Dispersing Agents for Water-Based Paints

Case Study

Summary

Application: **Paints & Coatings ~ Architectural Paints**

Additive: **LOPON® & POLYRON® Dispersing Agents**

Key benefits: VOC-free ~ High Sedimentation Stability ~ High Dispersing Ability ~ Improved Storage Stability ~ High PVC ~ Water-based

The Challenge

Prevention of agglomeration and consequently sedimentation is the key to a long shelf-life of architectural paints. Especially as the equal dispersion of colored pigments heavily impacts on the decorative function of architectural paints. Additionally, in architectural paints often high pigment volume concentrations (PVC) of above 60% are used which lead to serious problems in the long-term stability against sedimentation.

Also, in recent years the need for Eco-friendly and sustainable products in the coatings industry has increased. One major concern for indoor paints are volatile organic compounds (VOC) and semi volatile organic compounds (SVOC). Therefore, the challenge is to provide additives which add low or zero VOCs to paint formulations, while keeping the capacity to disperse and stabilize pigments and fillers for the long-term. Other characteristics, such as wet-scrub resistance should not be compromised.

The Solution

The function of dispersing agents is to stabilize primary particles, preventing reagglomeration. By introducing mechanical forces, pigment agglomerates are broken up into primary particles and smaller aggregates during the dispersion process. To achieve proper dispersion, molecules of dispersing agents adsorb onto the surface of the pigment particles and generate repulsive forces between individual pigment particles. Pigment particles are kept at a distance through electrostatic and/or steric stabilization.

Stabilizing a dispersion not only prevents pigment particles from reagglomerating, but also optimizes the distribution of pigments and other fillers. Stabilization leads to improvements in hiding power, scrub resistance and storage stability. Properly stabilized dispersions allow for a higher PVC.

Stabilization of pigments and fillers can be achieved by different mechanisms:

Electrostatic stabilization

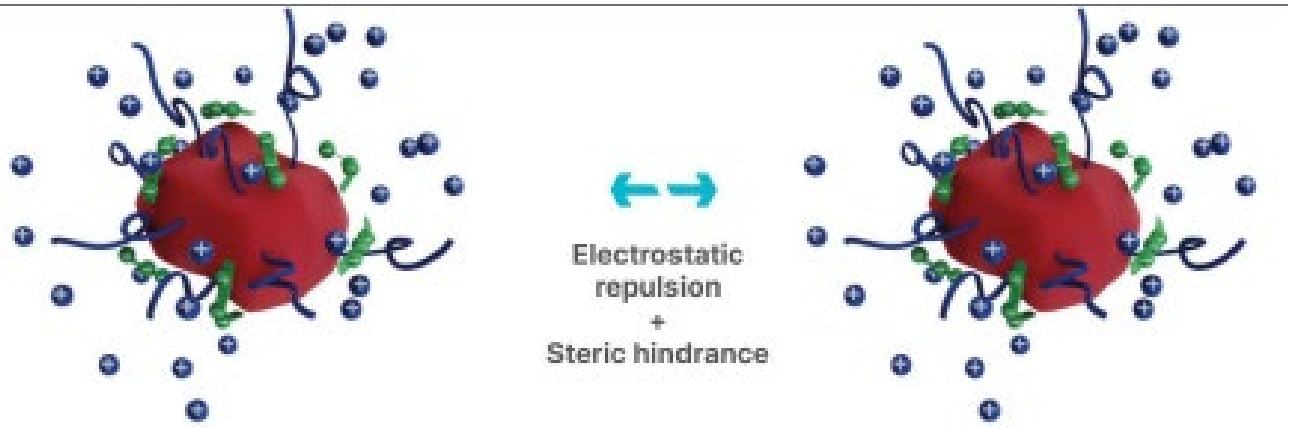
In an aqueous medium, the adsorbed dispersing agent dissociates into anionically charged macro molecules and low molecular weight cations. This results in an electrical double layer around each pigment particle. When pigment particles approach each other in solution, the repulsive forces due to their identical charge keep them apart.

Steric stabilization

During the dispersion phase the adsorbed dispersing agent forms a polymer shell around each pigment particle. When pigment particles approach each other, the polymeric shells penetrate one another. This penetration minimizes the mobility of the polymer chains resulting in a reduction of entropy. To compensate for this loss of entropy, the pigment particles must increase their distance from one another.

Elec

Electrosteric stabilization combines both mechanisms, electrostatic as well as steric stabilization.



