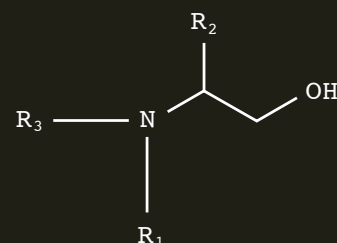
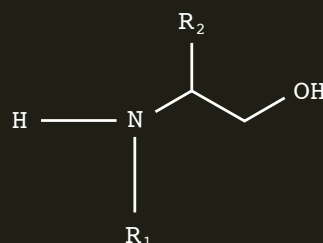


for tomorrow's
Technology



CODIS™ 95

Neutralising Alkanol-Amines
Co-Dispersant



for tomorrow's

World

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1. Introduction

Amines are used in emulsion polymerisation to provide mechanical stability of resultant dispersions and also in coatings manufacture to assist with pigment dispersion, grind stability if dispersing pigments into polymer dispersion and also pH buffering of dispersion coatings.

Ammonia is the most commonly used amine, being low cost, but is highly odorous and has high volatility resulting in pH instability. To overcome these disadvantages formulators have looked at successfully incorporating various Alkanol-amines. In addition to lower volatility and lower odour, these Alkanol-amines also allow superior corrosion resistance, VOC reduction in formulation, excellent pH buffering and very good pigment dispersion properties.

After application of the wet coating, the pH-adjusting agent MUST, at least partially, evaporate from the film in order to promote the coalescence of the resin binders and to avoid poor early water resistance.

ADDAPT Chemicals BV now markets CODIS™ 95, a proprietary blend of Alkanol-amines with an active content of 90%. This is a colourless liquid with a low viscosity, that remains liquid at temperatures below -10 °C and withstands >5 freeze/thaw cycles at -15 °C.

2. Typical properties CODIS™ 95

ADDAPT® CODIS™ 95 is a proprietary blend of Alkanol-amines in water. All constituents are EINECS; TSCA; ENCS; AICS; DSL; ECL and PICCS registered.

Appearance	Clear, colourless fluid
Colour (max.)	15 Hazen
Active content	90%
Water content	9.5 - 10.5%
Viscosity at 25 °C (#2 @ 20 rpm) at 5 °C	< 250 mPa.s < 750 mPa.s
Freezing point	< -10 °C
Freeze/Thaw stability	> 5 cycles @ -15 °C
Flashpoint	> 100 °C (DIN/ISO 2592)
pH (0.1 M aqueous solution, 20 °C)	12.0 - 14.0
Density at 20 °C	1.05 - 1.10 g/cm ³

3. Performance benefits CODIS™ 95

ADDAPT® CODIS™ 95 exhibit benefits such as:

- Highly efficient co-Dispersant
- Very efficient pH-buffer
- Excellent early water resistance
- Efficient Agent for Resin neutralisation
- Low Odour
- Completely water soluble
- Non-yellowing
- Enhances wet scrub resistance
- Medium volatility
- Good emulsifying properties
- Effective CO₂ scavenger
- In-can corrosion protection
- Does not cause Cobalt leaching
- Allows emulsification of > 17.5% water in solvent based Alkyd paints

4. FDA-status

CODIS™ 95 is in compliance with FDA regulations for direct and indirect food contact:

Section 175.105; Section 176.170 and 176.180 and Section 175.300.
Additional information about other clearances is available on request.

5. Performance – Water based systems

5.1 Amine comparison – primary/secondary

Amine	Composition	Comments
CODIS™ 95	Blend of Alkanol-amines in water	Non-secondary Amines
AMP 95	2-amino-2-methyl-1-propanol	Primary Amine
ADVANTEK	2-(n-Butylamino)ethanol	Secondary Amine
Spot 8040	Formulated alkanolamine 97%	Non-Secondary Amine
Ammonia	NH ₃	Primary Amine

5.2 Yellowing

To test for yellowing CODIS™ 95 was put in a beaker glass and exposed to air at room temperature. No change in colour was observed over a period of 2 month.

Further CODIS™ 95 was added at a level of 0.5% to neat Styrene/Acrylic; Acrylic; VA/Acrylic and VA/VEOVA emulsions. Samples were stored at 50 °C for 1 month. Again no discernible yellowing was observed.

5.3 Cobalt leaching

The leaching of Cobalt from tungsten-carbide tools can shorten tool life and the presence of Cobalt in the used fluid can lead to dermatitis and/or inhalation problems for exposed workers as well as cause problems in waste water disposal. CODIS™ 95 exhibits minimal Cobalt leaching.

