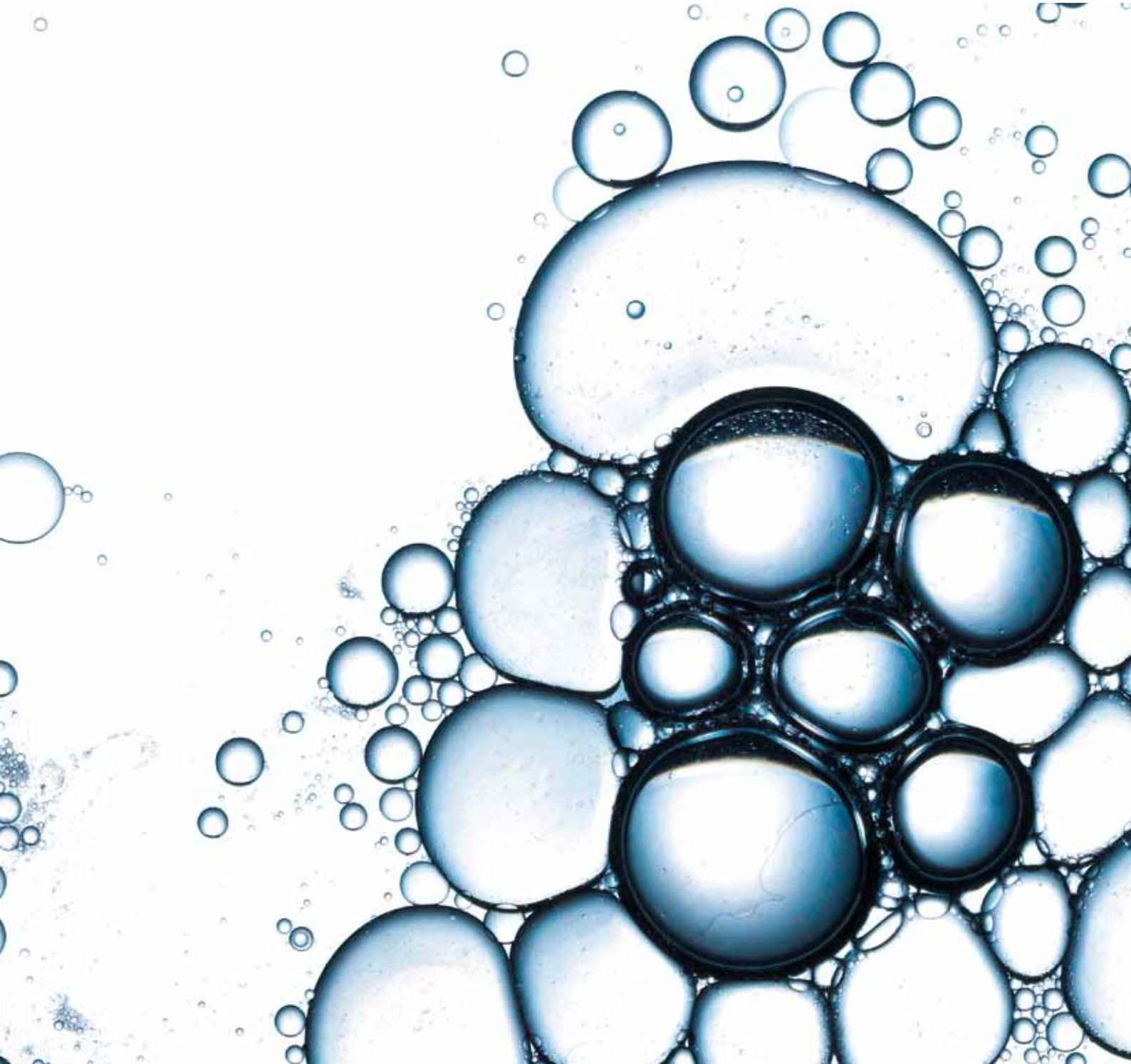
AkzoNobel Functional Chemicals
Chelates

Dissolvine® GL
Technical brochure

AkzoNobel
Tomorrow's Answers Today



Dissolvine® GL

Dissolvine GL
The greener chelate

1. Introduction

Dissolvine® aminopolycarboxylate-based chelates are used extensively to control metal ions in water-based systems for countless applications. They are highly effective in the control of water hardness ions and find wide application in cleaning surfaces, descaling boilers, processing textile and preventing scale in heating systems. In another area, the control of metal reactivity, they are important processing tools for reducing the detrimental effect of metals in pulp bleaching for paper manufacturing, improving personal care formulations, stabilizing food products and for pharmaceutical formulations. Finally, they are also used extensively in metalworking areas, ranging from metal plating, dosing essential elements to plants and supplying iron for the development of photographic films and paper using silver halide technology.

The sheer diversity of application demonstrates the versatility of the Dissolvine® chelate product range.

Although classical aminopolycarboxylates are excellent performers in terms of cost effectiveness and versatility, they do not always meet all the needs of the customer. Recognizing this fact, AkzoNobel is constantly seeking to develop even more environmentally benign products with an excellent chelating performance to complement our existing product range.

Dissolvine® GL has been developed as part of this continuing quest to find new and improved products. Produced from natural and sustainable raw materials, Dissolvine® GL is readily biodegradable, with a high solubility over a wide pH range. Compared to EDTA and NTA, Dissolvine® GL performs better when it comes to hard surface cleaning. It does not sensitize human skin, demonstrates enhanced biocidal boosting power and improved biodegradability properties. Compared to phosphates and phosphonates, it is a far more effective chelating agent. Also, it does not contribute to eutrophication and has improved toxicological properties.

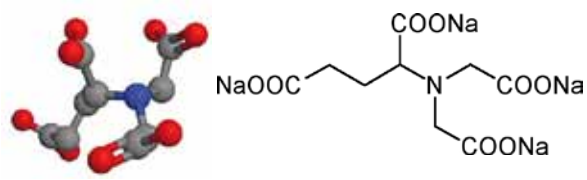
Figure 1: GLDA-Na_4 and green character, according to the Bra Miljöval protocol

2. Product description

Chemical structure

The active ingredient in Dissolvine® GL is glutamic acid diacetic acid, tetra sodium salt (GLDA). As shown below, GLDA has four carboxylic acid groups. In combination with the nitrogen atom these acid groups can form strong bonds with di- and trivalent metals.

