

Application Leaflet

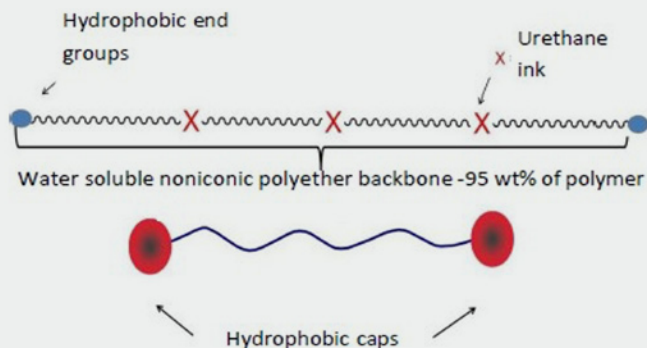
RHEOLATE[®] POWDER NiSAT

Adding future - 100% solid
NiSAT based rheology for
sustainable manufacturing of
architectural paints

Key Benefits

- Realizes up to 80% CO₂ reduction due to transport volume reduction
- Less storage space needed compared to typically used liquid products
- Biocide, VOC free and broad eco labelling compliancy
- Realizes up to 18% higher effectivity
- Improves rheology and creates excellent dry film properties

FIGURE 1: NiSAT chemistry



Introduction

Associatively acting thickeners are standard in the formulation of modern aqueous systems, such as paints and coatings, adhesives, etc. These are either the hydrophobic modified acrylic thickeners, often called HASE, and the NiSAT group of products. The term NiSAT, which is often used for this class of associative thickeners, abbreviates “NonIonic Synthetic Associative Thickeners.

The HASE product group contains ionic, mainly anionic thickeners, which require pH proper adjustment for activation. This product group utilizes two mechanisms, water thickening and associative.

NiSAT product group, as mentioned, are already non-ionic and in principle used over the widest range of pH values. These products represent an advanced product technology and are designed to give superior rheological characteristics so that many formulation requirements can be met. Depending on the product chosen, good levelling, spatter resistance, film build, and the flow characteristics can be achieved. The appearance of classic syneresis can even be minimized.

Furthermore, NiSAT products do not need special activation so that the majority can be added to the letdown or even at the end of processing. This product class does not adversely affect the corrosion or the water sensitivity of the resulting system, and other secondary parameters such as gloss will not be negatively influenced.

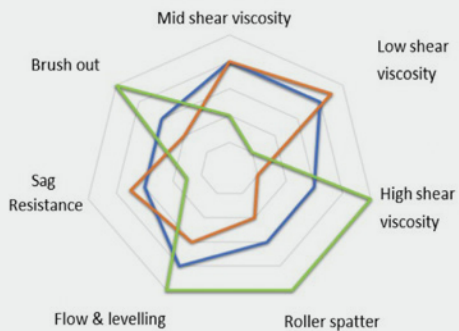
Chemistry

This class of thickeners consists mainly of nonionic co-polymers. The structure is schematically represented in Figure 1 and can be described as a minimum of two hydrophobic groups chemically bonded to a hydrophilic backbone. The water-soluble part of the molecule takes typically ~95% of the molecule weight. The total molecule weight of NiSAT's are typically in a range between 20000 and 50000 g/mol.

TABLE 1

| | RHEOLATE® FX1100 | RHEOLATE® 208 | RHEOLATE® PHX 7025 |
|-------------------|--|--|---|
| Chemistry | Polyether urea Polyurethane associative thickener | Polyether urea Polyurethane associative thickener | Polyether urea Polyurethane associative thickener |
| Rheological focus | Low shear, pseudoplastic | Mid - high shear Medium Newtonian | High shear Medium Newtonian |
| Use for | Aqueous systems, like coatings and adhesives. | Aqueous systems, like coatings and adhesives. | Aqueous systems, like coatings, adhesives, & sealants, inks, textile coatings. |
| Details | Contributes to low shear which impacts sag resistance, higher film build and improved edge covering. Perfect partner for RHEOLATE® PHX 7025. | Very effective in small- particle-size latex emulsions and in high- volume-solid systems. Can be use as stand-alone thickener in formulations. | Contributes very effectively to high shear which impacts flow & levelling, rollers pattering and brushout. Perfect partner for RHEOLATE® FX 1100. |

