See The Difference We Make

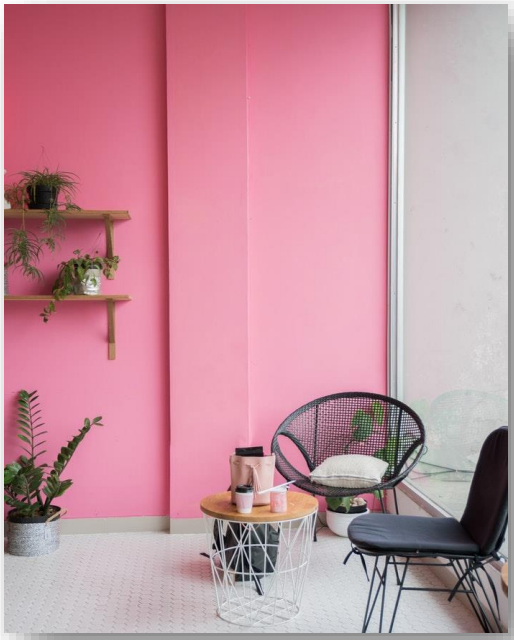
Water-based Dispersions: An Evolving Landscape

Written by: Nigel Smith (Global Technical Services Manager), DCL Corporation

Water based dispersions have wide and varied uses to color everything from decorative paints to soap and door mats. They are easy to use and control, have wide compatibility, optimised strength and of course, no dust. However, technical and regulatory demands on dispersions are constantly evolving and therefore old ranges become obsolete and new ones are developed regularly.

A pigment dispersion typically consists of:

- Pigments – Provide color and opacity
- Surfactant – Holds the pigment in dispersed form
- Humectant – Keeps the system in fluid form and controls drying rate
- Additives – Viscosity modifiers/stabilizers/anti-foams to control the physical properties of the dispersion
- Biocides – to prevent biological growth



Although the dispersions themselves may only make up 10% of a final formulation, the impact of choices made in the formulation of the dispersion can trigger a failure to meet an environmental standard in the end application.

Challenges with Water-Based Dispersions

1. Compatibility

Given the diverse number of applications then the challenges of meeting them all start to mount if a widely compatible system is to be designed.

Surfactants

The first part of the challenge is the surfactant, which:

- Tends to be pigment specific (inorganic, azo, polycyclic)
- Are now all NPE and APEO free
- Govern compatibility with resin systems
- Can also control viscosity (n.b.hyperdispersants)
- Anionics are preferred for paper coloration
- Principal surfactants are tailor made for our applications

Additional requirements for surfactants, such as food contact, vegan or Halal, etc., further restrict their selection.

Biocides

- Required to prevent spoilage of colorants and finished paints
- Typical biocides are based on isothiazolinones which are known to cause skin sensitisation at higher concentrations
- Changes in labelling requirements are came into force in May 2020 for all biocidal active substances affecting:
- CLP regulations (EU 1272/2008)

This has resulted in a change of labelling in Europe with regards to particular biocides.

Active	H317	EUH 208	Environmental	Comment
BIT	500ppm	50ppm	H400(M=1), H411	Currently no proposed changes
MIT	1,000ppm	100ppm	H400(M=1), H411	Changes to classification from May 2020
CIT/MIT	15ppm	1.5ppm	H400(M=100), H410 (M=10)	Changes to classification from May 2020
OIT	500ppm	50ppm	H400(M=10), H410 (M=1)	Risk Assessment Committee (RAC) opinion Nov 18, Adaptation to Technical Progress (ATP) in force 2022?
ZnPT	n/a	n/a	H400(M=100), H410(M=10)	RAC opinion Sept 18, ATP in force 2022?
NaPT	n/a	n/a	H400(M=100), H411	CLH Report March 19
Bronopol	n/a	n/a	H400(M=10), H410 (M=10)	Currently no proposed changes
DBNPA	10,000ppm	1,000ppm	H400(M=1), H411	CLH report May 2018
IPBC	10,000ppm	1,000ppm	H400(M=10), H410 (M=1)	Currently no proposed changes
PHE	n/a	n/a	n/a	RAC opinion June 2019
DDAC	n/a	n/a	H400(M=10), H411	Currently no proposed changes
TMAD	32%	1,000ppm	n/a	Currently no proposed changes
Diuron	n/a	n/a	H400(M=10), H410 (M=10)	Proposal
Terbutryn	30,000ppm	1,000ppm	H400(M=100), H410 (M=100)	Currently no proposed changes
DCOIT	300ppm	30ppm	H400(M=100), H410 (M=10)	RAC opinion Nov 18, ATP in force 2022?