5.4 Nitrosamine formation

Nitrosamines and especially ***N-Nitrosamines*** are considered to be very ***carcinogenic***.

Secondary (Alkanol)-amines are the most potent to form N-Nitrosamines. These N-Nitrosamines are readily formed by the reaction of secondary (Alkanol)-amines with Nitrites or Nitrogen Oxides.

Germany instituted regulations in the 1990's that prohibited the use of secondary amines in metalworking fluids. Both primary and tertiary amines can be used in metalworking formulations and metal primers with little risk of Nitrosamine build-up.

5.5 Wet Adhesion – Early water resistance

Since the introduction of AMP 95, other Alkanol-amines have entered the market place – all claiming to have performance benefits. These Alkanol-amines, along with ammonia, were assessed for film resistance properties in Revacryl DP5530 (ex-Synthomer).

5.5.1 Amines evaluated

Amine	Composition	Comments
CODIS™ 95	Blend of Alkanol-amines in water	Low odour, medium volatility
AMP 95	2-amino-2-methyl-1-propanol	Low odour, slow volatility
ADVANTEX	2-(n-Butylamino)ethanol	Slow odour, very slow volatility
Spot 8040	Blend of non-secondary amines in water	Strong odour, slow volatility
Ammonia	NH ₃	Strong odour, fast volatility

5.5.2 Experimental

Each amine was added at 0.2% addition level to neat Revacryl DP5530 (ex-Synthomer). Films were then applied at 100 microns wet film thickness onto degreased cold rolled steel panels. Panels were dried for 15 minutes at 60°C then 16 hours at room temperature. Panels were then soaked in tap water for 48 hours. On removal from water, panels were patted dry and a Cross Hatch Adhesive Tape Pull-Off test performed.

5.5.3 Results

Amine	Wet adhesion (% film removed)
CODIS™ 95	0
AMP 95	100
ADVANTEX	60
Spot 8040	100
Ammonia	0

5.5.4 Discussion

It is evident that amine choice has a major effect on wet adhesion of the polymer film onto cold rolled steel in this instance. Excellent results were obtained with Ammonia and CODIS™ 95. It is believed this is due to volatility of each amine under test, with lower volatility amines still being present in the film and imparting water sensitivity, in combination with a function of neutralisation of carboxylic groups present in the polymer.

Also due to its low odour and no discolouration, CODIS™ 95 is the preferred choice of neutralising amine.

6. Performance – Solvent based systems

The ability to incorporate high levels of water in solvent based Alkyd paints is shown in the following section where the performance of CODIS™ 95 is compared with a well known competitive product.