Chemical structure:



Chemical name:	L-glutamic acid N,N-diacetic acid, tetra sodium salt; GLDA
CAS No:	51981-21-6
Chemical formula:	$C_9H_9NO_8Na_4$
Molecular weight:	351.1 g/mol

Ecological footprint

Dissolvine® GL is based on the food-approved natural amino acid salt, monosodium L-glutamate (MSG). MSG is produced by biochemical conversion of vegetable material (such as sugar beet waste). This results in a good biological breakdown as is confirmed by the Closed Bottle biodegradability test (OECD 301D).

The greener nature of Dissolvine® GL, compared to a well-known chelate such as EDTA has also been quantified using internationally accepted standards:

- A biobased content analysis using ASTM-D6866 executed by a third party confirms the green nature of Dissolvine GL. The measured mean biobased content of 53 percent is very close to the theoretical percentage of green carbon atoms in GLDA, i.e. the ones derived from vegetable MSG. These account for 5 out of a total of 9 carbon atoms.

Table 1: Dissolvine® GL Product Characteristics

Product name	Dissolvine® GL-38	Dissolvine® GL-47-S	Dissolvine® GL-PD-S
Chemical formula	GLDA-Na_4	GLDA-Na_4	GLDA-Na_4
Physical form	liquid	liquid	solid
Appearance	clear liquid	clear liquid	white to off white powder
Odor	slightly ammonia like	slightly ammonia like	odorless
NTA (wt %)	< 2.5	< 0.10	< 0.20
Assay (wt %)*	38.0 min	47.4 min	80.0 min
pH (1% wv aqueous solution)	11.0 – 12.0	11.0 – 12.0	11.0-12.0
Liquid density** (kg/m3)	approx. 1330	approx. 1400	-
Poured bulk density (kg/m3)	-	-	approx. 650
Viscosity** (mPa.s)	approx. 41	90-150	-
Freezing point (°C)	< -15	< -15	-
Solubility in water** (g/l water)	miscible in all ratios	miscible in all ratios	approx. 1000
Solubility in water at low pH** (wt%)	miscible in all ratios	miscible in all ratios	> 25
Solubility in Ethylene Glycol** (wt%)	miscible in all ratios	miscible in all ratios	approx. 45
Solubility in 5M NaOH** (wt%)	miscible in all ratios	miscible in all ratios	approx. 60
COD (mg/g)	280 – 310	345-385	590-655

* based on Fe-sequestering capacity; ** at 20°C

- According to to the Bra Miljöval protocol drawn up by the Swedish Society for Nature Conservation (SSNC), 86 percent of Dissolvine GL® is based on renewable resources, a much higher proportion in comparison with other chelating agents. See figure 1.

- An Eco-Efficiency Analysis (EEA) conducted on a variety of alternative chelating agents concluded that GLDA is the most environmentally benign chelating agent. The EEA assessed the ecological and economic profiles of alternative systems delivering the same customer benefits. The references to external publications for the EEA analysis are SOFW (10-2009), Inform (10-2009) and SPC (11-2009).

Dissolvine® GL is a shining example of a sustainable, innovative material that can add value to your product. It offers added value from an economic and ecological perspective and is therefore classified as an eco-premium solution.

3. Chemical and physical properties

Table 1 lists the major chemical and physical properties of the Dissolvine® GL product range. Dissolvine® GL-38 and Dissolvine® GL-47-S are standard multi-purpose liquid chelating agents. Dissolvine® GL-PD-S is a spray dried equivalent of the liquid product, Dissolvine® GL-47-S, which is convenient for the preparation of highly concentrated formulations (solid or liquid). This solid product readily dissolves in water to yield a clear, slightly yellow, liquid, is hygroscopic and should be stored in closed bags or containers until it is used.

Co-granule

A GLDA co-granule is now available in various forms (coated and uncoated). This product offers improved handling properties. Please contact your local sales representative for more details.

Liquid density

The density of the liquid can be used as a quick reference to check the concentration of the material. See Figure 2.

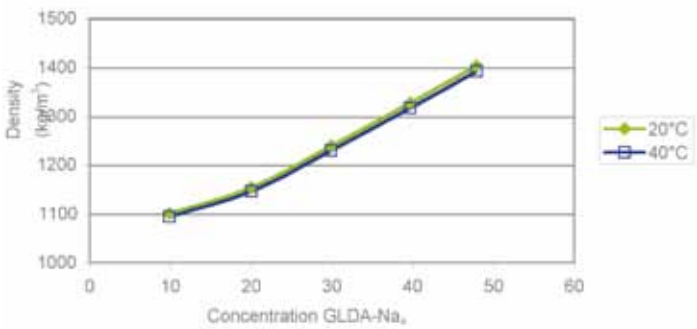


Figure 2: Density of Dissolvine® GL plotted against concentration at different temperatures.

Viscosity

Viscosity is an important parameter for handling products and depends on concentration and temperature. Figure 3 shows the viscosity of various concentrations of tetra sodium GLDA solutions as a function of temperature based on Dissolvine® GL-PD-S

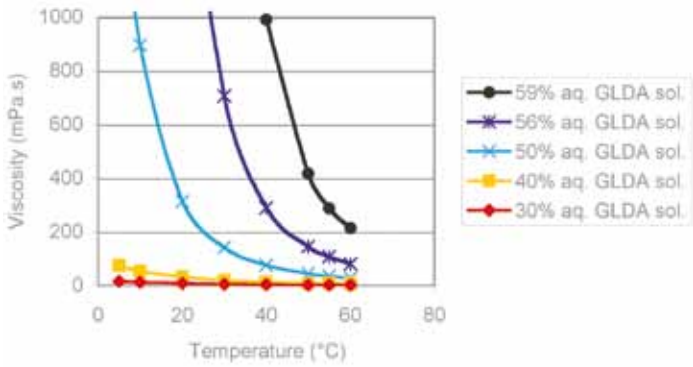
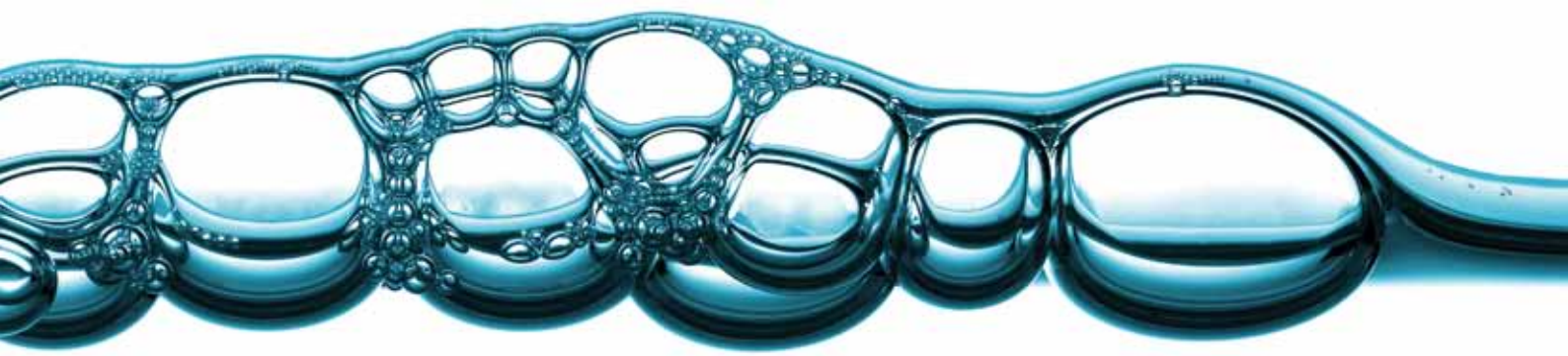