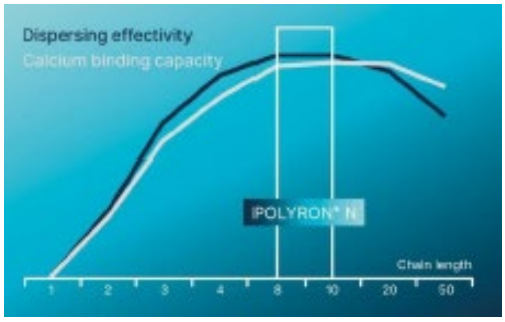
POLYRON® N – Inorganic Dispersant

Polyphosphate based dispersing agents like POLYRON® N have several benefits. In aqueous systems they dissociate according to the electrostatic stabilization mechanism to form anionic polyions. Besides providing stabilization to pigments and fillers, these anionically charged macromolecules complex multivalent cations such as Ca2+ and therefore also act as water softeners, which helps to also provide better shelf-life properties. Especially in high PVC formulations, concentration of multivalent cations can be high and cause damage to the binding resin.

Further key benefits of POLYRON® N are the absence of any VOC and SVOC and the fact that despite its pigment wetting ability it does not cause any foam in the dispersion process.

Left: Pigment preparation without dispersing agent; right: Pigment preparation with 0.1 % POLYRON® N. Adding just 0.1 % POLYRON® N, the viscosity can be strongly reduced at the same PVC, thus a flowable paint can be achieved.

The dispersing and calcium binding capacity of polyphosphates depends on their chain length. Best results are shown by polyphosphates with a chain length between 6 and 10.



POLYRON® N has an optimized chain length distribution and brings superior effectiveness in terms of both dispersion and water softening.

Dispersing effectiveness of various polyphosphates with Ca(OH)2 in water. From left to right: no dispersing agent, STPP, POLYRON® N, SHMP.

LOPON® – Polymeric Dispersants

Compared to polyphosphates, polymeric dispersants have the advantage of being structurally similar to the binder resin. Polymeric dispersing agents are compatible with many binders, resulting in improved film formation and positive impact to scrub resistance and gloss. Polymers are comparatively less polar than polyphosphates.

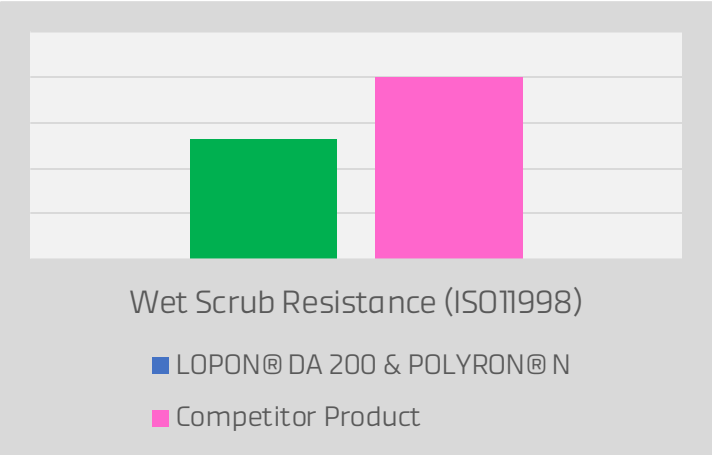
They cover the surface of the pigment with a lower charge density but serve as buffers and adhere at the interface and provide a steric stabilization.

Due to the organic nature, polymeric dispersants often add VOC and SVOC to the formulation. The LOPON® DA range of products are of low-VOC content and therefore can be used in interior architectural formulations.

Conclusion:

Combining polyphosphates and polymeric dispersants in water-based paints has a complementary effect. Adding both the electrostatic and steric stabilization results in high sedimentation stability. Additionally, the dosages of the dispersing agents can be optimized to very low levels.

Optimizing the loading levels of dispersant yields low VOC addition, but also can help to optimize other properties like wet scrub resistance. Given below our suggested testing formulation as well as the comparison of the resulting wet scrub resistance according to ISO 11998.



Raw Material	wt.-%
Water	32,00
Tylose® H 6000 YP2	0,40
POLYRON® N	0,05
NaOH (10% sol.)	0,20
LOPON® DA 200	0,25
LOPON® E 81	0,10
Kronos® 2160	13,40
Omyacarb® 2 GU	11,50
Omyacarb® 10 GU	12,00
Socal® P 2	9,60
Finntalc® M15	5,00
Mowilith® LDM 1871	15,00
Borchigel® L 75 N	0,20
Acticide® MBS	0,20
LOPON® E 81	0,10