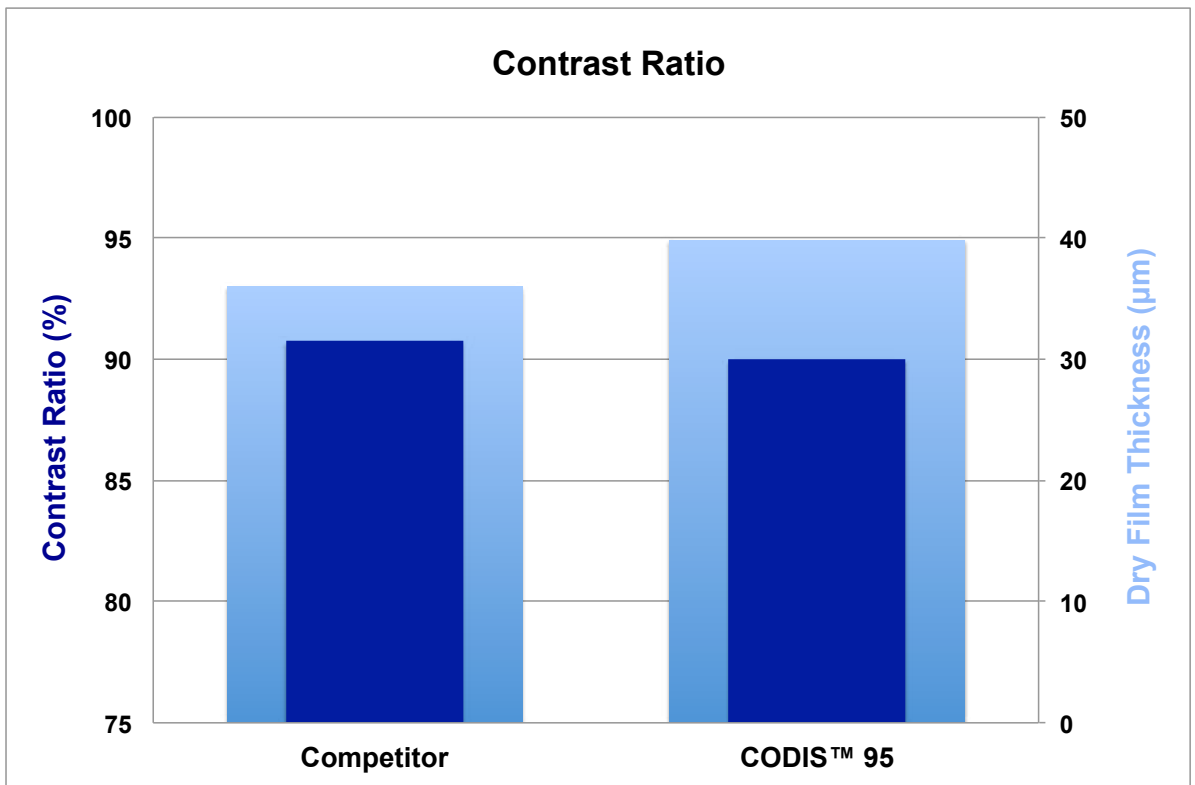
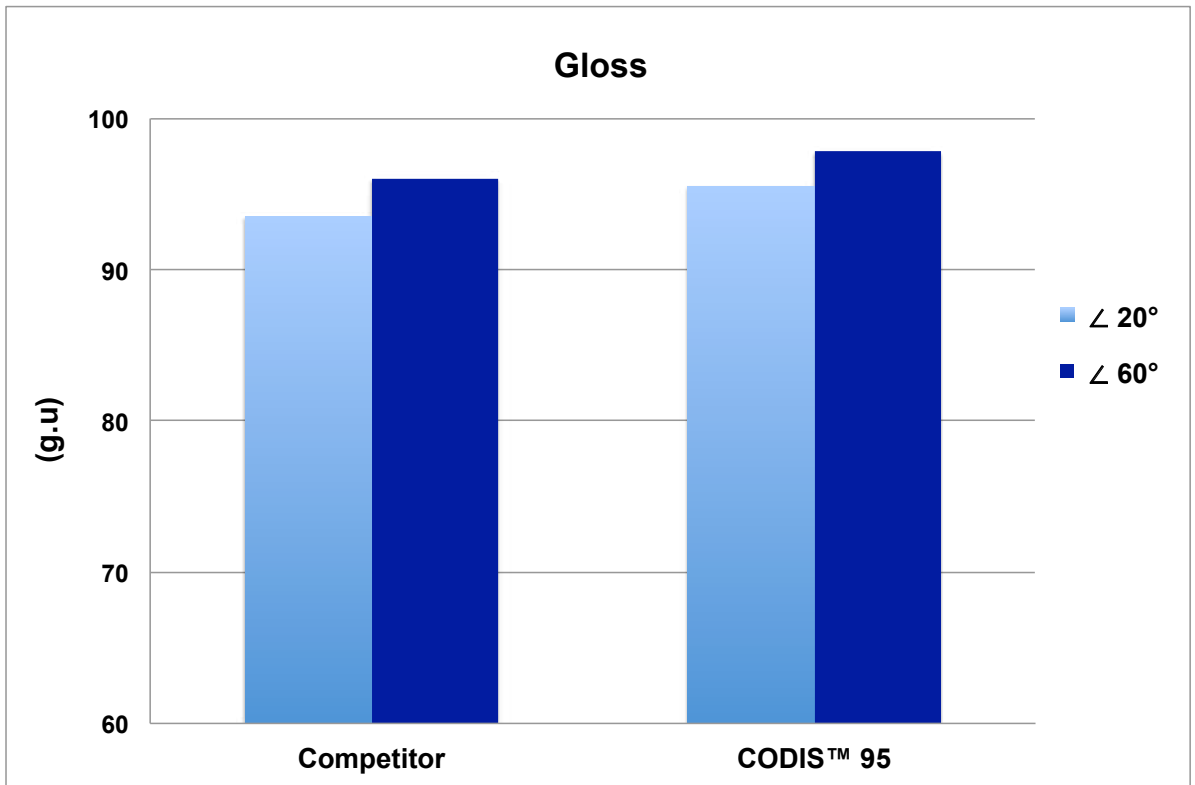
6.1 Solvent based ALKYD paint – Test formulation