Figure 3: Graph of the viscosity of various concentrations of Dissolvine® GL at different temperatures, using GL-PD-S as starting material



Solubility

Dissolvine® GL (GLDA) has a high water solubility over a wide pH range (see Figure 4), which is much higher than the classical chelates EDTA and NTA. Dissolvine® GL also has a high solubility in sodium hydroxide based systems. Tests with GLDA-Na4 have shown much higher solubility compared to products such as EDTA and NTA sodium salts of (see Figure 5). Good solubility is an important property in cleaning products as it enables formulators to make highly concentrated products, which reduces packaging and transport cost and contributes positively to conserving the planet.

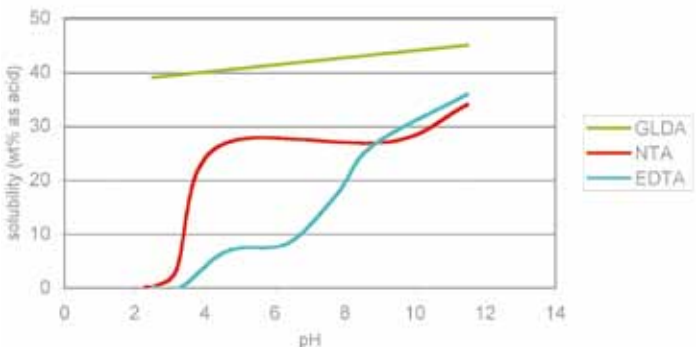


Figure 4: Solubility of chelating agents, expressed as their acids, in water at various pH levels

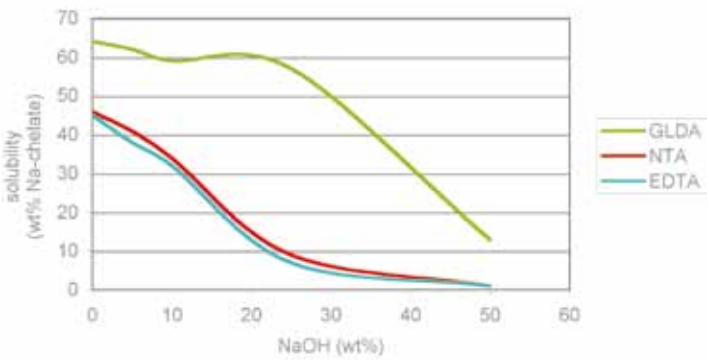


Figure 5: Solubility of chelating agents in concentrated sodium hydroxide solution.

Thermal stability

Like most Dissolvine® aminopolycarboxylates, Dissolvine® GL is very stable under both acid and alkaline conditions. This is a prerequisite for stable formulations based on Dissolvine® GL.

The thermal stability of the GLDA-Na_4 powder has been determined using Thermal Gravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). Dissolvine® GL solid loses all its water (10-15%) at temperatures around 200°C and starts to decompose at temperatures above 300°C.

Experiments with aqueous GLDA solutions at temperatures of up to 170°C for 6 hours, or one week at 150°C, show that GLDA is extremely stable especially under alkaline conditions. This is confirmed by literature on the use of GLDA in circulating aqueous systems, e.g. steam generating and cooling systems (US2004/0011743).

Acid/base dissociation constants

Chelating agents are acids, which can dissociate in water to the chelate anion and x hydrogen ions (H^+). The extent of acid dissociation is expressed as the equilibrium constant pK_a. The theoretical values are shown in Table 2. From the pKa values the ion species distribution of the GLDA molecule as function of the pH can be calculated, see Figure 6.

Table 2: The acid dissociation constants (pK_a)* for GLDA, NTA and EDTA.

	GLDA	NTA	EDTA
pK_{a1}	9.4	9.7	10.2
pK_{a2}	5.0	2.5	6.2
pK_{a3}	3.5	1.8	2.7
pK_{a4}	2.6	1.0	2.0
pK_{a5}	not available		1.5
pK_{a6}			0.0

* A.E. Martell, R.M. Smith, NIST Critically selected stability constants of metal complexes (NIST standard reference database 46, Version 7.0, 2003)

pK_a values: as determined at an ionic strength of 0.1M and at a temperature of 25°C, or if not available at 20°C.

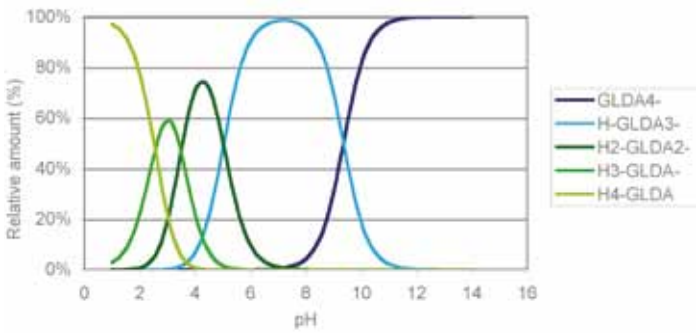


Figure 6: The ion species distribution for GLDA

Table 3: Sequestering values (mg/g product) Dissolvine® GL (GLDA), Dissolvine® A-40 (NTA) and Dissolvine® E-39 (EDTA) for several metal ions and $CaCO_3$.

