

# Borchi<sup>®</sup> Gel 0435

Associative HEUR thickener for  
water-borne coating systems with  
**NEW**tonian rheology profile

For decades, OMG Borchers' **Borchi® Gel** associative thickeners have been synonymous with quality and reliability in architectural and decorative paints, industrial coatings, and waterborne adhesive systems.

OMG Borchers GmbH has now extended its range with a number of new and innovative products that reflect the increasing demand for environmentally friendly products and also comply with the "Decopaint Directive" that is valid from 2007.



# Borchi® Gel 0435

VOC-free according to EU Directive  
1999/13/EC,

free of tin and APEO

Associative HEUR thickener  
for waterborne coating systems with  
**NEW**tonian rheology profile

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## Borchi<sup>®</sup> Gel – Associative thickeners

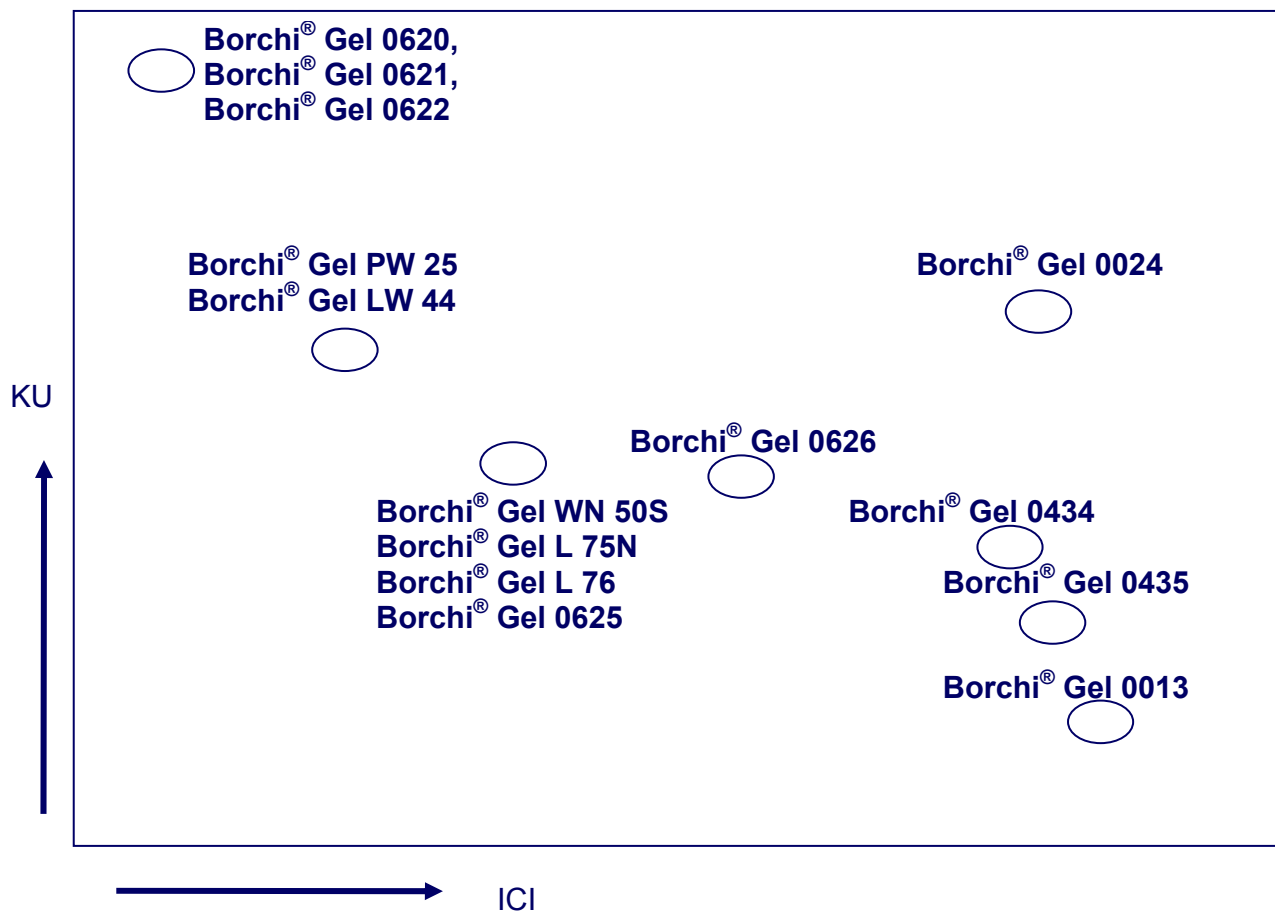
### Product overview

What sets associative thickeners apart from all other thickener systems is their ability to form non-covalent networks with other components of the coating – e.g. pigments, binder particles or fillers – in an aqueous medium. The optimal viscosity of a liquid phase subjected to high shear forces plays a key role in film build, hiding power, spatter tendency, and brush and roll resistance. When applying the coating by brush or roller, for example, good results can only be achieved if the viscosity of the material is sufficiently high, even under high shear stress (brush resistance).