FIGURE 2: Property profile



RHEOLATE® FX 110 RHEOLATE® 208 RHEOLATE® PHX 7025

NiSAT thickener grades are being delivered as liquid products or as 100% active, powdered material. Elementis has developed and patented powder NiSATS already in the early years of 2000.

Since this time the powder NiSAT technology has been established at many customers and in many different systems. These mentioned products were RHEOLATE® 208 and RHEOLATE® FX 1100. The newly development of RHEOLATE® PHX 7025 is now completing the family and enables to have full freedom in formulation.

Product Details

As it becomes obvious, with the RHEOLATE® powder NiSAT selection all for the paint and coating industry relevant rheology characteristics can be obtained. This can be realized either by single or combined use of the products left **TABLE 1**.

Sustainability

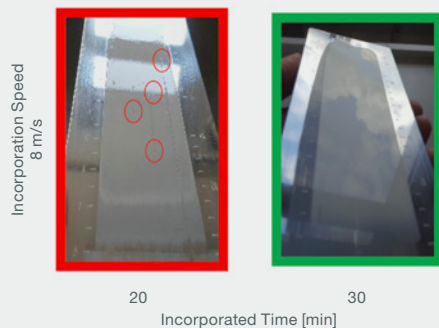
The use of powder in coatings formulations allow to generate several benefits in the logistic and production process:

- Due to the use of only the active thickener in powder form the transport volume can be significantly reduced - approximately 5 times less volume has to be moved from the supplier to the manufacturer obtain the same active thickener quantity compared to the relevant liquid product. Less trucks are needed for the required volume, which reduces carbon footprint on transportation up to 80% according to our measurements
- The reduced volume require up to 5 times less storing area than with the liquid thickener version
- Material transportation on the customers site is reduced in faster handling and logistical time savings
- Powder thickener is generally less sensitive to low storing temperatures

| | | RHEOLATE® FX-1100 | RHEOLATE® 208 | RHEOLATE® PHX 7025 |
|------------------------------|-------------------------|----------------------|------------------|-----------------------|
| Enabling labeling compliance | EU Ecolabel | | | |
| | Nordic Swan | | | |
| | Blauer Engel | | | |
| | Asthma Allergy | | | |
| | Nordic | | | |
| | French NF Environmental | | | |
| Additional information | Biocide Free | | | |
| | VOC content* | 0% | 0% | 0% |
| | SVOC content* | 0% | 0% | 0% |

| | | RHEOLATE® FX-1100 | RHEOLATE® 208 | RHEOLATE® PHX 7025 |
|------------------------------|---|----------------------|------------------|-----------------------|
| Enabling labeling compliance | Green Guard Gold | | | |
| | Leed 4.1 | | | |
| | Declare | | | |
| | A.A.F.A (asthma allergy foundation America) | | | |
| | Biocide Free | | | |
| Additional information | VOC content* | 0% | 0% | 0% |
| | SVOC content* | 0% | 0% | 0% |

*based on Boiling points of ingredients (theoretical assumption)



Safer ingredients

As currently available RHEOLATE® grades are only manufactured using tin-free catalysts.

Further advantages from a safety perspective can be added since no biocides are used to the material thickener material.

Emulsifier und surfactants are not needed during the incorporation process. As a consequence, the VOC content of the final formulation can be lowered significantly. This leads to a very advantageous situation in terms of labelling. Powder thickener are free of labelling.

Performance

Flexible use – Incorporation

The RHEOLATE® powder NiSAT range has relatively low shear requirements for the incorporation into the final system. We recommend the following processes.

