ELEMENTIS

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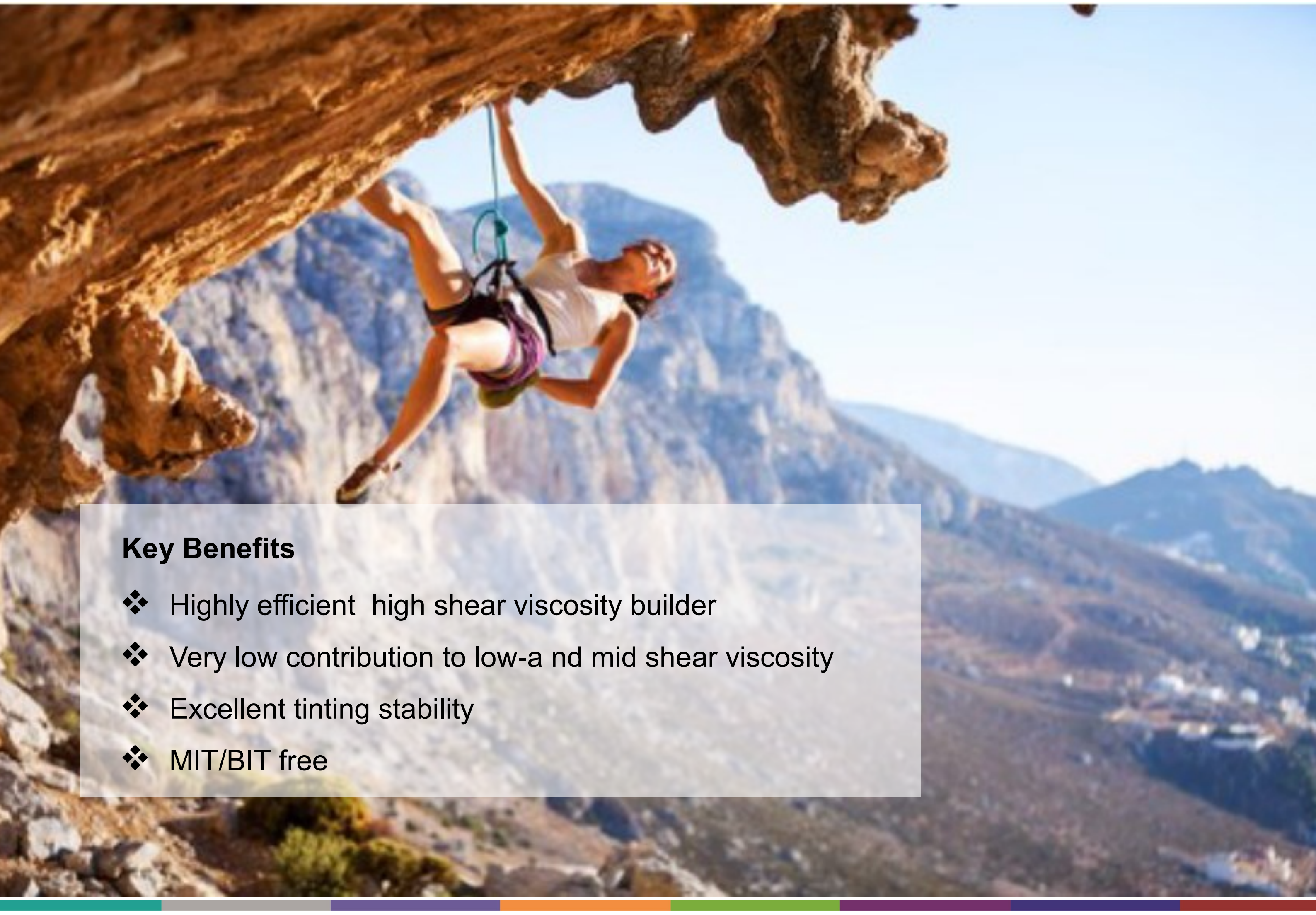
Application Leaflet