In industrial spray application, rheology additives ensure optimal flow and leveling and minimize the tendency of the coating to run. If the viscosity is too low, "curtains" or "runs" form during application, seriously impairing the final result.

Fig. 1 shows the various Borchi<sup>®</sup> Gel associative thickeners arranged according to their rheological effectiveness. The higher a product is placed in the chart, the stronger its thickening effect at low shear forces (low shear range, KU). The further the product is towards the right, the more marked is its effectiveness at high shear rates (high-shear range, ICI).

Fig. 1: Borchi<sup>®</sup> Gel – rheological profiles



With Borchi<sup>®</sup> Gel 0435, the viscosity can be accurately controlled in the range of higher shear rates ( $> 1000 \text{ s}^{-1}$ ). Rheological behavior in the low-shear range ( $< 1000 \text{ s}^{-1}$ ) is only very slightly affected. Borchi<sup>®</sup> Gel 0435 improves leveling and consequently enhances the brushing properties and hiding power of a coating system. The product is free of APEO, tin and VOC according to EU Directive 1999/13/EC.

## Borchi® Gel 0435

Associative polyurethane thickener, free of APEO and tin

### Product description

Borchi® Gel 0435 is an associative, APEO and tin-free polyurethane thickener for adjusting the rheology at shear rates beyond  $1000 \text{ s}^{-1}$ . It can be used as a universal thickener in all waterborne systems, pigmented or unpigmented. Areas of application include flat to high-gloss coatings for decorative and industrial use, sealing compounds, adhesive systems and leather coatings.

### Characteristic data

Active substance :	25 %	
Solvent :	water	
Appearance :	clear, yellowish liquid	
Density (at 20°C) :	1.03 g/cm <sup>3</sup>	DIN 53 217, Edition 1991
VOC content in g/L :	according to EU Directive 1999/13/EC (EU)	0
	according to EPA Method 24 (US)	107

### Property profile

Borchi® Gel 0435 forms a non-covalent network with the constituents of the coating and is thereby very effective in stabilizing the viscosity, in particular in the range of high shear rates. The product generates a virtually Newtonian flow, which leads to optimal application properties in roller and brush application. Borchi® Gel 0435 is highly effective in waterborne fine-particle gloss and eggshell gloss dispersions and in water-reducible, 1-component and 2-component polyurethane systems.

Borchi® Gel 0435 is highly compatible with all types of thickeners for adjusting the viscosity in the range of low and medium shear rates, e.g. HEUR, HASE or cellulose ethers. Borchi® Gel 0435 is very effective and develops a strong thickening effect in the range of high shear rates ( $>1000 \text{ s}^{-1}$ ) very soon after it is added.

Borchi® Gel 0435 guarantees high gloss levels and excellent leveling. The product can be added to the system as a ready-to-use preparation at any stage of the formulation. Pre-dilution is not necessary, but it can be reduced with water or glycols where necessary without problem.

## Efficiency

Every component of a coating system produces interactions with the other components, exerting a direct influence on the rheology profile. Unfortunately, this makes it impossible to directly apply specific results from one paint formulation to another.

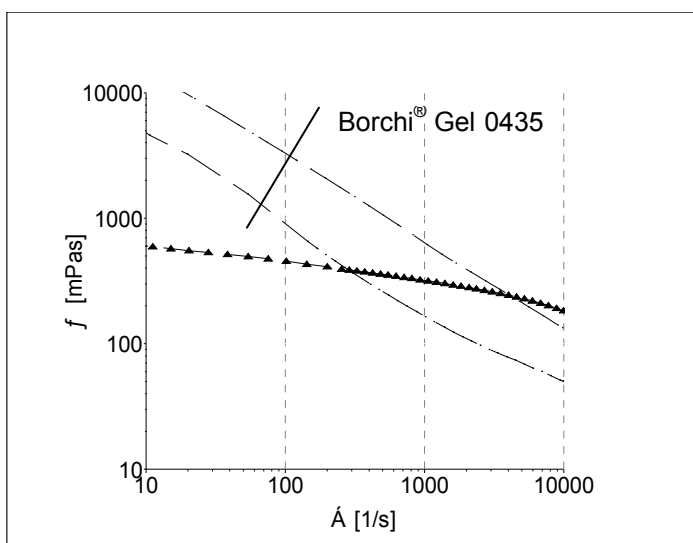
Table 1: Efficiency of Borchi® Gel 0435 in various binder systems

Binder basis	Influence on the viscosity at rest (Brookfield, KU)	Influence on the viscosity at high shear rates (ICI)
Straight acrylate	M	S
Acrylic copolymer (sv)	L	S
Urethane acrylate	M	M
Water-reducible alkyds	L	S
Water-reducible polyesters	L	S
Fatty acid modified polyurethanes	L	S

**S: Strong M: Medium L: Low**

Fig. 2 shows the characteristic, marked Newtonian rheology of Borchi® Gel 0435 compared with other conventional HEUR thickeners in a pigmented eggshell gloss dispersion based on acrylic copolymer. The very strong thickening effect at high shear rates (beyond  $1000\text{s}^{-1}$ , high-shear range) is clearly evident.

