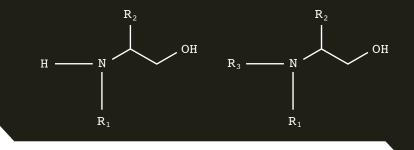


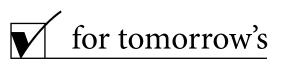




for tomorrow's Technology



# **CODIS<sup>™</sup> 95 & CODIS<sup>™</sup> BIO** Neutralizing Agents



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 either, at least partially, evaporate from the film in order to promote the coalescense of the resin binder and to avoid poor early water resistance or become completely inert in the resulting coating film.

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

Additionally ADDAPT® Chemicals BV markets CODIS<sup>™</sup> BIO, a multifunctional neutralizing agent for Ecolabel certified paints. It enhances compatibility with pigments, wetting and flash rust inhibition. It is based on renewable components, VOC/SVOC free and without hazardous labelling.

## 2. Typical properties CODIS<sup>™</sup> 95 & CODIS<sup>™</sup> BIO

ADDAPT® CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO are proprietary blends containing Alkanol amines in water. All constituents are EINECS, TSCA, ENCS, AICS, DSL, ECL and PICCS registered.

|                                 | CODIS™ 95                     | CODIS™ BIO                    |
|---------------------------------|-------------------------------|-------------------------------|
| Appearance                      | Clear, colourless liquid      | Clear, colourless liquid      |
| Colour (max.)                   | 15 Hazen                      | 25 Hazen                      |
| Active content                  | 90%                           | < 55%                         |
| Water content                   | 9.5 - 10.5%                   | 45.5 - 47.5%                  |
| Freezing point                  | < -10°C                       | < -10°C                       |
| Freeze/Thaw stability           | > 5 cycles @ -15°C            | > 5 cycles @ -15°C            |
| pH (1% aqueous solution, 25 °C) | < 11.3                        | < 10                          |
| Density at 25 °C                | 1.05 - 1.10 g/cm <sup>3</sup> | 1.12 - 1.17 g/cm <sup>3</sup> |

# 3. Performance benefits CODIS<sup>™</sup> 95 & CODIS<sup>™</sup> BIO

| CODIS™ 95  | CODIS™ BIO                                     |
|--|--|
| <ul> <li>Very good, cost efficient pH-buffer</li> </ul>                                    | Very efficient neutralizing agent              |
| <ul> <li>Cost efficient Co-dispersant</li> </ul>   | Improves tinting strength                      |
| <ul> <li>Enhances wet-scrub resistance</li> </ul>  | <ul> <li>Improves storage stability</li> </ul> |
| <ul> <li>Excellent early water resistance</li> </ul>                                       | Improves open-time                             |
| <ul> <li>In-can corrosion protection (flash rust)</li> </ul>                               | In-can corrosion protection (flash rust)       |
| Low odour  | No odour                                       |
| <ul> <li>Low VOC - medium volatility</li> </ul>  | No VOC/SVOC                                    |
| Non-yellowing  | Non-yellowing                                  |
| • Effective CO <sub>2</sub> scavenger  | <ul> <li>&gt; 75% biodegradable</li> </ul>     |
| <ul> <li>Very good emulsifying properties</li> </ul>                                       | Aerobic and anaerobic biodegradable            |
| <ul> <li>Allows emulsification of &gt; 17.5% water in<br/>solvent based systems</li> </ul> | • LABEL FREE!                                  |

## 4. FDA-status

CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO are 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

| Amine      | Composition                      | Comments                        |
|------------|----------------------------------|---------------------------------|
| CODIS™ 95  | Blend of Alkanol-amines in water | Non-secondary Amines            |
| CODIS™ BIO | Proprietary blend                | Tertiary Amines                 |
| AMP 95     | 2-amino-2-methyl-1-propanol      | Primary amine - < 7% sec. amine |
| ADVANTEX   | 2-(n-Butylamino)ethanol          | Secondary Amine                 |
| Ammonia    | NH <sub>3</sub>                  | Primary Amine                   |

#### 5.1 Amine comparison – primary/secondary/tertiary

#### 5.2 Yellowing

To test for yellowing CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO were 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<sup>™</sup> 95 and CODIS<sup>™</sup> BIO were 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<sup>™</sup> 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).

| Amine      | Composition                      | Comments                         |
|------------|----------------------------------|----------------------------------|
| CODIS™ 95  | Blend of Alkanol-amines in water | Low odour, medium volatility     |
| CODIS™ BIO | Proprietary formulation in water | No odour, non volatile           |
| AMP 95     | 2-amino-2-methyl-1-propanol      | Low odour, slow volatility       |
| ADVANTEX   | 2-(n-Butylamino)ethanol          | Slow odour, very slow volatility |
| Ammonia    | NH <sub>3</sub>                  | Strong odour, fast volatility    |

#### 5.5.1 Amines evaluated

#### 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                            |
| 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<sup>™</sup> 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.

