ELEMENTIS

A global specialty chemicals company

Application Leaflet

RHEOLATE® HX 6010IF and RHEOLATE® HX 6008IF

High performance Newtonian NiSAT based rheology modifiers for waterborne alkyd based paint

Key Benefits

- Highly effective viscosity build at high-shear rates
- Improved leveling due to Newtonian flow
- Minor influence on secondary paint properties

Enhanced Performance Through Applied Innovation

Introduction

Historically, solventborne alkyd paints are widely used in the coating industry for trim paint and exterior woodwork. Waterborne alkyd systems were already introduced 50 years ago to reduce the VOC content and ensure easier water cleanup of tools.

To achieve the desired flow characteristics of solventborne alkyds in waterborne, special thickeners with Newtonian rheological behavior are required. It is important that they do not influence secondary paint properties such as gloss, appearance, workability, and color acceptance of the final coating.

In waterborne alkyds, associative thickeners with Newtonian behavior often exhibit inadequate efficiency, because of reduced interaction between the hydrophobic anchor groups and the resin. In these products, the hydrodynamic volume of active molecules is typically responsible for the viscosity achieved under high shear conditions. As a consequence of the lower tendency to interact, larger quantities of rheological additives are often needed to obtain the required viscosity. Further, often some mid-shear contribution can be observed, which, however, is not desired in all cases.

RHEOLATE® HX 6010IF and RHEOLATE® HX 6008IF are ideal candidates for waterborne alkyd systems due to their high efficiency in comparison to traditional NiSAT grades.

RHEOLATE® HX 6010IF shows a purely Newtonian flow. It mainly builds viscosity at high-shear rates. Only a minor effect on the viscosity at low and mid-shear forces is observed.

	RHEOLATE® HX 6010IF	RHEOLATE® HX 6008IF
Composition	Polyurethane solution in water	
Appearance	Opaque liquid	
Specific gravity	1.05	
Active solids (by weight), [%]	21	25
Viscosity, [cps]	<3000	1000 - 4000
pH	6	4 - 6
VOC (ASTM D 6886-03), [%]	<0.01	<0.2

Incorporation and levels of use

RHEOLATE® HX 6008IF and RHEOLATE® HX 6010IF can be used as delivered or further diluted with water. They can be added at any time during the manufacturing process, however incorporation into the mill base before the letdown is recommended. Both grades can be combined with other associative rheological additives, clay based thickeners or cellulosic thickeners to achieve the desired rheological profile.

It is important to assess the effectiveness of RHEOLATE® HX products in the entire system, as performance might be affected by other raw materials. Further detailed background information on the technology of nonionic synthetic associative thickeners can be found in the Elementis Rheology Handbook.

Products tested

Formulation

Table 1: Waterborne PU-alkyd based topcoat

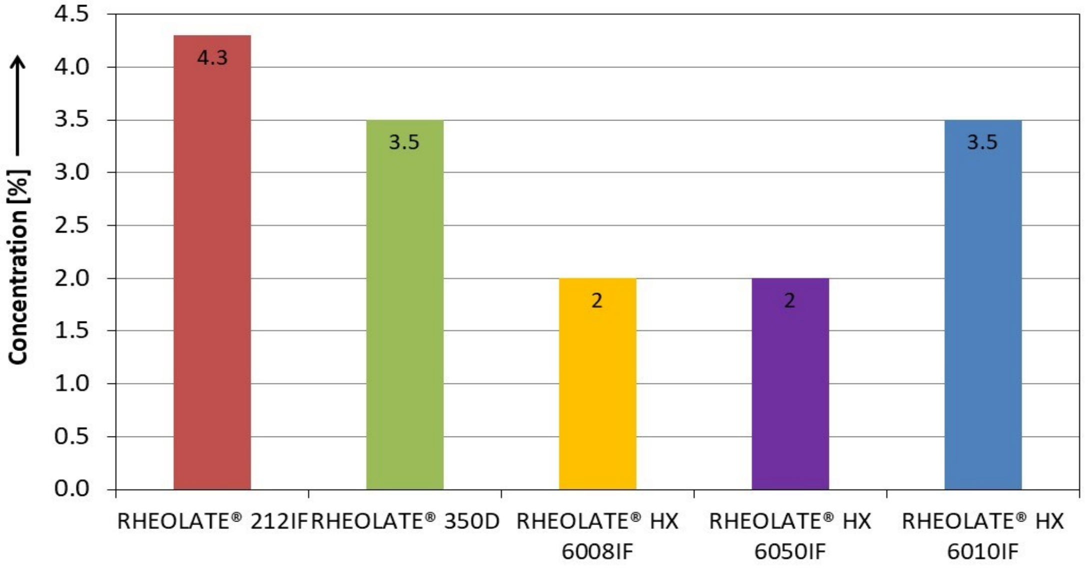
Component	Concentration [%]
Demineralized water	11.25 - X
Defoamer	0.50
Dispersant	1.15
Rheological additive	**X**
Titanium dioxide	22.65
NuoPac® PU-580	60.10
Siccative	1.15
Slip-agent	0.05
Leveling/flow additive	0.15
Total	100.00

