ELEMENTIS

Application Leaflet

Additives for silicate systems

Rheology modifiers, coalescent, defoamers and wetting and dispersing agent

Unique chemistry, sustainable solutions

Introduction

Silicate paints have been successfully applied for decades. Originally silicate systems were formulated as two component products. The reason was the gelling process in water. In the 50th of the last century, the one component silicate-dispersions were developed. These emulsions are usually formulated in combination with polymer dispersions to improve the storage stability of the silicate paint in water.

Silicate-dispersion paint and renderings have been made using the following binder combinations:

- Inorganic binder (silicate)
  - Potassium silicate solution (Stabilized) in water ($K_2O.nSiO_2$)
  - Potassium silicate hydrate

- Organic binder (the dispersion) e.g.
  - Styrene acrylate
  - Acrylate

The compatibility of both binders must be very good as well as the stability at pH > 11.

Silicate-dispersion paints are important for manufacturing of e.g. coatings and renderings for mineral substrates in exterior areas due to the excellent adhesion. The silicate binder penetrates the porous mineral substrate and reacts with the reactive components. [e.g.: $Ca[OH]_2$, water or Quartz]. This effect guides to excellent durability of the system after application.

The characteristics of silicate based systems are the following:

- High pH value (11-12), therefore no biocides necessary
- Excellent adhesion to mineral substrates
- Excellent durability
- Resistance to acids and industrial gases
- Light fast and dirt repellency
- Outstanding water resistance
- Limited water uptake
- Excellent cost/performance balance
- Chemical bonding to mineral substrates due to silicification
- Breathable coatings

Wetting & dispersing agents

Silicate based paints are typically highly alkaline. Therefore, e.g. only pigments can be used that are stable to these pH values.

Dispersing agents are used to optimize the pigment dispersion and to stabilize the pigment particles during storage and the film formation process.

Best results are obtained by using polymeric dispersing agents in combination with a non-ionic wetting agent.

Suitable dispersing agent are NUOSPERSE® FX 600, NUOSPERSE® FX 610 and NUOSPERSE® 2000. The dispersant molecules are adsorbing onto the pigment surface providing negative charges on the pigments surfaces to protect the particles against re- agglomeration. In case of NUOSPERSE® 2000 the dispersant properties are combined with those of a humectant. Typically used wetting agents formulated in combination with the above mentioned grades in this kind of systems, are NUOSPERSE® FN 265 and NUOSPERSE® FN 211 These grades are providing additional stability by sterical stabilization. Both de- scribed stabilizing mechanism combined are providing excellent good long-term stability of the paint. Further, NUOSPERSE® FN 265 and NUOSPERSE® FN 211 are known to provide excellent viscosity stability on a long term view.

However, the high pH of around 11 of silicate systems must be kept in consideration e.g. for dispersing demand testing to identify the optimum dispersant concentration.

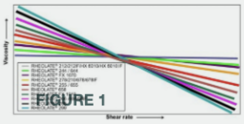


FIGURE 1

Rheological additives

Thickening agents are used in paints in order to give the system the desired rheological properties. Silicate based paints or renderings are mostly applied with a roller, brush or trowel.

Criteria for a good rheological profile of the paint are

- Brushability
- Roller/spattering behaviour
- Sag/slump stability
- Levelling character
- Edge covering
- Water sensitivity
- Stability

NiSAT grades have a positive effect on all abovementioned properties. Most widely used NiSAT for silicate systems is the RHEOLATE® FX 1010. However, also other NiSAT grades are suitable for this kind of applications depending on the required flow characteristics. Specific grades have to be selected in accordance with the proposed requirement, e.g. they method of application.

In case of silicate based rendering systems, clay based grades such as BENTONE® DY and BENTONE® LT have shown their ability to be excellent partial alternatives to cellulose ethers. The use of BENTONE® DY and BENTONE® LT is typically resulting in optimum workability and tooling, excellent sag and slump resistance as well as extended open times of the rendering.

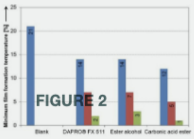


FIGURE 2

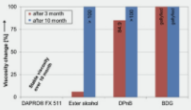


FIGURE 3

Coalescing agents

Coalescing agents are used in paints to improve the film formation. They act as a plasticizer with strong solvating power for the polymeric particles. This reduces the film formation below their natural minimum film formation temperature (MFFT). In the case of silicate paints the product has to be stable against hydrolysis. Hydrolysis of the coalescing agent might cause in increasing paint viscosities. A coalescing grade which has shown its strength in silicate based systems in DAPRO® FX 511 (**FIGURE 2**).

As mentioned the hydrolytic stability can be critical. This property is usually visualized as the viscosity stability of a basic silicate system.

Data displayed in **FIGURE 3** are showing that only with DAPRO® FX 511 stable viscosities could be achieved in a silicate based paint. The use of all other tested coalescents resulted in a tremendous viscosity rise.

Defoamers

Foam is an undesirable effect in paint processing having adverse effect on the efficiency of manufacturing and application as well as the appearance of the final paint film. A defoamer will prevent foam during manufacturing and application of the paint.

However, choosing a defoamer is a quite complex process. A defoamer has to achieve a balance between sufficient incompatibility in order to allow proper deairation, on the other hand a certain compatibility must be given to prevent surface defect, e.g. cratering.

The following defoamers are specifically suitable for this kind of application.