## 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<sup>™</sup> 95 is compared with a well known competitive product.

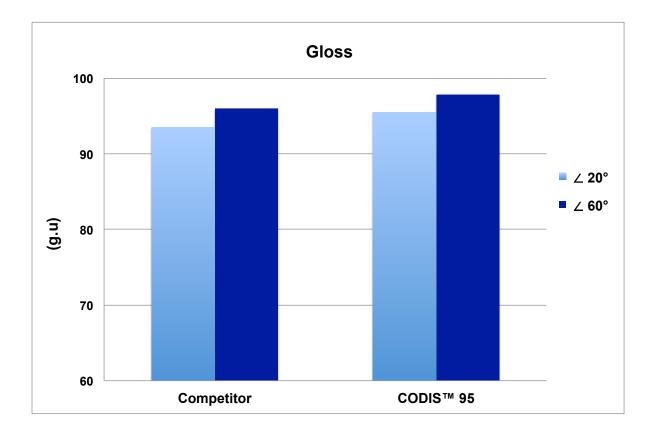
| Component                   | Competitor | CODIS™ 98 |
|-----------------------------|------------|-----------|
|                             |            |           |
| Polikyd AS 652/75D*         | 37.10      | 37.10     |
| Bentone SD-1                | 0.10       | 0.10      |
| Disperbyk 108               | 0.45       | 0.45      |
| Titanium Dioxide R-706      | 28.90      | 28.90     |
| Calcium Octoate 5%          | 1.30       | 1.30      |
| Cobalt Octoate 2%           | 1.05       | 1.0       |
| Zirconium Octoate 6%        | 1.35       | 1.3       |
|                             |            |           |
| White Spirits (Solvent D40) | 8.80       | 8.3       |
| Xylene                      | 3.05       | 2.0       |
| Anti Skipping agent (MEKO)  | 0.25       | 0.2       |
| Anti-Skinning agent (MEKO)  | 0.25       | 0.23      |
| Competitor                  | 0.15       |           |
| CODIS™ 95                   |            | 0.1       |
| Water                       | 17.50      | 18.9      |
| Total                       | 100.00     | 100.00    |

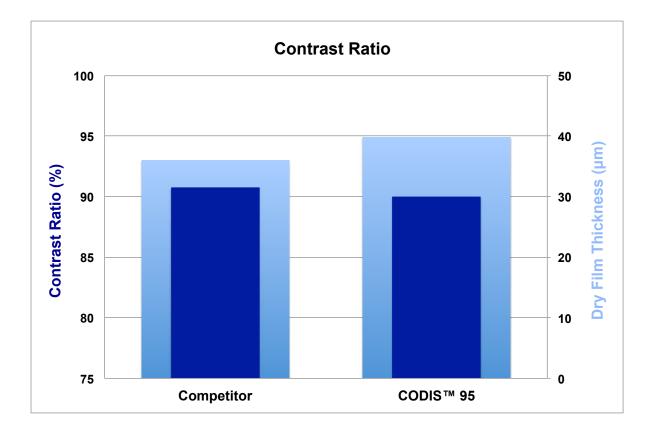
#### 6.1 Solvent based ALKYD paint – Test formulation

| 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

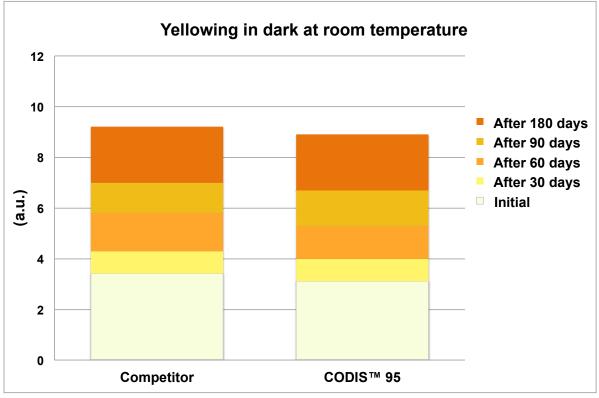
Incorporation of this amount of water using CODIS<sup>TM</sup> 95 versus this well known competitor results in higher gloss levels both at  $\angle 20^{\circ}$  and  $\angle 60^{\circ}$  whereas the contrast ratio is higher at somewhat lower film thickness.