RHEOLATE® HX 6010 IF

Highly efficient high shear nonionic synthetic associative thickener (NiSAT) for excellent application properties



Key Benefits

- Highly efficient high shear viscosity builder
- Very low contribution to low-a nd mid shear viscosity
- Excellent tinting stability
- MIT/BIT free

Introduction

RHEOLATE® HX 6010IF is a 21% active solids, nonionic synthetic associative thickener for aqueous applications. It is designed as a Newtonian highshear (ICI) builder for water based decorative paints but can also be used in other water based systems including wood coatings, inks, textile coatings, adhesives and sealants.

RHEOLATE® HX 6010IF is free from MIT and BIT.

Composition

Composition	Polyurethane solution in water
Appearance	Opaque liquid
Active content, [%]	21
Specific gravity [g/cm^3]	1.05
Viscosity [mPas] (Broofield; Sp 4; 20 rpm)	<3000
pH	~6
VOC [%] (ASTM D 6886-03)	25

Benefits

- Highly efficient high shear (ICI) thickener
- Outstanding application properties
- Compatible with many resin systems and especially efficient with acrylic and styrene acrylic resins
- Excellent balance of sag and levelling
- Excellent tinting stability
- Very low VOC content
- Very low contribution to low and mid shear (KU) viscosity
- Easy managable
- pH independent
- High spattering resistance
- Good storage stability
- MIT and BIT free

Applications

- High quality, low VOC aqueous decorative paints
- Water based adhesives and sealants
- Aqueous industrial coatings
- Waterborne inks
- Wood coatings
- Textile coatings

Handling

RHEOLATE® HX 6010IF can be used as supplied or, if necessary, further diluted with water. Addition can take place at any time during the manufacturing process but incorporation into the mill base before let down is recommended. RHEOLATE® HX 6010IF can be combined with other associative rheological additives, clay based thickeners or cellulosic thickeners for higher package viscosity.

Typical use levels of RHEOLATE® HX 6010IF are 0.3% to 3.0% (thickener solids weight) on total system weight.

Overview properties

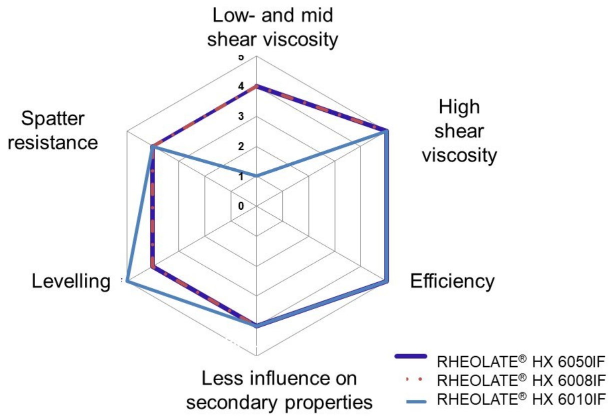


Figure 1: Positioning within the RHEOLATE® HX

Evaluation in pvc 30 paint

The objective of this study was to evaluate RHEOLATE® HX 6010IF against other thickeners at equal ICI viscosity of 2 +/- 0.1 Poise in PVC 30% pure acrylic paint formulation. In this study several high-shear thickening additives were included (*Table 1*).

Name	Active content [%]	Description
RHEOLATE® HX 6010IF	21	Polyether polyurethane
RHEOLATE® HX 6008IF	25	Polyether polyurethane
RHEOLATE® HX 6050IF	25	Polyether polyurethane
RHEOLATE® 212IF	20	Polyurethane associative
Market reference 1	10	Hydrophobically modified ethylene oxide urethane (HEUR
Market reference 2	18.5	Hydrophobically modified ethylene oxide urethane (HEUR)
Market reference 3	20	Hydrophobically modified polyether
Market reference 4	25	Non-ionic water soluble polyurethane

Table 1: Overview tested products

All paints used in the first part of this study were first adjusted to the same High-shear ICI viscosity of 2 +/- 0.1 Poise and then were measured for rheograms, KU and Brookfield viscosities.

