



ELEMENTIS

Application Leaflet

RHEOLATE® HX 6010 IF

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

Unique chemistry, sustainable solutions

Key Benefits

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

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

Introduction

RHEOLATE® HX 6010 IF 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.

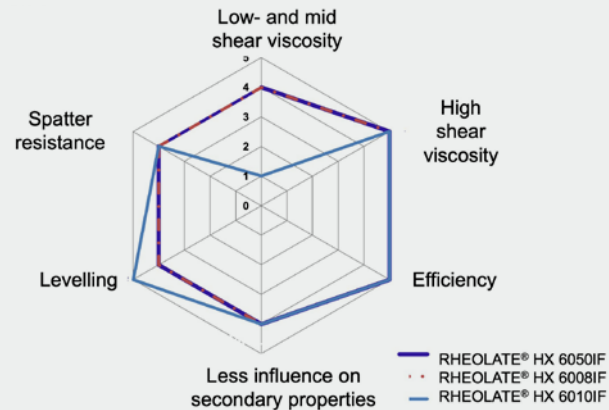
RHEOLATE® HX 6010 IF is free from MIT and BIT.

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

Overview properties

FIGURE 1: Positioning within the RHEOLATE® HX



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 6010 IF 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 6010 IF can be combined with other associative rheological additives, clay based thickeners or cellulosic thickeners for higher package viscosity.

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

TABLE 1: Overview tested products

Name	Active content [%]	Description
RHEOLATE® HX 6010 IF	21	Polyether polyurethane
RHEOLATE® HX 6008 IF	25	Polyether polyurethane
RHEOLATE® HX 6050 IF	25	Polyether polyurethane
RHEOLATE® 212 IF	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 2: Viscosity data in acrylic pvc 30 paint

Additive	Conc. [%]	Viscosities	
		Stormer KU [units]	Brookfield (20 rpm) [mPas]
RHEOLATE® HX 6010 IF	2.40	79	1200
RHEOLATE® HX 6008 IF	1.50	106	2900
RHEOLATE® HX 6050 IF	1.80	139	8550
RHEOLATE® 212 IF	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

Evaluation in pvc 30 paint

The objective of this study was to evaluate RHEOLATE® HX 6010 IF 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**).

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 6010 IF against market references weight.

It becomes visible that when adjusted to equal high shear viscosity (ICI), the use of RHEOLATE® HX 6010 IF 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 characteristics visualized in **FIGURE 2**.

FIGURE 2: Rheology behaviour RHEOLATE® HX group

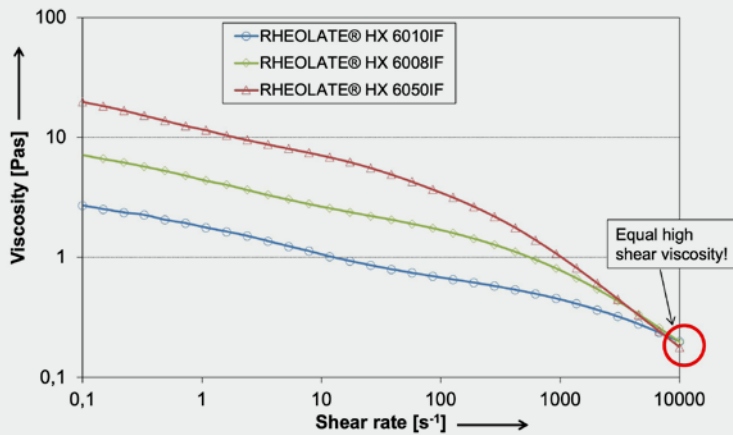
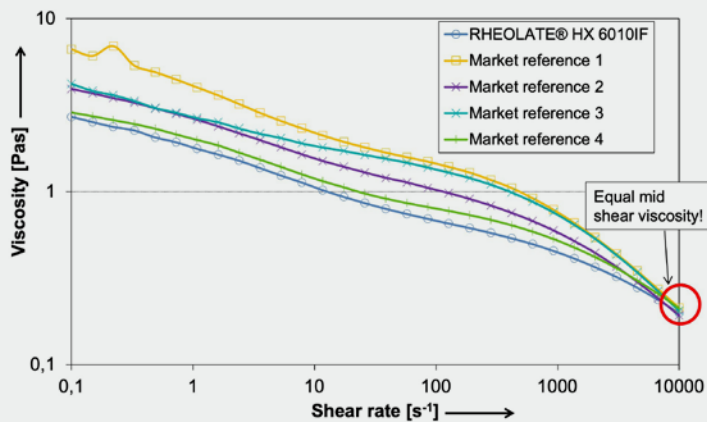


FIGURE 3: Rheology comparison to market references



Part 1: RHEOLATE® HX comp.

At equal ICI viscosity of 2 Poise, RHEOLATE® HX 6008IF has shown the best efficiency followed by RHEOLATE® HX 6050IF and RHEOLATE® HX 6010 IF. RHEOLATE® HX 6010 IF 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 6010 IF 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 6010 IF in comparison to the also tested market reference grades is shown.

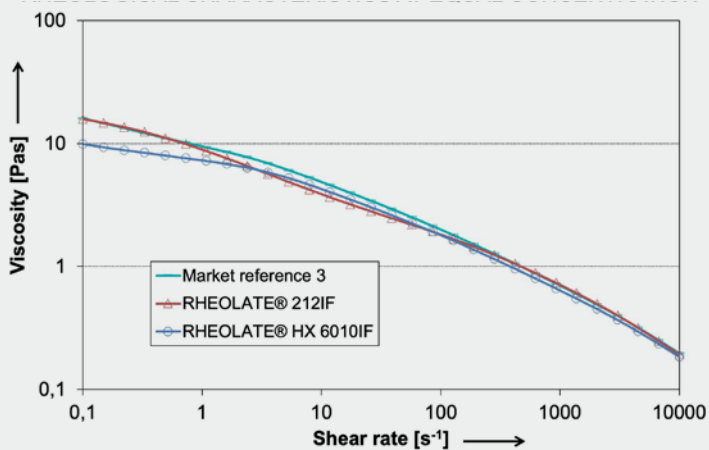
Part 2: Market reference comp.

RHEOLATE® HX 6010 IF 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 targeted ICI viscosity of 2.0 +/- 0.1 Poise. It is for RHEOLATE® HX 6010 IF nearly 20% less compared to Market Reference 3. Therefore it can be concluded that RHEOLATE® HX 6010 IF 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 viscosity at higher loading level.

TABLE 3: Viscosity data in acrylic pvc 19 paint

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

FIGURE 4: Rheology comparison

Evaluation in pvc 19 paint

The objective of this study was to evaluate RHEOLATE® HX 6010 IF 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**.

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

RHEOLATE® HX 6010 IF 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**.

TABLE 4: Application properties

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

TABLE 5: Colour acceptance & viscosity stability

Additive	Carbon black			Organic violet			Organic blue		
	Δ KU [units]	Δ ICI [P]	Rub-out [ΔE]	Δ KU [units]	Δ ICI [P]	Rub-out [ΔE]	Δ KU [units]	Δ ICI [P]	Rub-out [ΔE]
RHEOLATE® HX 6010 IF	1	-0.1	0.12	-2	-0.1	0.15	4	0	0.13
RHEOLATE® 212 IF	-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

RHEOLATE® HX 6010 IF 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 visualized.

RHEOLATE® HX 6010 IF 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.

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

Conclusion

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

RHEOLATE® HX 6010 IF 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

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 DPhB	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	

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 indicate 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 being 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.

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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Unique chemistry,
sustainable solutions