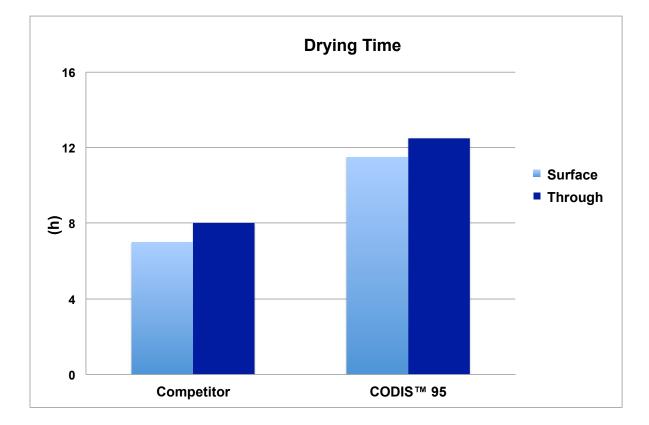


#### 6.3 Yellowing in the dark

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



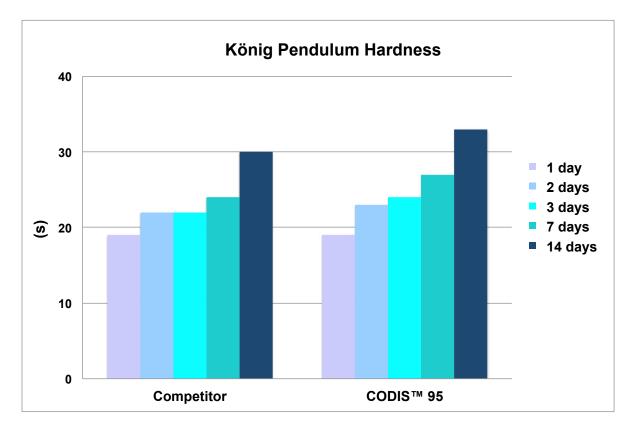
A prolonged drying time was observed for CODIS<sup>™</sup> 95 which is mainly due to the slower evaporation rate and also inherent to a non-optimised formulation.



#### 6.4 Drying time

#### 6.5 König Pendulum Hardness

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



### 7. Health, Environmental and Safety issues

For labelling of CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO some physical data were compared with Aminomethyl Propanol (95% in water).

|                                    | CODIS™ 95        | CODIS™ BIO   | AMP 95           |
|------------------------------------|------------------|--------------|------------------|
| Renewable content                  | > 40%            | > 75%        | Х                |
| Free of Environmental Hazard Label | $\checkmark$     | $\checkmark$ | H412             |
| Ready Biodegradable                | $\checkmark$     | $\checkmark$ | $\checkmark$     |
| Free of Physical Hazard Label      | $\checkmark$     | $\checkmark$ | H227             |
| Free of Human Hazard Label*        | H314, H319, H335 | $\checkmark$ | H303, H315, H319 |
| Hazardous pictogram - GHS          | GHS05, GHS07     | $\checkmark$ | GHS07            |
| VOC content, % wt.                 | 45%              | 0%           | ≈ 95%            |
| SVOC-free                          | $\checkmark$     | $\checkmark$ | $\checkmark$     |

- H227 Combustible liquid
- H303 Maybe harmful if swallowed
- H314 Causes severe skin burns and eye damage
- H315 Causes skin irritation
- H319 Causes serious eye damage
- H335 May cause respiratory irritation
- H412 Harmful to aquatic life with long lasting effects
- \* CODIS<sup>™</sup> 95: Label based on the sum of ingredients. CODIS<sup>™</sup> 95 has similar pH compared to AMP 95 (1% in water *literature*): < 11.3 and a somewhat lower pKa: 9.54 vs 10.02

#### Environmental information

Both CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO are expected to partition (preferentially locate) in water when released to the environment. Because of their water solubility and reactivity with other compounds, CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO biodegrade rapidly and are not likely to bioaccumulate in the aquatic food chain. Studies on a wide variety of freshwater fish show that CODIS<sup>™</sup> 95 and CODIS<sup>™</sup> BIO have very low toxicity to fish.

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