binder, Trilon BD is applied at a rate of between 0.5 % and 2 %, expressed as a proportion of the printing ink. It can be added in solid form to the pigment before it is dispersed or it can be dissolved and added to the fountain solution.

Trilon BD can cause some inks to dry more slowly. This problem can be overcome by increasing the drier content or changing over to other driers.

Safety

We know of no ill effects that could have resulted from using the Trilon B types for the purpose for which they are intended and from processing them in accordance with current practice.

According to the experience we have gained over many years and other information at our disposal, the Trilon B types do not exert any harmful effects on health, provided that they are 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.

Storage

Trilon B Liquid and Trilon BX Liquid should not be stored at temperatures below 0 °C, because this can cause them to precipitate. It can be reconstituted by heating it briefly to 40 – 50 °C and stirring.

Trilon B Liquid, Trilon B-A-T Liquid and Trilon BAQ are easily capable of being pumped at temperatures down to – 10 °C.

Trilon B Powder is hygroscopic, and so it should be kept in tightly sealed containers.

The Trilon B types supplied in powder form have a shelf life of two years, provided they are stored in their original packaging and kept tightly sealed.

The Trilon B types supplied in liquid form have a shelf life of one year in their tightly sealed original packaging.

We would recommend storing the Trilon B types supplied in liquid form in tanks made from AISI 316 Ti or AISI 321 stainless steel.

Ecology and toxicology

EDTA can be broken down and removed from the environment by biotic and abiotic processes. EDTA is quickly broken down by photochemical degradation. In particular, EDTA-iron complexes readily decompose on exposure to sunlight into substances that are readily biodegradable [1].

EDTA is inherently biodegradable, provided that the bacteria are sufficiently adapted and the residence time is long enough. Both of these conditions can be present in the environment [2, 3, 3 a].

EDTA can be broken down quickly by UV oxidation, which can be made use of in industrial wastewater treatment plants [1a].

However, this biodegradation process takes a relatively long time, with the result that the removal rates that are measured with methods such as the Zahn-Wellens test [4, 5] or in treatment plants are generally low. EDTA is not persistent in the environment. The interaction between the various different mechanisms ensures that the rates of removal are high enough that only a fractional amount of the EDTA that is used finds its way into the environment.

The information given above has been confirmed by experts from EU member states in the EU EDTA Risk Assessment, which was completed in 2004.

No problems affecting consumers were identified in any of the applications for EDTA or in the production of EDTA.

EDTA was found to have low toxicity to aquatic organisms in the environment.

No risks were identified that could be attributed to the influence of EDTA on the mobility of heavy metals [8].

Labelling

Please refer to the latest Safety Data Sheets for detailed, up-to-date information on classification, labelling and product safety.

Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed.

January 2007

Literature

[1] Lockart, H. B. jr.; Blakeley, R. V. Aerobic photodegration of Fe(III) DTPA. Environm. Sci. & Techn., 12, 1975, p. 1035 –1036

[1a] F. Wirsing; M. Sörensen WWT (Wasserwirtschaft Wassertechnik) 11 – 12 (2004), p. 54 – 55

[2] Belly, R. T.; Lauf, J. J.; Goodhue, C. T. Degradation of DTPA by microbial populations from an aerated lagoon. Appl. Microbiology, 29, 1975, p. 787 – 794

[3] Tiedje, J. M. Influence of environmental parameters on DTPA biodegradation in soils and sediments. J. Environm. Qual., 6, 1977, p. 21 – 26

[3 a] Hempel, D. C. et al. Wasser, Abwasser 135, Vol. 6, 1994 p. 353 – 358

[4] Zahn, R.; Huber, W. Ringversuch zur biologischen Abbaubarkeit von Produkten. Tenside Detergents 12, 1975, p. 266 – 270

[5] Gerike, P.; Fischer, W. K. A correlation study of biodegradability determinations with various chemicals in various tests. Ecotoxicology and Environmental Safety, 3, 1979, p. 159 – 173

[6] Langer, A. et al. VGB Kraftwerkstechnik 68, Vol. 9, 1988 p. 945 – 947

[7] Kostroun, F. et al. VGB Kraftwerkstechnik 75, Vol. 9, 1995 p. 819 – 823

[8] European Union risk assessment report on tetrasodium ethylenediamine tetraacetate (Na_4EDTA), 1st priority list, Vol. 51, 2004 (EUR 21315 EN)

[9] Svoboda, R. Lehr, C. Seipp, H.-G. Power Plant Chemistry 6 (2004), p. 197

BASF Aktiengesellschaft
Performance Chemicals for
Detergents and Formulators
67056 Ludwigshafen, Germany
www.basf.com/detergents-formulators