Product	Assay (wt%)	$CaCO_3$	Ca^{2+}	Cu^{2+}	Fe^{3+}	Mg^{2+}	Mn^{2+}	Zn^{2+}
Dissolvine® GL-38	38	108	43	69	60	26	59	71
Dissolvine® GL-47-S	47	134	54	85	75	33	73	88
Dissolvine® A-40	40	156	62	99	87	38	85	102
Dissolvine® E-39	39	103	41	65	57	25	56	67

Chelating power

Chelating agents are added to products or processes to control metal ions. For example, in cleaning and personal care chelating agents are used to soften the water by complexing calcium and magnesium ions, whereas in other applications chelates are used to remove unwanted scale by complexing the scale metal ions. In an application such as metal plating, chelates are used to deliver the metal ions in just the precise form. For every application, it is important to select a chelating agent that is sufficiently strong to be able to do the job. An indication of the affinity a chelate has for a certain metal can be derived from the dissociation constants, stability constants and conditional stability constants.

The stability or equilibrium constant (K), generally expressed as log K, is an indication of the strength of the complex formed between the metal ion and the chelating agent. The higher the log K values, the more tightly the metal ion will be bound to the chelating agent and the more likely it is that the complex will be formed, see Table 4.

The pH of the system and the oxidizing nature of the environment can affect the stability and effectiveness of the chelating system. For each metal complex there is an optimum pH and an active pH range in which the metal complex is stable. The conditional stability constant (log K') is an indication of the stability of the complex as a function of the pH, see Figure 7.

Table 4: Stability constants (log K values)1 and active pH range for Dissolvine® GL (GLDA).

Metal ion	Ca^{2+}	Cu^{2+}	Fe^{3+}	Mg^{2+}	Mn^{2+}	Zn^{2+}
Log K	5.9	13.1	11.7[2]	5.2	7.6[2]	10.0[2]
Active pH range[3]	6-14	2-12[4]	2-8[4]	7-10	5-10[4]	3-12[4]

[1] A.E. Martell, R.M. Smith, NIST Critically selected stability constants of metal complexes (NIST standard reference database 46, Version 7.0, 2003); Log K values as determined at an ionic strength of 0.1M and at a temperature of 25°C.
[2] As determined by AkzoNobel; Log K values as determined at an ionic strength of 0.1M and at a temperature of 25°C.
[3] Active pH range: calculated for a hydroxide environment in de-mineralized water at 0.1 mol/l. Lower pH limit: the conditional stability constant logK' ≥ 3. Upper pH limit is based on the precipitation of the metal hydroxide; at upper pH limit the fraction chelated ≥ 95%.
[4] Upper pH limit is determined experimentally.

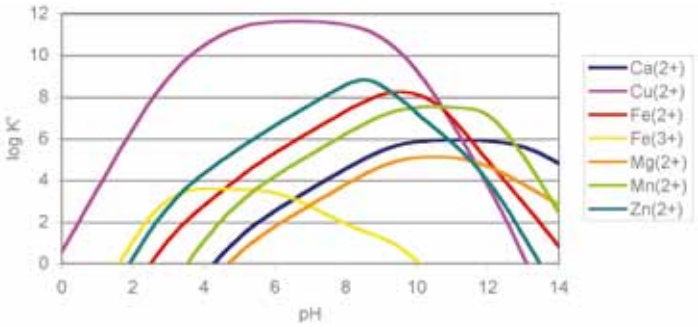


Figure 7: Theoretical curves of the conditional stability constant (log K') of GLDA for various metal ions as a function of pH (1:1 metal:chelate complex).

Experimental data show that the calcium affinity of GLDA in practical applications is much higher than would be expected based on the artificially obtained conditional stability constant (as is clearly shown in the chapter on functionalities in applications, Figure 9). A separate application leaflet (no. 291) on calcium affinity of chelates is available on request.

The quantity of chelating agent needed depends on the concentration of metal ion to be chelated and the type of chelating agent used. Dissolvine® products generally chelate on an equimolecular basis (i.e. the higher the molecular weight of the chelating agent, the higher the quantity of chelating agent required to chelate the metal ion). The chelating capacity of Dissolvine® GL -38 and GL-47-S are compared to two commonly used products in Table 3, at the top of this page.

