

Eliminating the Mystery to Formulating Quality Waterborne Coatings

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Introduction

Due to environmental regulations waterborne coatings are now a major segment of the coatings industry. Water presents numerous challenges for the formulator due to its high surface tension.

Formulating issues typically encountered are:

- Substrate wetting
- Stable pigment dispersion
- Proper rheology
- Surface defects
- Defoaming and air release

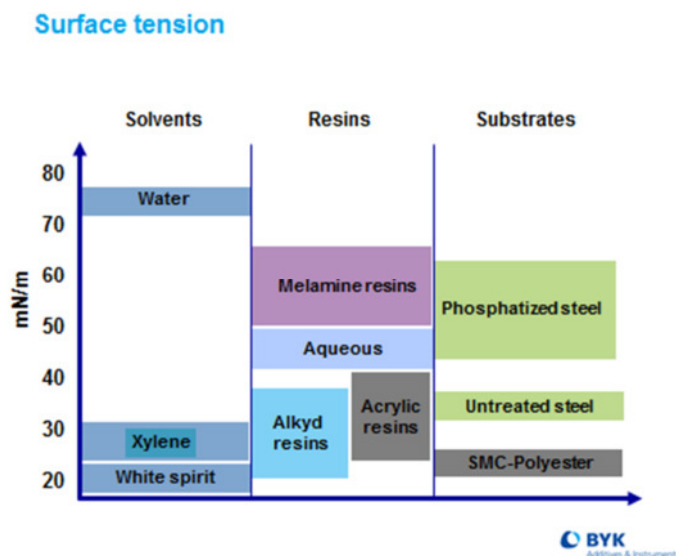
By following a prescribed step-by-step method of screening additives in the development of the formula a number of problems can be resolved in an orderly manner.

In this presentation topics to be discussed are the order of evaluation and addition for surface additives, pigment dispersing aids, rheological products and defoamers to provide the formulator with the best waterborne coating.

1. The impact of water

The high surface tension of water versus most solvents and non-water resins results in formulating challenges because customers still expect the more environmentally-friendly technology to perform similar to the older solvent borne technologies they used in the past. Ultimately customers want the same added value and ease of use / application that non-water coatings provide.

To make matters worse, today's more environmentally-friendly coatings now also need to be able to coat over today's newer low surface energy substrates; i.e. plastics and not just metals. So where additives tended to be more of a method to fine tune solvent borne formulas they become a necessity when formulating waterborne coatings.



2. Additive selection

Not only is additive selection key but also the order of assembling the formula and testing the various additives is important to develop a quality waterborne formula.

Various issues the formulator can encounter are:

- Substrate wetting
- Pigment wetting / dispersing / stabilizing
- Flocculation / Gloss
- Surface flow / leveling
- Cratering / fisheyes
- Foaming during production and application

3. Order of evaluation

A) The first property to be tested is substrate wetting.

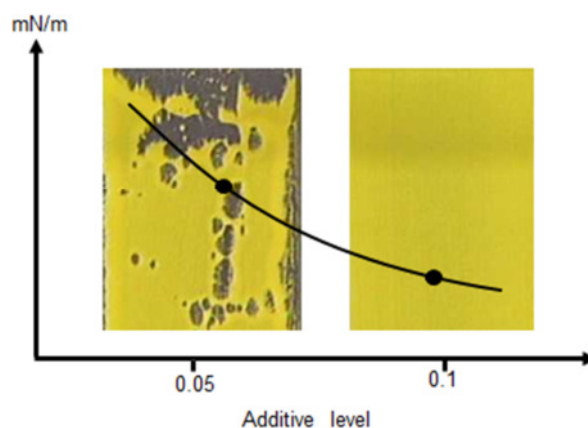
Without proper substrate wetting the coating cannot cover the substrate. Therefore it is not able to satisfy the reasons why customers use paint which are added value for protection, appearance and/or function.

For proper substrate wetting the surface tension of the coating needs to be slightly lower than that of the substrate and any possible contamination on the substrate.

Reducing the surface tension too much will negatively impact the leveling of the coating.

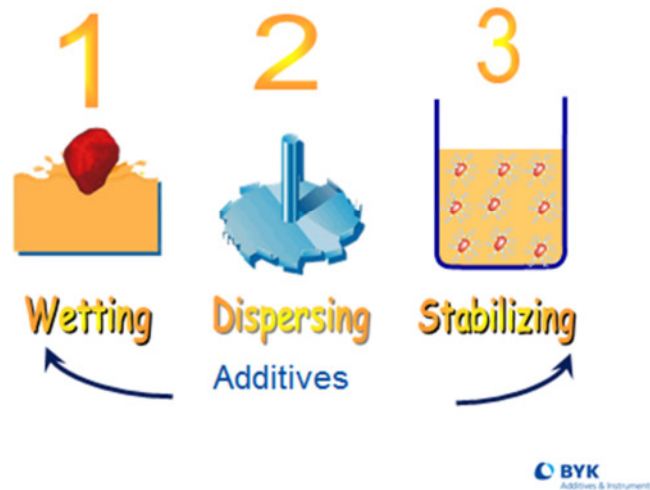
So as with the use of all additives which are very powerful chemicals a ladder study should always be conducted to determine the proper use level and this should be followed by aging studies to determine if the use levels perform over time or need to be adjusted.