DAPRO® DF 21	Mineral oil/hydrophobic silica
DAPRO® DF 17	Mineral oil/hydrophobic silica
DAPRO® DF 52	Polyol based, silicone and mineral oil free

Practical examples

1. Pigment concentrates

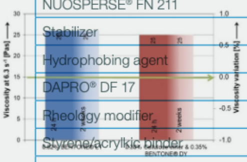
Pigment concentrates for silicate dispersion paints are based on NUOSPERSE® FN 265, NUOSPERSE® FX 600, water and a humectant (propylene glycol). All formulations are free from solvents and low in VOC. (**TABLE 1**)

Pigment	[%]	NUOSPERSE® 2000 [%]	NUOSPERSE® FX 600 [%]	NUOSPERSE® FN 265 [%]	NUOSPERSE® FN 211 [%]	Kaolin [%]	Water [%]	RHEOLATE® FX 1010 [%]	RHEOLATE® FX 1070 [%]
Tiona 595	60.0	20.0	–	–	–	–	18.0	–	2.0
Kronos 2056	75.0	–	2.0	2.0	2.0	–	17.0	2.0	–
Bayferrox Black 318M	55.0	25.0	–	–	–	3.0	17.0	–	–
Bayferrox Yellow 420	55.0	25.0	–	–	–	3.0	17.0	–	–
Bayferrox 130 BM	60.0	–	–	10.0	–	–	30.0	–	–
Bayferrox 306	60.0	–	–	10.0	–	–	30.0	–	–
Bayferrox 3910	55.0	–	7.0	3.0	–	–	35.0	–	–
Hansa Yellow 2 GX 70	35.0	30.0	–	–	–	–	35.0	–	–
Heliogen Blue L 7101F	35.0	30.0	–	–	–	–	40.0	–	–
Novoperm Yellow HR 70 VP	40.0	20.0	–	–	–	–	40.0	–	–
Sico Fast Orange L 2952 HD	35.0	30.0	–	–	–	–	35.0	–	–
Heliogen Blue L 7101F	25.0	35.0	–	10.0	–	–	30.0	–	–
Heliogen Green L 8730F	25.0	35.0	–	10.0	–	–	30.0	–	–
Hostaperm Violet RS Spec	30.0	30.0	–	–	–	–	40.0	–	–
Lamp Black 101	25.0	30.0	–	10.00	–	–	30.0	–	–

TABLE 2

Component	Concentration [%]	Supplier
Water	11.00 - X	
NUOSPERSE® FX 600	0.30	Elementis
NUOSPERSE® FN 211	0.50	Elementis
Stabilizer	0.20	
Hydrophobing agent	0.80	
DAPRO® DF 17	0.25	Elementis
Rheology modifier	X	
Styrene/acrylic binder	8.50	
Titanium dioxide	3.00	
Calcium carbonate extender blend	62.00	Elementis
Plustalc H15	6.45	
Silicate binder	7.00	

FIGURE 4



2. Silicate based renderings

The main rheological additive used is this market segment cellulose ether, often in a combination with Xanthan gum. The Xanthan gum provides usually provides good viscosity stability, however, is creating high cost. But, the workability and the sag resistance of these systems are often not ideal.

Clay-based rheological additives such as BENTONE® DY and BENTONE® LT are providing excellent viscosity build and stability and are therefore superb alternatives for cellulose ethers/Xanthan gum combinations. Further, the use of BENTONE® DY and BENTONE® LT as partial or full replacement are resulting in optimum workability, excellent sag resistance and extended open times.

NUOSPERSE® FN 211 as wetting agent and viscosity stabiliser as well as DAPRO® DF 17 as defoamer also resulted in excellent properties.

In the guide formulation (**TABLE 2**) the viscosity of the rendering was adjusted by the mentioned content of rheology modifier to a viscosity, measured at a shear rate of 6.3 s^{-1}, of approximately 25 Pas.

BENTONE® LT is a grade which could be as a stand alone alternative to a combination out of cellulose ether and Xanthan gum. BENTONE® DY is typically formulate as a partial replacement for cellulose ether.

2.1. Viscosity stability

BENTONE® LT is a grade which could be as a stand-alone alternative to a combination out of cellulose ether and Xanthan gum. BENTONE® DY is typically formulate as a partial replacement for cellulose ether.

Both tested samples displayed optimum stability of the viscosity over 2 at elevated temperature of 50°C (**FIGURE 4**).

In no case a skin formation, syneresis or sedimentation was noticed.

TABLE 3

Component	Open time [min]	Workability 0 = poor; 5 = excellent	Sag stability [mm]
0.62% BENTONE® LT	120	4	5
0.3% BENTONE® DY 0.3% Cellulose ether	110	5	6

2.2. Application properties

BENTONE® LT gives the longest open time combined with excellent sag stability and workability. BENTONE® DY formulated alongside with cellulose ether provides the best sag stability and workability. The open time is only marginally shorter than with BENTONE® LT (**TABLE 3**).

Test methods

Viscosity
Viscosity was measured with Anton-Paar MCR 300, measuring system Z3 rendering, at shear rate of 6.3 s^{-1}.

Open time
To test the open time the plaster was applied with a film thickness of 3 mm. The open time is the time from applying until the surface was dry.

Application properties
A wide trowel was used to apply and smooth the plaster on a vertically positioned gypsum plasterboard. The stickiness on the tool and the force required for smoothing were compared and the surface assessed visually.

Sag stability
To test the sag resistance the film thickness without sagging was determined. The plaster was applied with a wedge blade (0 – 3 cm height) and stored vertically until it dried out.

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