4. Environmental and toxicological data

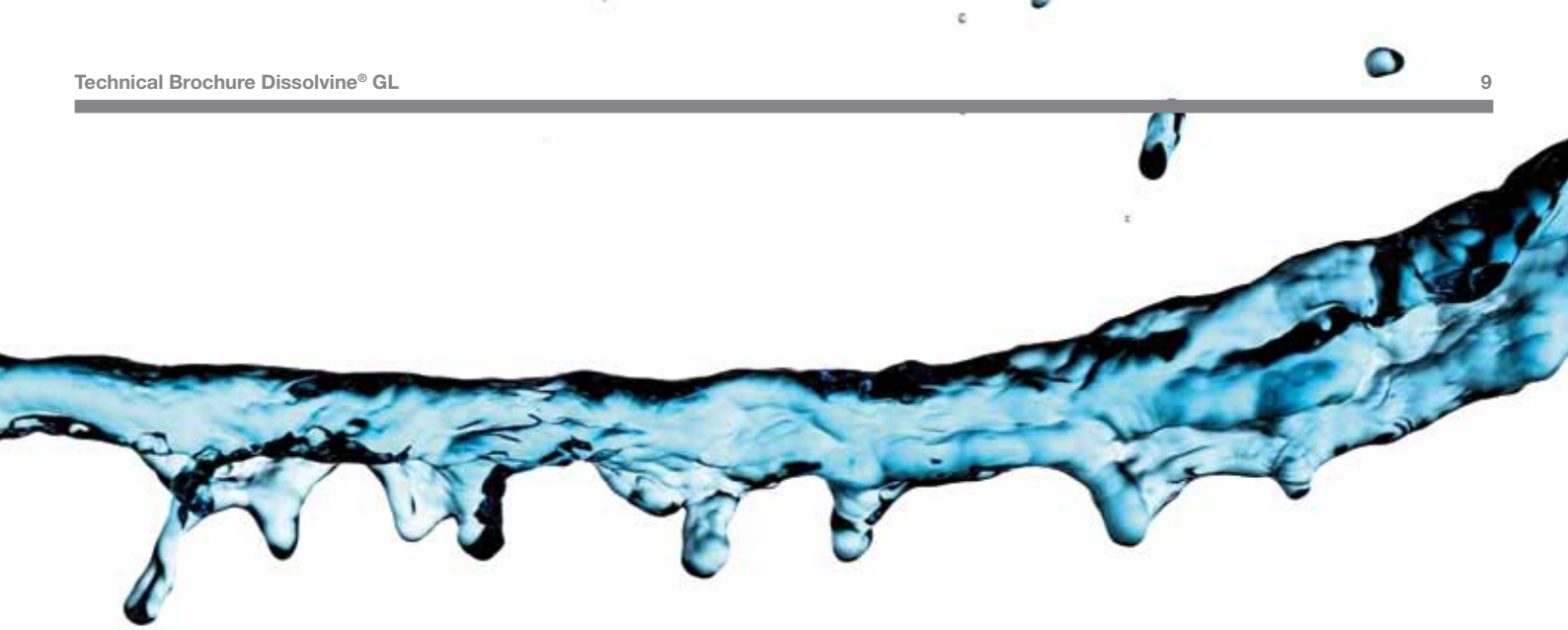
(Eco)-toxicological data

A major advantage of Dissolvine® GL is its excellent properties with regard to human toxicity and environmental acceptability. Dissolvine® GL is completely safe for man and the environment. This can be seen in Table 5, which shows test results for solid Dissolvine® GL. The entire data set on GLDA was determined under GLP and according to OECD guidelines. The latest OECD guidelines on acute toxicity (i.e. OECD 201-203) adopted a limit test at 100 mg/l of test substance. Above this limit a substance is considered to have no toxic effects.

Table 5: (Eco)-toxicological test data for Dissolvine® GL

	Method	Result
Physical chemical properties		
Partition coefficient (n-octanol/water) HPLC	OECD 117	Log $P_{ow} < 0$
Effects on biotic systems		
Algae, growth inhibition (green algae)	OECD 201	72h - NOEC ≥ 100 mg/l
Daphnia sp. acute immobilization (daphnia magna)	OECD 202	48h - NOEC ≥ 100 mg/l
Fish, acute toxicity (rainbow trout)	OECD 203	96h - NOEC ≥ 100 mg/ll
Fish, short term toxicity on embryo and sac-fry stages under flow through conditions (zebrafish)	OECD 212	NOEC = 103 mg/l
Daphnia magna reproduction (chronic toxicity)	OECD 211	NOEC ≥ 265.7 mg/l
Health effects		
Acute oral toxicity (rat)	OECD 425	LD_{50} > 2000 mg/kg bw
Acute dermal toxicity (rat)	OECD 402	LD_{50} > 2000 mg/kg bw
Acute inhalation toxicity (rat)	OECD 403	4h-LC_{50} > 4.2 g/m³ (highest attainable concentration)
Acute dermal irritation/corrosion (rabbit)	OECD 404	not irritating
Acute eye irritation/corrosion (rabbit)	OECD 405	not irritating
Skin sensitization (guinea pig)	OECD 406	not sensitizing
Repeated dose 90-day oral toxicity (rat)	OECD 408	NOAEL = 300 mg/kg bw/day
Prenatal developmental toxicity (rabbit)	OECD 414	NOAEL ≥ 300 mg/kg bw/day
Two-generation reproduction toxicity (rat)	OECD 416	NOAEL = 5000 ppm for parental toxicity (corresponding to ca. 300-400 mg/kg bw/day); NOAEL ≥ 15000 ppm for both reproduction and developmental toxicity (corresponding to ca. 900 - 1200 mg/kg bw/day; highest dose tested)
Bacterial reverse mutation (Ames test)	OECD 471	not mutagenic
In vitro mammalian chromosome aberration test (CHL cells)	OECD 473	weakly clastogenic to CHL cells in vitro
In vitro mammalian cell gene mutation test (HGPRT; CHO cells)	OECD 476	not mutagenic
In vivo mammalian erythrocyte micronucleus test (mouse)	OECD 474	not genotoxic

NOAEL= No Observed Adverse Effect Level
NOEC= No Observed Effect Concentration
bw = bodyweight



Biodegradability

Produced from naturally occurring raw materials, Dissolvine® GL is widely regarded as a good basis for micro-organisms to feed upon. Indeed, this is confirmed by the results obtained in several biodegradability studies performed with Dissolvine® GL, see Table 6.

Table 6: Biodegradability test data for Dissolvine® GL.

Biodegradability studies	Method	Result
Ready biodegradability Closed bottle test with river water	OECD 301D	83% at day 28
Ready biodegradability Closed bottle test with activated sludge	OECD 301D	76% at day 28
Biodegradability in sea water	OECD 306	78% at day 42
Inherent biodegradability; Zahn-Wellens	OECD 302B	>98% after 10 days
Simulation test-aerobic sewage treatment; Activated sludge units	OECD 303A	>95%

In ready biodegradability tests, test (OECD 301D), carried out in compliance with the principles of Good Laboratory Practice, Dissolvine® GL was biodegraded >60%* at day 28 (Table 6 and Figure 8). This product should therefore be classified as *readily* biodegradable. The level of biodegradation, which is in excess of 60%, also demonstrates that Dissolvine® GL is *ultimately* biodegradable. These results were confirmed by independent third party studies.

**Minimum 60% target < 28 days is required to allow for a product to be classed "readily biodegradable".*

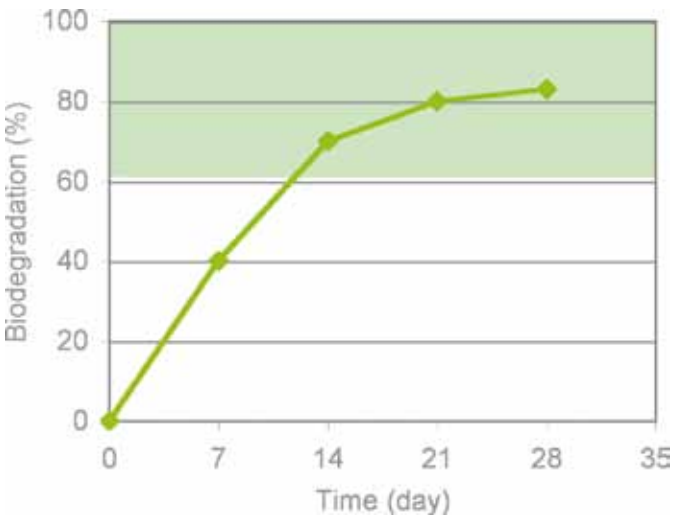


Figure 8: The biodegradability of Dissolvine® GL in a ready biodegradability test (OECD 301D) inoculated with river water