Substrate Wetting



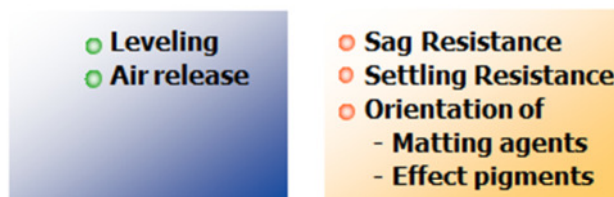
- B)** Next the wetting & dispersing of the pigments / fillers needs to be evaluated. Proper deflocculation and stabilization of the pigments not only provides the formulator with the most value from the pigments and fillers but also develops gloss, color stability and reproducibility from batch to batch and for different application methods in addition to providing a positive influence on leveling. The wetting/dispersing additive must have good compatibility in the coating system.

Wetting and Dispersing Process



- C)** The third evaluation is rheology. Rheological additives can provide anti-settling in the can and anti-sag properties on application on one hand, but also leveling on the other hand.

Thixotropy vs. Pseudoplasticity



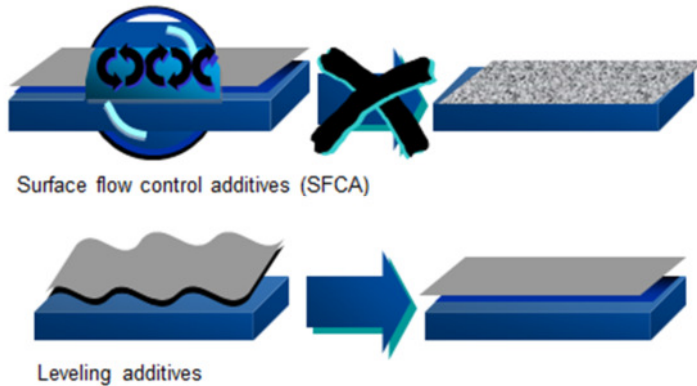
- D)** Now we test additives for flow and leveling.

There is a distinctive difference between flow and leveling.

Flow: the elimination or reduction of surface tension differentials during drying

Leveling: the achievement of the lowest possible surface area

Flow and Leveling

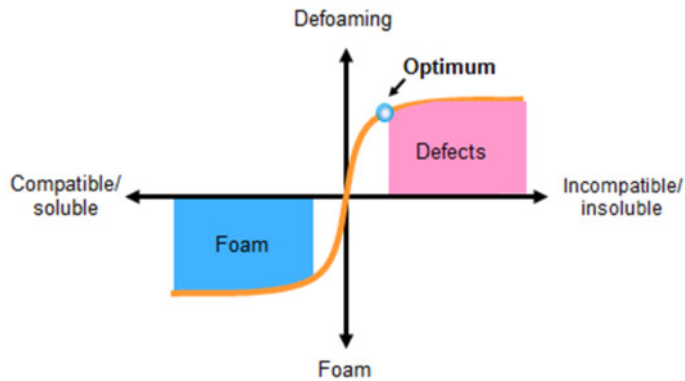


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In water-borne flow and leveling is mainly adjusted by the rheology additive(s). Key is to find the best possible balance between flow/leveling on one hand and sag resistance on the other hand.

- E) The final property to evaluate is defoaming / air release.
The reason this is tested last is that all the formula ingredients including all additives discussed so far may have an impact on foam stabilization.
Foam comes from various sources:
- adsorbed air on pigments and fillers
 - reaction gases depending on the resin technology
 - production and application
 - porous substrates
- Defoamers break the bubbles at the liquid / air interface.
Air release additives bring the small bubbles within the film together to form larger bubbles that are more buoyant and rise to the surface faster so they can break.
The goal is to find the strongest, most incompatible defoamer / air release additive at the right dosage that doesn't create defects.

Defoamer Selection



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Order of addition is important for production.
Order of evaluation is important for formulating.

How to Evaluate Additives For Water-Borne Coatings?

•The sequence of evaluating additives is highly important

•**The correct order:**

- Substrate wetting
- Wetting & dispersing
- Rheology
- Flow & leveling
- Defoaming

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