Component	Competitor	CODIS™ 95
Polikyd AS 652/75D*	37.10	37.10
Bentone SD-1	0.10	0.10
Disperbyk 108	0.45	0.45
Titanium Dioxide R-706	28.90	28.90
Calcium Octoate 5%	1.30	1.30
Cobalt Octoate 2%	1.05	1.05
Zirconium Octoate 6%	1.35	1.35
White Spirits (Solvent D40)	8.80	8.35
Xylene	3.05	2.05
Anti-Skinning agent (MEKO)	0.25	0.25
Competitor	0.15	---
CODIS™ 95	---	0.15
Water	17.50	18.95
Total	100.00	100.00
* Resiquimica		

Characteristics	Competitor	CODIS™ 95
Initial Flow time at 23°C (s)		
Stormer at 23°C (KU)	82.8	80.0
Solvent for viscosity adjustment to 80 KU (%)	0.4	---
Viscosities can		
Stormer at 23°C (KU)	80.0	80.0
Solids content (%)	58.4	57.8
Density at 23°C	1.210	1.208
Solvent for viscosity adjustment to DIN4 70s (%)	3.0	3.3
Viscosities for application by brush		
DIN4 23°C (s)	74	72
Theoretical VOC (g/l)	299	299

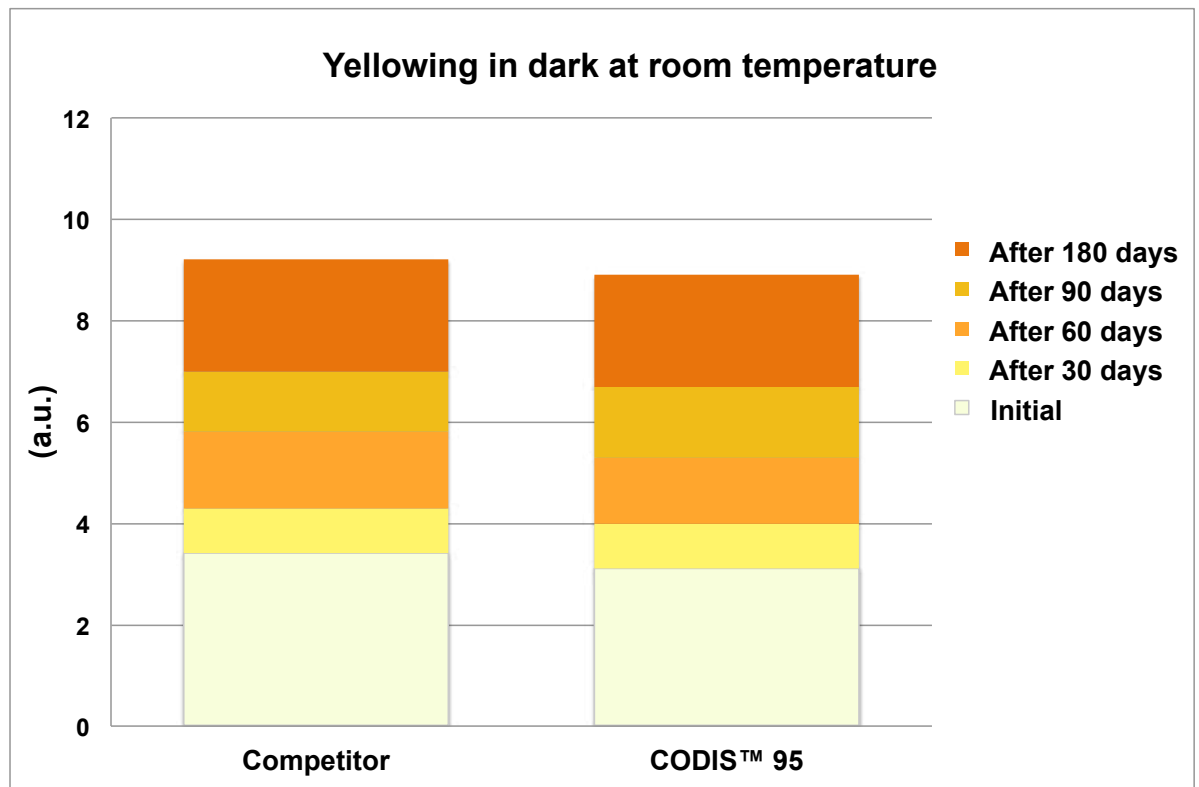
6.2 Gloss development and contrast ratio

Incorporation of this amount of water using CODIS™ 95 versus this well known competitor results in higher gloss levels both at $\angle 20^\circ$ and $\angle 60^\circ$ whereas the contrast ratio is higher at somewhat lower film thickness.