Part 1: Comparison of RHEOLATE® HX thickeners against each other

Part 2: Comparison of RHEOLATE® HX 6010IF against market references weight.

Additive	Conc.	Viscosities	
	[%]	Stormer KU [units]	Brookfield (20 rpm) [mPas]
RHEOLATE® HX 6010IF	2.40	79	1200
RHEOLATE® HX 6008IF	1.50	106	2900
RHEOLATE® HX 6050IF	1.80	139	8550
RHEOLATE® 212IF	3.25	82	1500
Market reference 1	3.34	96	2200
Market reference 2	2.30	90	1800
Market reference 3	3.00	81	1200
Market reference 4	2.36	97	1850

Table 2: Viscosity data in acrylic pvc 30 paint

It becomes visible that when adjusted to equal high shear viscity (ICI), the use of RHEOLATE® HX 6010IF resulted in the lowest mid shear viscosity (KU and Brookfield) of all tested thickeners.

Comparing all RHEOLATE® HX grades to each other creates the rheology characteritics visualized in *Figure 2*.

Part 1: RHEOLATE® HX comp.

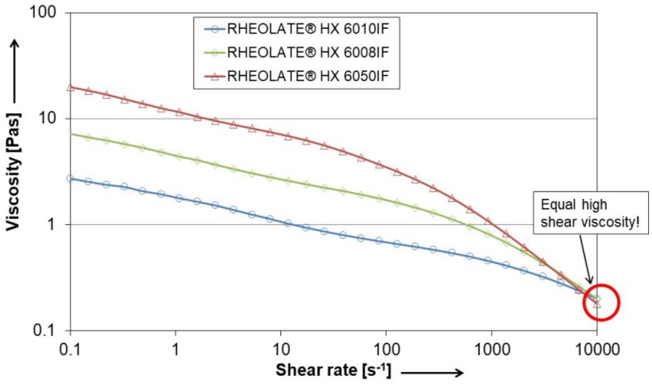


Figure 2: Rheology behaviour RHEOLATE® HX group

At equal ICI viscosity of 2 Poise, RHEOLATE® HX 6008IF has shown the best efficiency followed by RHEOLATE® HX 6050IF and RHEOLATE® HX 6010IF. RHEOLATE® HX 6010IF gave the lowest KU and Brookfield viscosities compared to other thickeners. RHEOLATE® HX 6050IF and RHEOLATE® HX 6008IF provided the higher KU viscosities in comparison to other thickeners studied. RHEOLATE® HX 6010IF showed the most Newtonian viscosity profile. The flow behaviour of RHEOLATE® HX 6050IF is found to be the most shear thinning. For more information please refer to the Elementis application leaflets of RHEOLATE® HX 6050IF and RHEOLATE® HX 6008IF.

In *Figure 3* the flow characteristics of RHEOLATE® HX 6010IF in comparison to the also tested market reference grades is shown.

Part 2: Market reference comp.

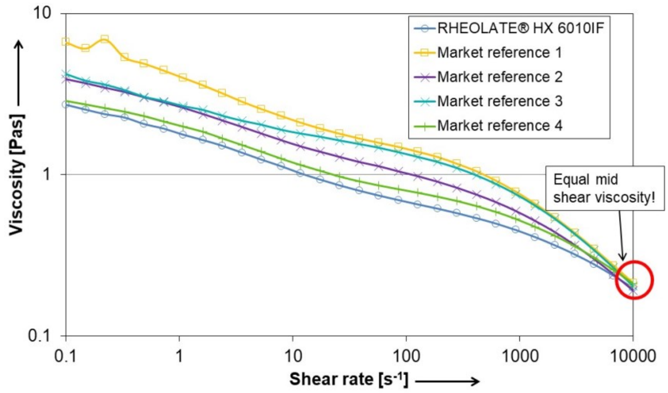


Figure 3: Rheology comparison to market references

RHEOLATE® HX 6010IF and Market reference 3 displayed quite similar KU and Brookfield viscosities (*Table 2*) and a quite similar flow curve (*Figure 3*). There is however a significant difference in the loading level to achieve the tar-geted ICI viscosity of 2.0 +/- 0.1 Poise. It is for RHEOLATE® HX 6010 nearly 20% less compared to Market Reference 3. Therefore it can be concluded that RHEOLATE® HX 6010IF is more efficient in the current system.