X is variable in accordance with individual concentration.

Thickener loading

The figure 1 shows the amount of thickener required to reach a high-shear/ICI viscosity of 4.0 Poise.

Figure 1

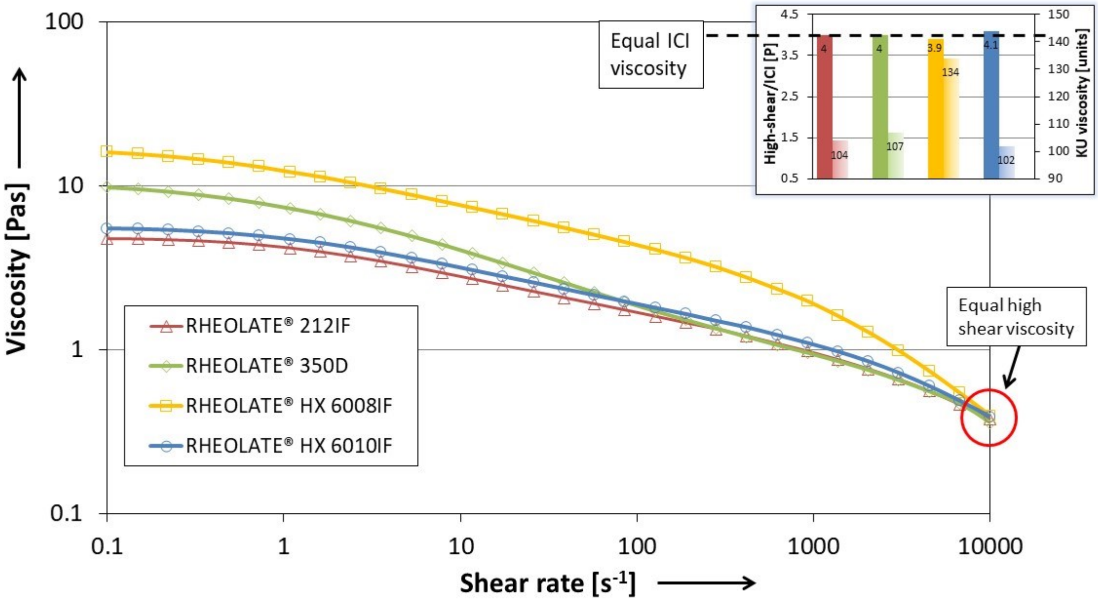


RHEOLATE® HX 6010IF and RHEOLATE® 350 D require lower loading levels than RHEOLATE® 212IF to reach the same high-shear viscosity. The lowest addition levels are observed with RHEOLATE® HX 6008IF.

Rheological character

The figure 2 shows the flow characteristics of the waterborne PU-alkyd based topcoat, formulated with the amount of thickener necessary to achieve equal high-shear viscosities at 10000 s^{-1} (ICI). The small inset shows the ICI viscosity and the corresponding KU contribution for the individual thickeners.