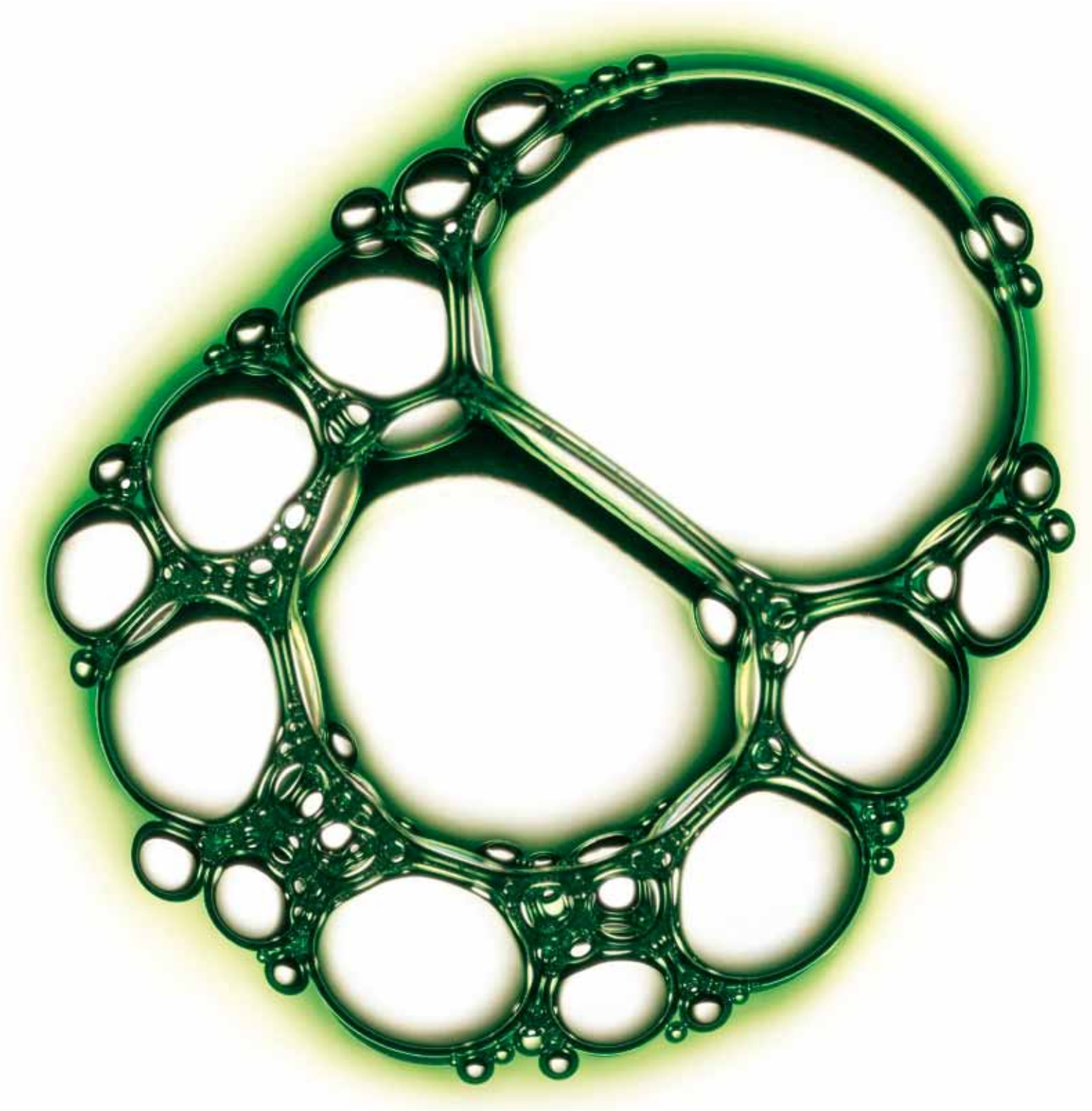
In the Closed Bottle Test Dissolvine® A-40 (NTA) is readily biodegradable as well. In contrast Dissolvine® E-39 (EDTA) degrades too slowly to permit classification as *readily* biodegradable. Dissolvine® E-39 (EDTA) is classified as *inherently* biodegradable based on a number of biodegradability tests.

A test simulating conventional activated sludge treatment (OECD 303A) was performed. In this test biodegradation was followed by specific analysis of Dissolvine® GL and by monitoring the change of dissolved organic carbon present in the effluent. At temperatures of 10 and 20°C, almost complete removal of Dissolvine® GL was obtained. Consequently, Dissolvine® GL can be treated under conditions prevailing in conventional activated sludge plants.

5. Summary

Chelate	Strong chelant?	Readily biodegradable?	Safe for man and environment?	Green nature?
EDTA	√	X	√	X
NTA	√	√	X	X
Phosphates	√	inorganic*	X **	X ***
Phosphonates	X	X	X	X
GLDA	√	√	√	√

* Inorganic material
** Eutrophication
*** Large eco footprint



6. Main functionalities in applications

Complexing hard water ions

One of the main reasons why chelates are added to a wide variety of products and processes is the complexation of hard water ions, such as calcium and magnesium. Hard water ions need to be complexed to prevent precipitation of unwanted scale and/or to allow other chemicals in the formulation, such as surfactants, to do their job properly. As most formulations or process streams contain several components the chelate has to compete for the hard water ions. In other words, it should have a higher affinity for hard water ions than the other components.

To illustrate the calcium binding efficiency of GLDA, experiments have been performed with various chelating agents and Hydroxy Naphtol Blue (HNB) as competitive chelating agent and indicator. HNB has a relatively high affinity for calcium and colors from blue to red when fully complexed to calcium. As a result, the color of a solution containing calcium ions, HNB and the chelate to be tested gives a measure for the calcium binding efficiency of the test chelate. Figure 9 compares the calcium affinity at pH=11-12 of a number of chelates. The calcium binding efficiency of GLDA is far higher than expected when measured on the basis of the (conditional) stability constant for Ca-GLDA. This means that Dissolvine® GL is the most effective biodegradable chelating agent for the complexation of hard water ions.