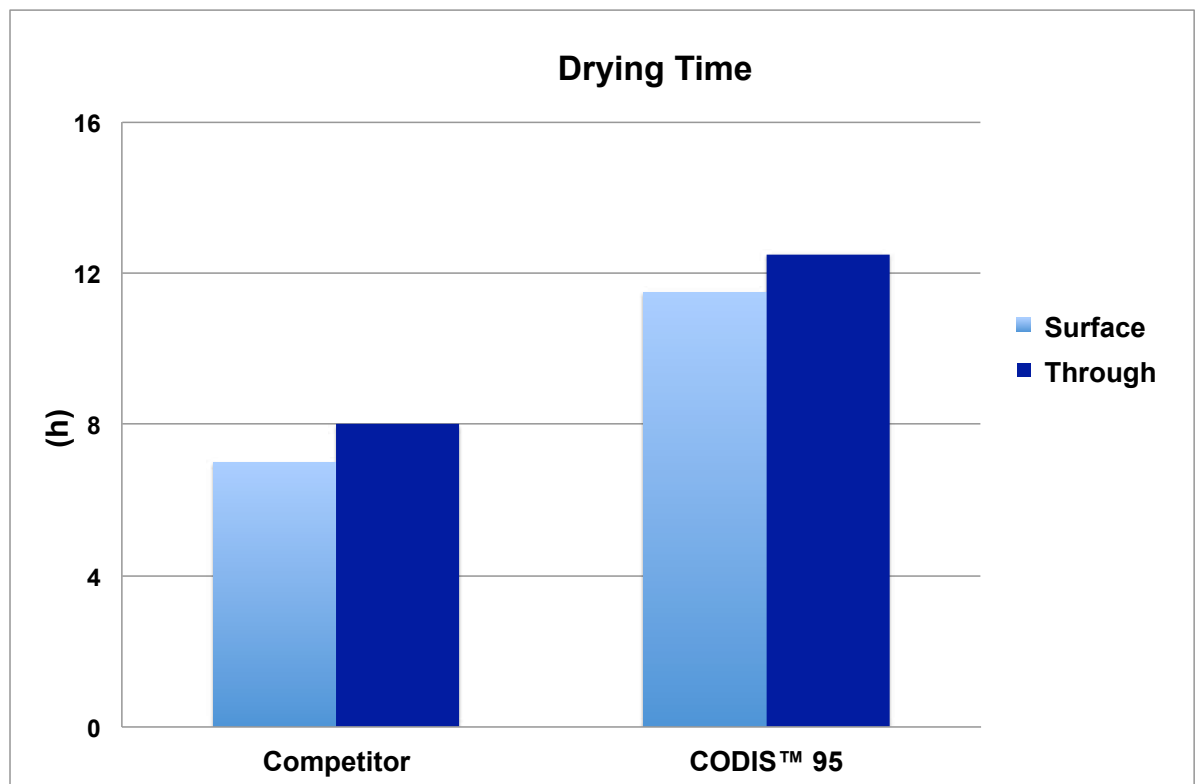
6.3 Yellowing in the dark

Upon aging in the dark CODIS™ 95 is less susceptible to yellowing compared to the competitor (see graph below). A similar trend is observed at 60 °C.