Figure 2

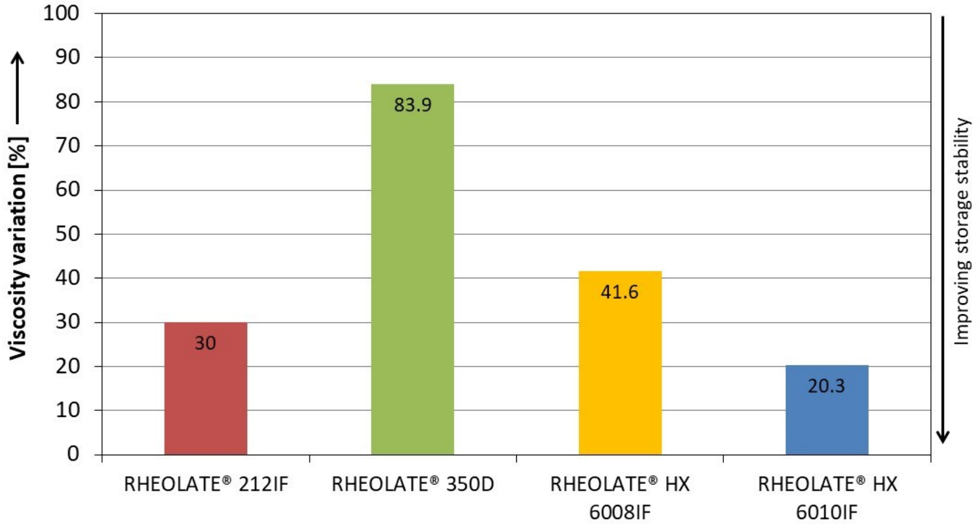


RHEOLATE® HX 6010IF and RHEOLATE® 212IF demonstrate the most Newtonian flow. The sample containing RHEOLATE® 350 D displays equal viscosity values at high and mid-shear rates, but decidedly higher viscosity at lower shear. RHEOLATE® HX 6008IF provides the highest viscosity at all tested shear rates, which is confirmed by the high KU viscosity.

Viscosity stability

The figure 3 displays the viscosity change measured at a shear rate of 0.1 s^{-1} after 3 weeks of storage at an elevated temperature of 50 °C. The lower the bar, the better the performance.

Figure 3

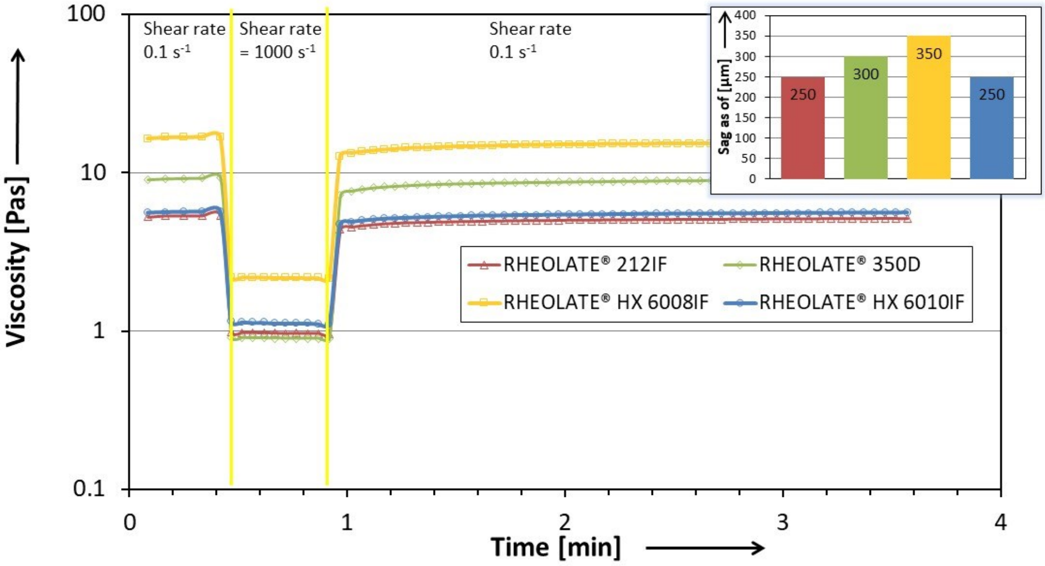


The sample formulated with RHEOLATE® HX 6010IF shows the least viscosity variation after storage at elevated temperature.

Viscosity recovery in relation to sag stability

The figure 4 demonstrates the recovery behavior of the test paints after the removal of high-shear forces. The sag resistance tested with an application blade is shown in the right corner.