Millbase incorporation

During the dispersion and milling of pigments and fillers, typically sufficient shear forces to incorporate the thickener easily and effectively are provided.

Studies in low PVC paint have shown that at a tip speed of 14 m/s for 30 min, e.g. by tooth bladed cowles dissolver is sufficient to produce particle free end systems.

Post addition

Post addition processes are running with lower speed than millbase processes since the systems viscosity is usually in such cases low.

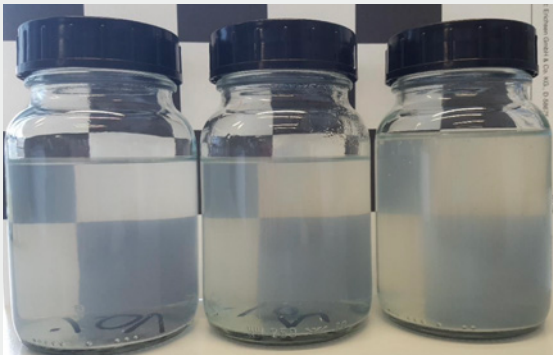
Internal studies in low PVC paints have revealed that incorporation with a dissolver at a tip speed of 8 m/s applied for approximately 30 minutes allow a particle free incorporation of the powder thickener.

RHEOLATE® PHX 7025

10% active

20% active

Liquid NiSAT



Intermediate

As a further method of incorporation, the RHEOLATE® powder thickener group allow to create intermediates with different solid content in water.

As an example, RHEOLATE® PHX 7025 pre-gels can easily be blended in ratio level of up to 20%. Consider, typically supplied liquid NiSAT products contains in the majority up to 25%. Higher contents are generally possible but are depending on the handling. It is generally recommended to add biocide when the intermediate is stored for a longer period.

In the case RHEOLATE® 208 and RHEOLATE® FX 1100 the potential pre-gel concentration are different. The following intermediate concentration are recommended.

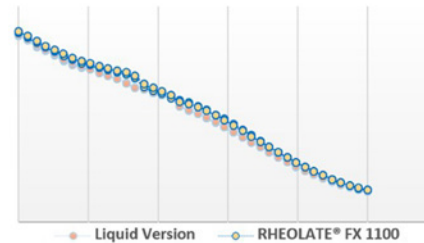
| | |
|--------------------|-----|
| RHEOLATE® 208 | 4% |
| RHEOLATE® FX 1100 | 3% |
| RHEOLATE® PHX 7025 | 20% |

Incorporation can e.g. be done by cowles dissolver (min 20. minutes; 16 m/s) or propeller mixer at moderate shear (min 30).

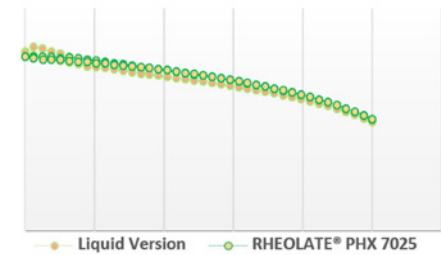
Efficiency

The RHEOLATE® NiSAT powder thickeners are providing 100% rheologically active material. In the typically available liquid products active content varies between 25-50%. Additionally to the active component, liquid NiSAT grades are containing further chemicals to reduce the product viscosity to a manageable and pumpable level. These can be hydrophilic coalescents or surfactants. In the case of the powder versions these components are missing. As a consequence, powder NiSAT grades are providing higher effectivity compared to the liquid versions related to the active component. The effectivity advantage can in dependence of chemistry.