Market references 1, 2 and 4 already showed a more shear thinning flow behaviour displayed in KU and Brookfield viscosities as well as in flow curve. Market references 2 and 4 needed a comparable loading level to adjust targeted ICI viscosity. Market reference 1 showed the most contribution to low and mid shear viscosi-ty at higher loading level.

Evaluation in pvc 19 paint

The objective of this study was to evaluate RHEOLATE® HX 6010IF against RHEOLATE® 212IF and the most matching market reference 3 in PVC 19% pure acrylic paint at equal mid-shear/KU viscosity of 115 +/- 3 units and high-shear/ICI viscosity of 2 +/- 0.1 Poise.

RHEOLATE® 655 was used in addition to the above mentioned Newtonian NiSAT grades as Mid shear viscosity builder at a concentration of 0.15% each.

The resulting mid shear/KU viscosities have been presented in *Table 3*.

Additive	Conc. [%]	Viscosities Stormer KU [units]
RHEOLATE® HX 6010IF	1.50	79
RHEOLATE® 212IF	3.25	82
Market reference 3	1.75	81

Table 3: Viscosity data in acrylic pvc 19 paint

The use RHEOLATE® HX 6010IF resulted in the lowest mid shear/KU viscosities.

RHEOLATE® HX 6010IF required the lowest loadings compared to RHEOLATE® 212IF and the market reference in order to obtain equal high shear viscosity.

A rheological comparison can be found in *Figure 4*.

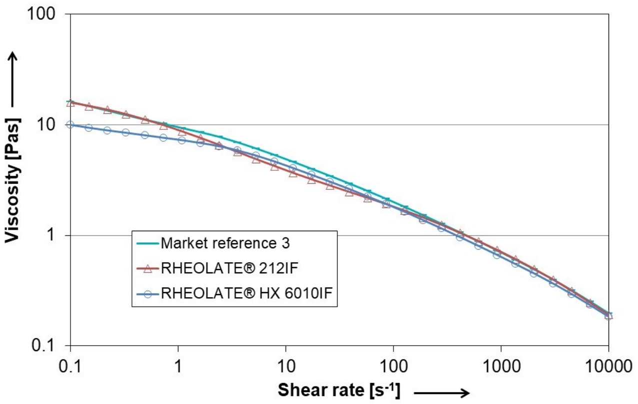


Figure 4: Rheology comparison

RHEOLATE® HX 6010IF showed the lowest contribution in comparison to the low and mid shear viscosity and provides therefore the most Newtonian flow character.

In the following *Table 4*, the influence of the tested Newtonian NiSAT grades on the application properties has been vizualized.

Additive	Sag as of [µm]	Levelling Blade 419 (0 = poor; 10 = excellent)	Levelling Brush-out (0 = poor; 5 = excellent)
RHEOLATE® HX 6010IF	400	6	3
RHEOLATE® 212IF	350	6	3-4
Market reference 3	350	6	4

Table 4: Application properties

RHEOLATE® HX 6010IF performed slightly better in sagging whereas no significant difference was observed in levelling and Brush-out. Structural recovery measurements support the observed sag resistance values.

In *Table 5* the influence of the NiSAT thickeners on the colour acceptance and the viscosity stability after the addition of 1% colorants carbon black, organic blue and violet) is shown.