H400 'Very toxic to aquatic life'
H410 'Very toxic to aquatic life with long lasting effects'
H411 'Toxic to aquatic life with long lasting effects'

Although changes in these limits do not prevent the use of these biocides, they do then affect the labelling associated with them. Consumers are always looking for the "safest" option which is often associated with the lowest level of hazard labelling.

As these limitations get stricter, then well proven solutions now attract hazard labels, so more creative combinations are always being evaluated.

2. Compliance

Providing effective solutions that remain compliant is our ongoing challenge. New requirements for low Volatile Organic Compounds (VOC) (boiling point <250°C) and Semi Volatile Organic Compounds (sVOC) (b.p. >250°C <370°C) contents in finished paints now impact upon the choice of pigments and additives in dispersions, as well as their technical performance.

Even the test methodology for VOC and sVOC measurements has an effect on reportable values – For example, ISO 11890-2 uses high temperature Gas Liquid Chromatography (GLC) to separate out volatile fragments and compare them against a defined marker. However, these high temperatures can cause certain pigment and additive molecules to break down releasing lower molecular weight fragments, which are then considered as VOC or sVOC's. Under atmospheric exposure these fragments would never exist.

Testing VOC and sVOC levels using an exposure chamber confirms this, but it is slow and expensive. Therefore, the regulatory and environmental bodies tend to use the ISO 11890-2 test method.

3. Eco - labels

The decorative paint industry has several regional eco-label organisations which campaign for safer products and provide certification if the correct standards can be demonstrated to be met. Unfortunately, these requirements do not always align from country to country and standard to standard, adding to complexity and often meaning the most stringent levels from each standard are required to ensure compliance with the widest number of eco-labels.

DCL already have dispersion products that satisfy the EcoLabel and Blue Angel 2015 environmental labels, but the upcoming Blue Angel 2019 label for "Biocide free paints" will potentially come with the following restrictions:

- Limited shelf life
- High pH
- Limited selection of colors
- Restrictive PPE could be required to apply the paints
- Some bacteria can survive in these paints

The remaining "Biocide containing paints" face:

- More labelling
- Restrictions on use
- Management of sensitisation risks
- Professional use only?

	EcoLabel	Blue Angel 2015	Blue Angel 2019
Applicable to	Decorative wall paints	Matt white wall paints	Matt & Silk white and colored wall paints
VOC (B.P. <250oC) in the finished paint	< 700ppm	< 700ppm	< 700ppm
sVOC (B.P. >250oC <370oC) in the finished paint	< 700ppm	N/A	< 500ppm
Volatile Aromatic Hydrocarbons	< 100ppm	< 100ppm	< 100ppm
Substances of Very High Concern (SVHC) by weight	<0.1%	<0.1%	<0.1%
Technical Rules for Hazardous Substances 905 Compliant (TRGS905) compliant	Yes	Yes	Yes
Specified heavy metals	< 100ppm	< 100ppm	< 100ppm
Alkyl Phenyl Ethoxylate free	Yes	Yes	Yes
Plasticiser free	Yes	Yes	Yes
Perfluorinated compound free	Yes	Yes	Yes
Formaldehyde free	Yes	Yes	Yes
Biocide package compliant with EcoLabel requirements	Yes		
Total sum of Isothiazolinones	< 500ppm		
MIT < 200ppm, BIT < 500ppm, OIT < 500ppm, CMIT < 15ppm	Yes		
Biocide package compliant with Appendix A Blue Angel 2018		Yes	
Biocide free (BIT < 10ppm, MIT < 1.5ppm, CIT < 0.5ppm, all other IT < 2ppm)			Yes
Free formaldehyde	N/A	N/A	< 10ppm

Concluding Remarks

Continuous development is required to meet and exceed both the current and future regulatory requirements, but the DCL laboratories are already hard at work on products to ensure all of our customers remain compliant and at the front of any technical developments.