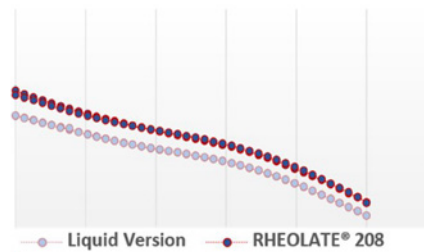
In the following the results of an effectivity study (Figure 3) in an aliphatic PU-Alkyd dispersion are shown. The active loading in case of RHEOLATE® 208 and RHEOLATE® FX 1100 was in all the case 0.33%. In case of RHEOLATE® PHX 7025 the active loading was set to 0.86%. The active loading of the individually tested liquid versions was identical.



| Product | KU Units |
|-------------------|----------|
| RHEOLATE® FX 1100 | 131 |
| Liquid Version | 116 |
| Benefit | 12% |



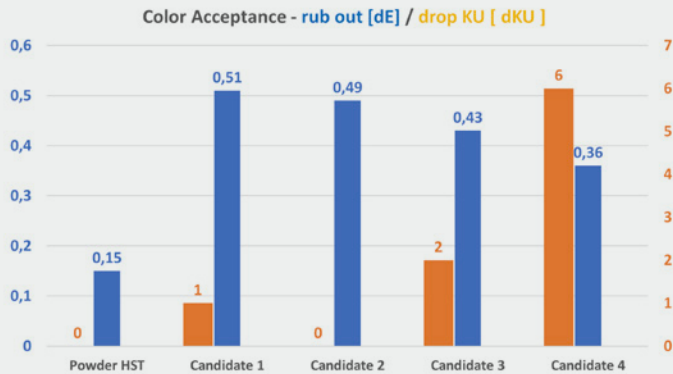
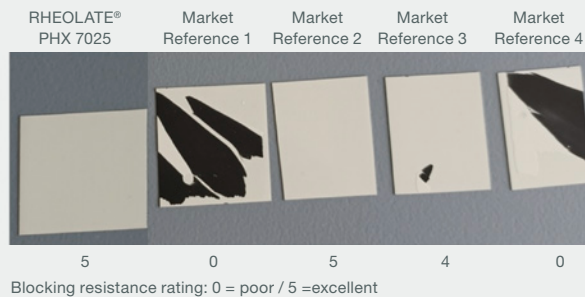
| Product | KU Units |
|--------------------|----------|
| RHEOLATE® PHX 7025 | 79 |
| Liquid Version | 73 |
| Benefit | 8% |



| Product | KU Units |
|----------------|----------|
| RHEOLATE® 208 | 125 |
| Liquid Version | 106 |
| Benefit | 18% |

FIGURE 3: Efficiency comparison

As visualized, the maximum achievable efficiency benefit at equal active loading is 18%. The relevant flow characteristics of the individual powder NiSAT grade in comparison to the relevant liquid version remains unaffected.

FIGURE 4: Colour & viscosity stability up on tinting**FIGURE 5:** Blocking resistance

Film properties

The use of the RHEOLATE® powder NiSAT grades generates in comparison to the relevant liquid versions also benefits in terms of wet and dry film properties. This is the case since the powder thickener do not contain substances such as coalescents, emulsifiers and surfactants as in liquid products. These can have an adverse influence on the resulting film properties.

The left study (**FIGURE 4**) shows a comparison of RHEOLATE® PHX 7025 to various liquid Newtonian NiSAT grades in terms of their effect properties like color acceptance, rub out behavior and viscosity stability. In the test a colorant (1%; Chroma Chem black 7 WAB) has been added to a the same aliphatic PU-Alkyd paint utilized in case of the efficiency testing.

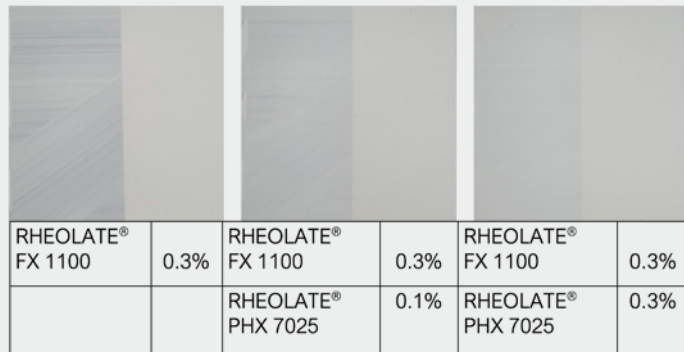
The sample formulated with RHEOLATE® PHX 7025 shows the best stability indicated by the lowest tan delta and KU differences after tinting.