Additive	Carbon black Δ KU [units]	Carbon black Δ ICI [P]	Carbon black Rub-out [ΔE]	Organic violet Δ KU [units]	Organic violet Δ ICI [P]	Organic violet Rub-out [ΔE]	Organic blue Δ KU [units]	Organic blue Δ ICI [P]	Organic blue Rub-out [ΔE]
RHEOLATE® HX 6010IF	1	-0.1	0.12	-2	-0.1	0.15	4	0	0.13
RHEOLATE® 212IF	-4	-0.1	0.11	-6	-0.1	0.2	-2	0	0.12
Market reference 3	-6	0	1.03	-11	0	0.37	-5	0	0.34

Table 5: Colour acceptance & viscosity stability

RHEOLATE® HX 6010IF and RHEOLATE® 212IF showed a significantly lower KU viscosity reduction and superior col-our acceptance (lower Δ E) in comparison to Market reference 3 with all three tinters. No significant changes were observed in the ICI viscosity values.

Conclusion

RHEOLATE® HX 6010IF is an extremely high efficient next generation nonionic synthetic associative thickener for waterborne systems.

RHEOLATE® HX 6010IF provides:

- Provides excellent high shear rate viscosity build (ICI) with very low land mid-shear contribution (best in class Newtonian flow behaviour)
- Has excellent tinting stability
- Outperforms all tested ICI thickeners
- MI/BIT free

Appendix

Test methods

High-shear/ICI viscosity

Indicates the viscosity at high shear rates of 10000 s^{-1} measured by a cone/plate equipped ICI viscometer.

Rheology data

Determined using the Anton-Paar MCR 301 rheometer, equipped with PP 50 measuring geometry at a gap width of 1 mm, at a temperature of 23°C. KU viscosity.

KU describes the Krebs-Stormer viscosity. Represents the mid-shear or in-can viscosity.

Sag control

Sag was tested using a test blade with applicable layer thicknesses of 50 - 500 µm. The displayed values indi-cate the maximum applicable layer thickness without runners.

Levelling

Levelling was determined using test blade 419 and after brush application. The characteristics were judged visually on a scale from 0 to 10 (in case of blade testing) and 1 to 5 (in case of brush-out testing). The higher the mentioned number indicates better performance.

Colour acceptance and viscosity stability

Determined after the addition of 1% colorant. The tinted paints were applied at 150 µm on a leneta chart after 10 minutes mixing in the Scandex shaker. The rub-out tests are be-ing performed 2 min after application. After drying the ΔE value was determined using the Datacolor Micro-flash 100. Viscosity stability was measured using the KU viscosimeter.

Test formulation

Acrylic pvc 30 paint

Raw material	Concentration [%]	Function
Tapwater	17.95	Diluent
NUOSPERSE® FX 504	0.10	Dispersing agent
Defoamer	0.20	Defoamer
Softener	0.10	Softener
Titaniumdioxide	4.10	Pigment
Calciumcarbonate, various particle sizes	21.70	Extender
MICROTALC® IT Extra	2.40	Extender
Aluminiumsilicate	1.10	Extender
Aqueous copolymer dispersion, acrylic and methacrylic acid esters	51.55	Binder
Dowanol DPnB	0.55	Coalescing agent
Rheological additive	X	Viscosity control
Ammonia Solution (w=24.9%)	0.15	pH adjustment
In-can preservation	0.05	Biocide
	100.0	

Acrylic pvc 19 paint

Raw material	Concentration [%]	Function
Tapwater	15.35-X	Diluent
NUOSPERSE® FX 605	2.00	Dispersing agent
NUOSPERSE® FX 600	1.00	Dispersing agent
Defoamer	0.30	Defoamer
RHEOLATE® 655	0.15	Rheology modifier
Titaniumdioxide	23.00	Pigment
Aqueous copolymer dispersion, acrylic and methacrylic acid esters	58.00	Binder
Newtonian NiSAT	X	Rheology modifier
Ammonia Solution (w=24.9%)	0.15	pH adjustment
In-can preservation	0.05	
	100.00	

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