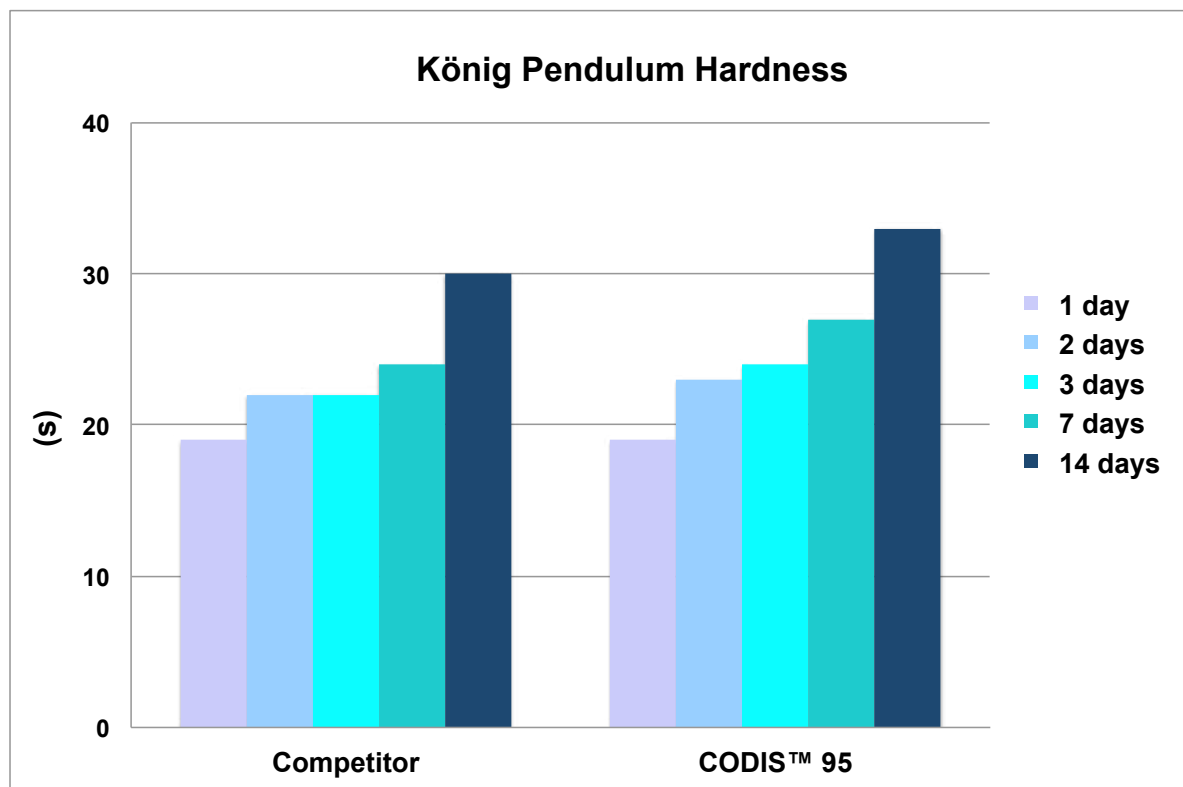
A prolonged drying time was observed for CODIS™ 95 which is mainly due to the slower evaporation rate and also inherent to a non-optimised formulation.

6.4 Drying time



6.5 König Pendulum Hardness

Remarkably however, the development of the König Pendulum Hardness was positively affected by CODIS™ 95 in comparison with the competitive product.



7. Health, Environmental and Safety issues

For several Alkanol-amines the Labelling and some physical data were compared.

Amine	Labelling	pH (5%)	pK _a (25 °C)	Flashpoint	R-phrases
CODIS™ 95	C	11.7	9.54	> 100 °C	R: 20/21/22 - 34
AMP 95 (*)	Xi (**)	12.0	10.02	67.0 °C	R: 36/37/38 - 52/53
ADVANTEKX	C	11.9	10.00	90.6 °C	R: 22 - 34
Spot 8040	C F	11.2 @ 0.1N		50.1 °C	R: 10-20/21/22 - 34
Monoethanolamine	C (**)	12.1	10.03	99 °C	R: 20/21/22 - 34
Ammonia	C N	>13	NE	NA	R: 34 - 50

Despite having the lowest pH and pK_a-value, CODIS™ 95 was labelled C (corrosive).

“...with strong alkaline substances showing high pH values, due to strong irritation, a critical effect can be expected on human tissue. This is expected to be comparable with strong alkaline substances like NaOH...”

Environmental information

ADDAPT™ CODIS 95 is expected to partition (preferentially locate) in water when released to the environment. Because of its water solubility and reactivity with other compounds, CODIS™ 95 biodegrades rapidly and is not likely to bioaccumulate in the aquatic food chain. Studies on a wide variety of freshwater fish show that CODIS™ 95 has very low toxicity to fish.

Literature

- (*) - Ausschuss für Gefahrstoffe- AGS-Geschäftsführung-BAuA- www.baua.de - Begründung zu 2-amino-2-methylpropanol in TGRS 900 - Ausgabe: Januar 2006
- (**) - See also (*) - page 16
Greim, H - 1996 - Gesundheitsschädliche Arbeitsstoffe, Toxikologisch-arbeitsmedizinische Begründungen von MAK-Werten, Loseblattsammlung, 22 Lfg. DFG, Deutsche Forschungsgemeinschaft, VCH Verlag Weinheim, 1966.

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