Another large benefit can be achieved with the use of the powdered NiSAT grades in terms of the blocking resistance. In Figure 5 the effect of the various NiSAT grades is shown on used PU-Alkyd based paint. Active loading of all tested NiSAT grades was 0.86%.

It becomes obvious that the sample manufactured with RHEOLATE® PHX 7025 performs excellently in the terms of the blocking resistance. Most of the tested liquid market reference product guides to less block resistant paints.

Also combination of RHEOLATE® PHX 7025 with other NiSAT grades are perfectly possible in order to create tailor-made rheological characteristics. From the powder NiSAT side it makes most sense to combine with the also powdered RHEOLATE® FX 1100.

FIGURE 6: Hiding power & levelling



In **FIGURE 6** the results of the effect of RHEOLATE® PHX 7025 on a styrene acrylic wall paint formulation equipped with a fixed loading of RHEOLATE® FX 1100 is displayed. It can be seen, that with increasing loading of the Newtonian RHEOLATE® PHX 7025 in the thickener package levelling and hiding power are optimized.

Conclusion

The powdered RHEOLATE® NiSAT grades are ideal products for the manufacturing of sustainable paints and coatings.

- Adding sustainability: Powder NiSAT grades realize up to 80% CO₂ reduction on transportation and require up to 6 times less storage space
- Adding safer ingredients: Powdered NiSAT's are free from biocides and are therefore ideal product in the manufacturing of anti-asthma and anti-allergy paints.
- Adding performance: Powder NiSAT grades realize higher effectivity, improve rheology and create.

APPENDIX

Test methods

Rheology data

Determined using the Anton-Paar MCR 302 rheometer, equipped with CP 25 measuring geometry at a gap width of 1 mm, at a temperature of 23°C.

KU viscosity

KU describes the Krebs-Stormer viscosity. Typically the mid-shear or appearing in-can viscosity is represented.

| Raw Material | Concentration [%] |
|--------------------------|-------------------|
| Demineralized water | 15.27–X |
| DAPRO® DF 52 | 0.03 |
| NUOSPERSE® FX 610 | 1.10 |
| SUPREADTM 2059 | 1.00 |
| Alkyd/PU binder emulsion | 57.50 |
| Rheology modifier | Afbeelding |
| Siccative | 1.20 |
| Pigment titanium dioxide | 22.60 |
| Toner | 0.03 |
| Coalescing agent | 1.00 |
| Total | 100.0 |

Brush-out levelling

Brush-out leveling was tested by brushing out 40 g of paint equally on leneta chart (Measuring range: 0 = poor/5 = excellent). The higher the mentioned number the better the performance.

Blocking resistance

Test paint has been blade applied on leneta charts at a layer thickness of 250 µm. After 48 hours drying time Afterwards the test panels were cut in pieces (5 cm x 8 cm) and placed with its coated side on top of each other. The specimen has been stored for 3 hours at elevated temperature of 50°C with a 5 kg weight on top. After 15 minutes cool down the panels were separated by hand and the blocking resistance judged visually.

Color acceptance

Tested after tinting the PU-alkyd based test paint with 1% colorant (Chroma Chem black 7 WAB). Incorporation by 10 minutes scandex shaker. Applied on leneta charts by blade at a layer thickness of 150 µm. After 2 minutes the rub-out test has been performed. Delta E between has been determined by Datacolor Microflash 100.

Test formulation

Aqueous, PU-alkyd based test paint.

NOTE:

The information herein is currently believed to be accurate. We do not guarantee its accuracy. Purchasers shall not rely on statements herein when purchasing any products. Purchasers should make their own investigations to determine if such products are suitable for a particular use. The products discussed are sold without warranty, express or implied, including a warranty of merchantability and fitness for use. Purchasers will be subject to a separate agreement which will not incorporate this document.

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