Figure 4

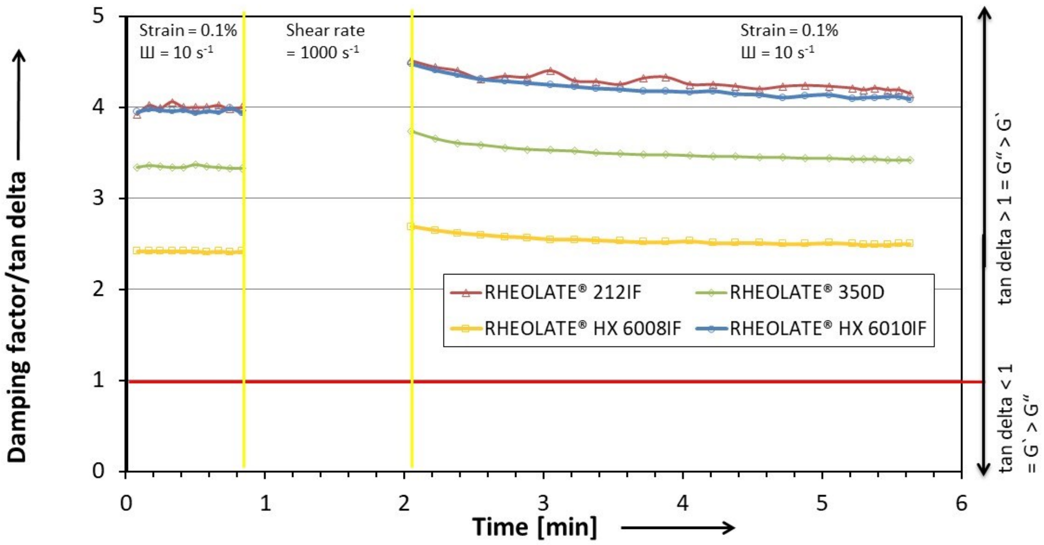


All samples display equal viscosity recovery times. The sample containing RHEOLATE® HX 6008IF displays the highest viscosity of all tested samples immediately after the removal of shear. This is followed by RHEO-LATE® 350 D. RHEOLATE® HX 6010IF and RHEOLATE® 212IF give the lowest viscosities at low-shear. Sag resistance, measured as maximum layer thickness after blade application directly correlates with the viscosity

Viscoelasticity

The figure 5 shows the viscoelastic properties determined in an oscillatory test before and after the influence of high-shear. Damping factor (tan delta) values of above 1 indicate predominantly fluid characteristics; values of below 1 indicate predominantly elastic properties.

Figure 5

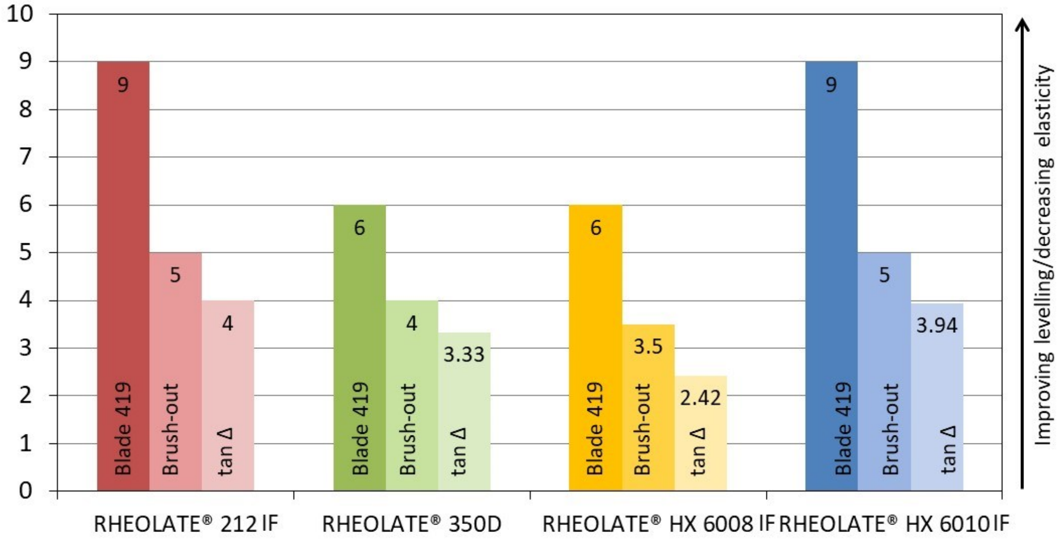


All tested samples demonstrate tan delta values of above 1 which indicates a dominant fluid character. Material formulated with RHEOLATE® HX 6010IF and RHEOLATE® 212IF show the highest tan delta values indicating the strongest fluid behavior of all tested samples.