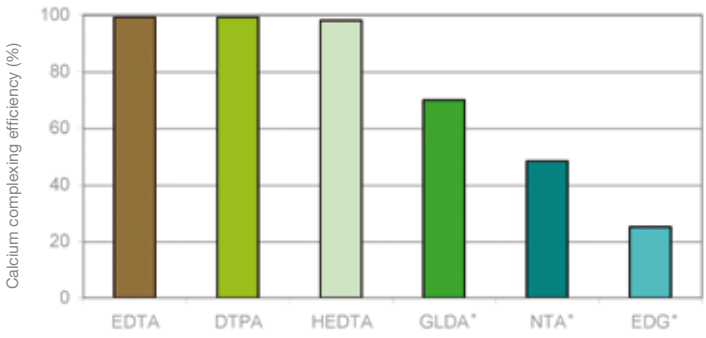


Figure 9: The calcium complexing efficiency of various chelating agents in competition with Hydroxy Naphtol Blue at pH 11-12.
* Readily biodegradable chelating agent.

Removing scales

In addition to preventing precipitation of scale Dissolvine® chelating agents are used to remove unwanted scale. The most frequently encountered scales consist of calcium, barium and iron as their carbonate, sulfate or oxide. Figure 10 compares the $CaCO_3$ dissolving capability of a variety of chelating agents. Compared to other aminopolycarboxylates, phosphonates and succinates Dissolvine® GL is the best readily biodegradable chelate for the removal of $CaCO_3$ scale.

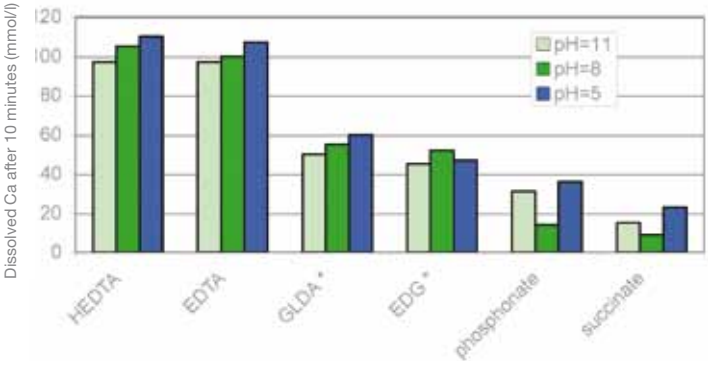


Figure 10: The dissolution of $CaCO_3$ by various chelating agents at 3 pH levels.
* Readily biodegradable chelating agent.

Removing stains

Machine dishwashing tests conducted independently have shown that GLDA is particularly effective at removing tea stains, when compared to alternative sequestrants at the same concentration in a formulation based on 7% NaOH and 11.4% sequestrant (demi-water to 100%). The test results shown in Figure 11 reveal that GLDA is superior in I&I cleaning to phosphates and citrates on a weight basis. GLDA performs better than EDTA and equal to NTA on a weight basis.

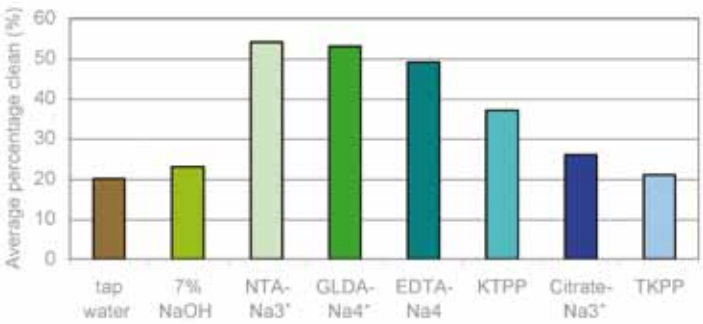


Figure 11: GLDA's ability to remove tea stains compared to alternative alkaline builders.
KTPP = Potassium tri polyphosphate; TKPP = Tetrapotassium pyrophosphate.
(From WO96/22351).
* Readily biodegradable chelating agent.

Table 7: The influence of Dissolvine® GL on a variety of preservatives against Pseudomonas aeruginosa, Aspergillus niger and Staphylococcus aureus. Additional log reduction of colony forming in a 7 day challenge test due to the addition of 0.1% GLDA.

Active ingredients	Trade products	Pseudomonas aeruginosa	Aspergilus niger	Staphylococcus aureus
Phenoxyethanol + Ethylhexylglycerine	Euxyl PE 9010*	@ 7500 ppm + log 6 reduction	@ 7500 ppm +log 4 reduction (* 0.2% GLDA)	@ 7500 ppm +log 4 reduction
Benzyl alcohol + Methylchloroisothiazolinon + Methylisothiazolinone	Euxyl K100*, Paratexin CIB Kathon CG*, Microcare CB*, Microcare IT*, Microcare ITL* Rokonsal KS-4, Rokonsal S-1	@ 500 ppm + log 1.5 reduction	No significant influence	No significant influence
Methylisothiazolinone + Ethylhexylglycerine	Euxyl K220*	No significant influence	@ 1200 ppm + log 1 reduction	No significant influence
Phenoxyethanol + Methylparaben + Ethylparaben + Propylene Glycol	Euxyl K320*, Paratexin BSB Phenonip ME, Phenonip XB Microcare MEM* Rokonsal MEP	@ 3000 ppm +log 4 reduction	No significant influence	@ 5000 ppm +log 1 reduction
Bronopol	Bioban BP-30*, Nipaguard BNPD Microcare BR*, Microcare BRP* Midpol, Bioban BP-Pharma* Myacide AS*	@ 5 ppm +log 5.5 reduction	@ 100 ppm +log 2 reduction	@ 5 ppm +log 5 reduction
Benzoic acid	Microcare SB, CA 24, CA 24 E*, Rokonsal BS	@ 100 ppm +log 5.5 reduction	@ 5900 ppm +log 3 reduction	@ 200 ppm +log 3 reduction
Imidazolinidyl urea	Paratexin IU, Nipa Biopure*	@ 500 ppm +log 4 reduction	@ 4000 ppm +log 1.5 reduction	@ 250 ppm +log 4 reduction

* signifies that this is a registered trademark of a third party

When only comparing readily biodegradable chelates for the removal of various stains, it was found that GLDA scores slightly better in household automatic dishwashing than the alternative products on a weight basis. The formulations had a neutral pH and contained 5wt% sequestrant. The result is given in Figure 12.