Leveling in context with viscoelasticity

The figure 6 shows the leveling behavior with blade and brush application. The values are compared to the damping factors/tan delta values shown in the graph before.

Figure 6



Both grades, RHEOLATE® HX 6010IF and RHEOLATE® 212IF, provide the most Newtonian flow character and display the best leveling which correlates to the largest tan delta values. RHEOLATE® 350 D and RHEOLATE® HX 6008IF, are less Newtonian, and do not level as well.

As previously mentioned, all tested samples have tan delta values higher than 1 indicating dominant fluid characteristics. It can clearly be seen that higher tan delta levels indicate improved leveling.

Application properties

The table 2 shows application data such as gloss, surface appearance, general workability and behavior upon tinting.

Table 2

Rheological additive	Gloss at 60° [units]	Surface defects/ cissing	Block resistance	Color acceptance ΔE
RHEOLATE® 212IF	86	5	5	0.40
RHEOLATE® 350 D	89	5	4	0.20
RHEOLATE® HX 6008IF	87	5	5	0.21
RHEOLATE® HX 6010IF	87	5	5	0.34

All samples tested demonstrate almost equal gloss values and block resistance. No coating appearance issues, such as surface defects or cissing are detected. After tinting, only minor differences in ΔE values tinting were found, all within an acceptable range.

None of the tested rheology modifiers negatively affects any of the tested properties of the final coating.

Conclusion

RHEOLATE® HX 6010IF provides outstanding high-shear viscosity build with only a minor effect on mid-shear viscosity. It is more efficient in use than the traditional Newtonian NiSAT grades. RHEOLATE® HX 6010IF gives excellent storage stability and application properties. It shows great leveling properties as indicated by the viscoelastic data.

If moderate mid-shear thickening together with a strong Newtonian character is required, RHEOLATE® HX 6010IF is the most efficient option. RHEOLATE® HX 6008IF is the most efficient thickener of all four tested, but also has the highest KU contribution. RHEOLATE® HX 6008IF provides higher sag resistance than RHEOLATE® HX 6010IF when used as a stand-alone thickener.

Traditional grades such as RHEOLATE® 212IF and RHEOLATE® 350 D are less efficient in use: they need a higher loading level to reach the same high-shear viscosity. At this higher loading level RHEOLATE® 212IF exhibits the same Newtonian character as RHEOLATE® HX 6010IF. RHEOLATE® 350 D imparts strong high shear thickening with less influence on KU build than the RHEOLATE® HX 6008IF.

Appendix

Test methods

- High-shear/ICI (at 10000 s^{-1}) viscosity was measured in accordance with the Elementis standard methods of testing at a temperature of 23 °C , 24 hours after manufacturing the adhesives.
- The rheograms and viscoelasticity/oscillation curves were determined using the Anton-Paar MCR 301 rheometer, equipped with measuring geometry PP 50 , at a gap width of 1 mm and at a temperature of 23 °C.
- Sag was tested using a test blade with applicable ayer thicknesses of 100 - 500 µm. The displayed values indicate the maximum applicable layer thickness without runners.
- Leveling was determined using test blade 419 (measuring range from 0 to 10). Brush-out leveling was testes by brushing out 25 g of paint equally on leneta chart (Measuring range: 0 = poor/5 = excellent). In both cases, the higher the mentioned number the better the performance.
- Gloss was determined using the BYK/Gardner haze/gloss tester at a measuring angle of 60 °C.
- Surface defects/cissing and block resistance was measured visually on a scale from 0 to 5 ; the higher the number the better the performance.
- Color acceptance was measured as ΔE values after equipping the individual paints with 2% of blue universal colorant VOC-free, PEG containing Colortrend 807-7055 EXE ES blue.

Abbreviations used

- NiSAT stands for “Nonionic Synthetic Associative Thickener”.

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