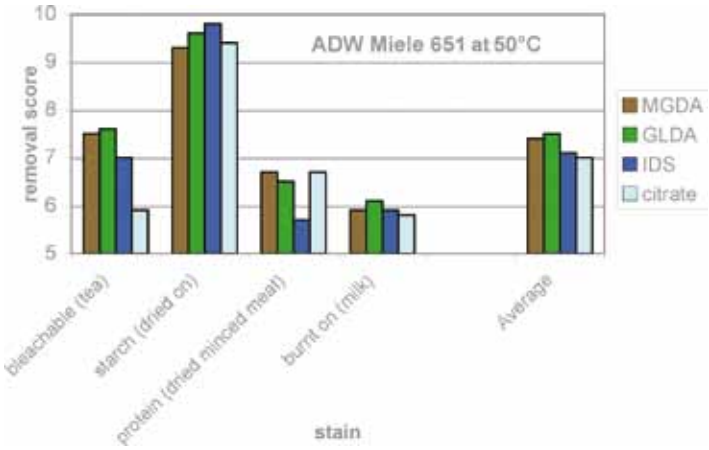


Figure 12: Stain removal performance of GLDA compared to alternative biodegradable sequestrants. (From WO2007/052064)

Enhancing the effect of preservatives

Chelates are often added to personal care products to improve shelf life. They are used, for example, to prevent rancidity occurring in fatty products by complexing trace amounts of metals, to complex hard water ions, or to boost the effect of other ingredients such as preservatives. All Dissolvine® GL products are fully compliant with the European Cosmetics Directive and its amendments and adaptations (latest update 16 April 2009) including the 7th amendment.

The results of the challenge test are illustrated in Figure 13 using Bronopol as preservative. The results of all the experiments are summarized in Table 7. Dissolvine® GL has no biocidal properties, but it can boost the effectiveness of preservatives and in doing so reduce the amount of preservative needed to achieve the desired effect. This ability to boost has been proven in gram negative bacteria, gram positive bacteria and mold, and for a variety of preservatives.

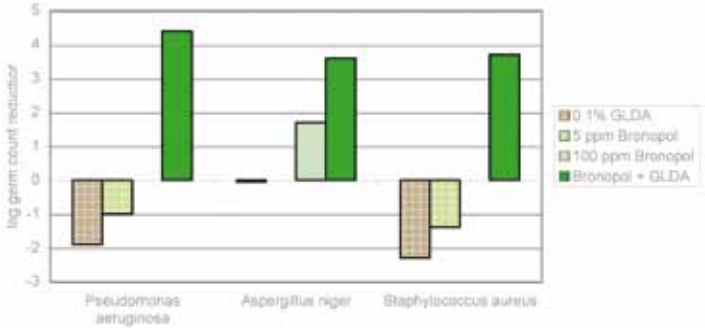


Figure 13: The influence of GLDA on Bronopol. The chequered areas indicate conditions with germ growth, whereas the solid bars represent conditions with germ reduction.

Enhancing the effect of biocides

Dissolvine® GL is particularly suited for this application as it is more effective than EDTA when measured by the European standard 1276 (June 1997) test for bactericidal activity. As a formulation it meets the criteria for designation as a green label. The criterion to pass the test is a log 5 reduction in bacterial activity within 5 minutes. The results for the gram negative bacteria Pseudomonas aeruginosa in a hard water environment (17°dH) are presented in Figure 14. By comparison, a smaller quantity of GLDA is required to obtain the equivalent biocidal activity.

Similar positive effects on GLDA on the activity of biocides against gram negative bacteria, gram positive bacteria and fungi are described in patent number EP0683978. Chelates appear to remove calcium and magnesium ions present in the membrane of the bacterial cells, thereby increasing the permeability of the membrane to biocides. One unexpected effect is GLDA's greater ability to provide a boost compared to NTA or EDTA.

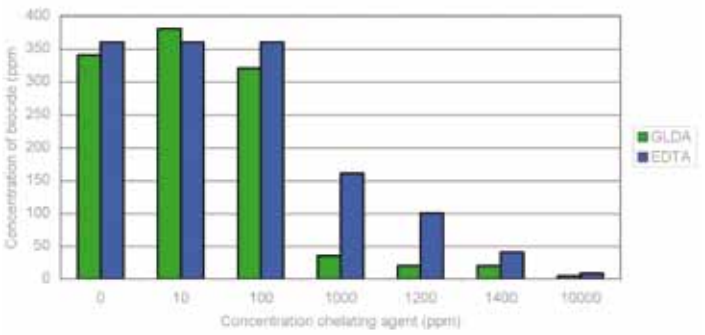
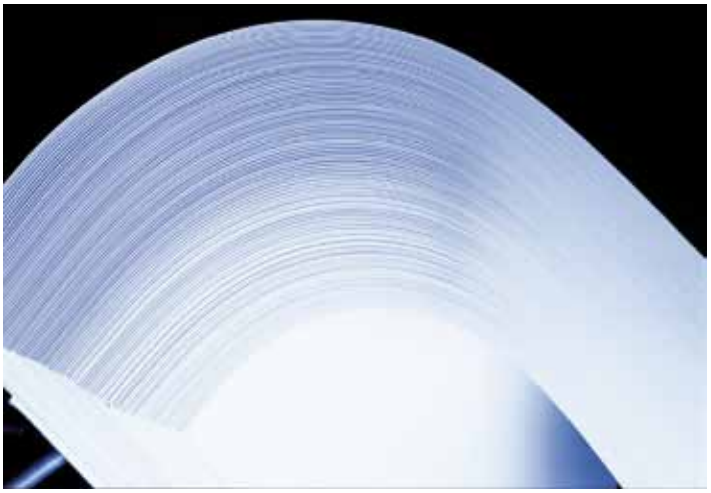


Figure 14: The influence of EDTA and GLDA on the biocidal activity of Arquad® MCB-50 against Pseudomonas aeruginosa.

7. Application areas:



Household cleaning
- Automatic dishwashing
- Laundry detergents
- Hand dishwashing
- Surface cleaning

Industrial cleaning
- Mechanical dishwashing
- Cleaning in place
- Transport cleaning
- Hard surface cleaning
- Laundry detergents
- Biocidal detergents
- Metal cleaning

Gas sweetening

Metal plating and electronics

Oil industry

Personal care & cosmetics
- the INCI names are:
  - Tetrasodium glutamate diacetate
  - Tetrasodium Dicarboxymethyl Glutamate

Polymer production

Printing ink

Pulp and paper

Textiles

Dissolvine® GL
The greener chelate

Dissolvine® GL
The greener chelate

Further information

For more detailed product information please refer to the separate product leaflets. For samples, technical service and further information, please contact your nearest AkzoNobel Office or agent, or visit our website at **www.dissolvinegl.com**

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