Fig. 2: Rheological behavior of Borchi® Gel 0435



Borchi® Gel 0435 develops a marked Newtonian flow behavior in most systems.

The effectiveness of an associative thickener is always dependent on the type and quantity of the binder and the other components in the formulation.

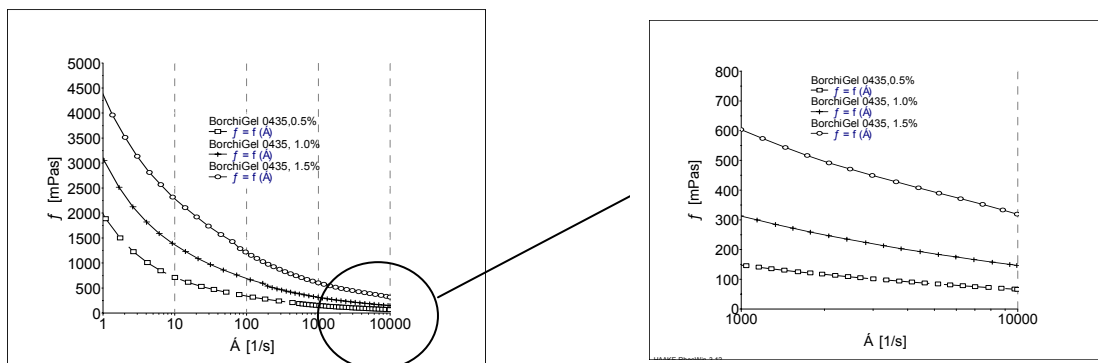
## Adjusting the viscosity in the high shear range

Correctly setting the viscosity in the high shear range is decisive for the optimal application and satisfactory properties of a coating system. If viscosity is too low (around  $< 100 \text{ mPas}$  at  $10,000 \text{ s}^{-1}$ , equivalent to  $\text{ICI} < 1.0$ ), it will mean poor hiding power, sagging on vertical surfaces and a high tendency to spatter when applied with a roller.

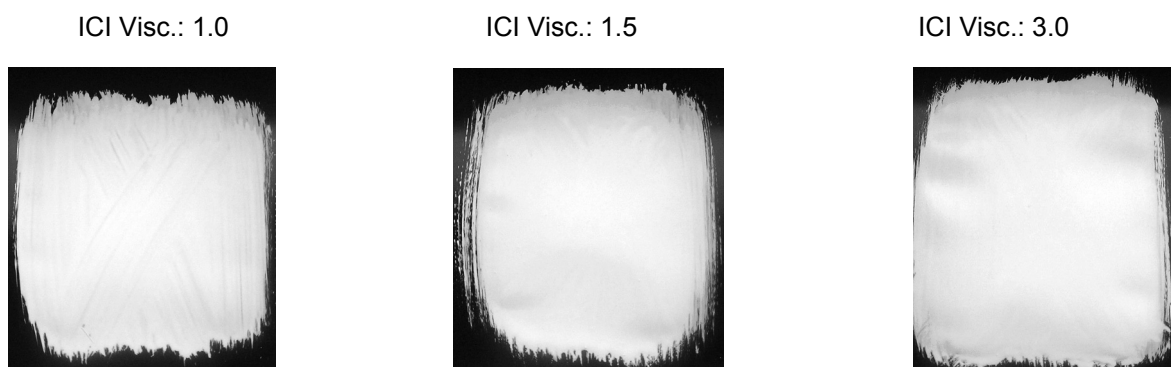
Even with only small additions, BorchGel<sup>®</sup> 0435 develops a high shear viscosity but does not influence the technical properties of the overall system. In an ideal case, nearly any desired viscosity can thus be set in the high-shear range.

Fig. 3 shows the viscosity with different additions of BorchGel<sup>®</sup> 0435 in an emulsion paint based on styrene acrylate in the shear range from  $1 \text{ s}^{-1}$  to  $10,000 \text{ s}^{-1}$ . The graphic on the right is an enlarged view of the higher shear rates ( $> 1,000 \text{ s}^{-1}$ ) range.

**Fig. 3:** Rheological behavior of BorchGel<sup>®</sup> 0435 in a styrene acrylate emulsion paint



To evaluate the leveling and flow, the emulsion paint was applied by brush to a black piece of cardboard and the leveling of the brush marks was evaluated (Fig. 4).



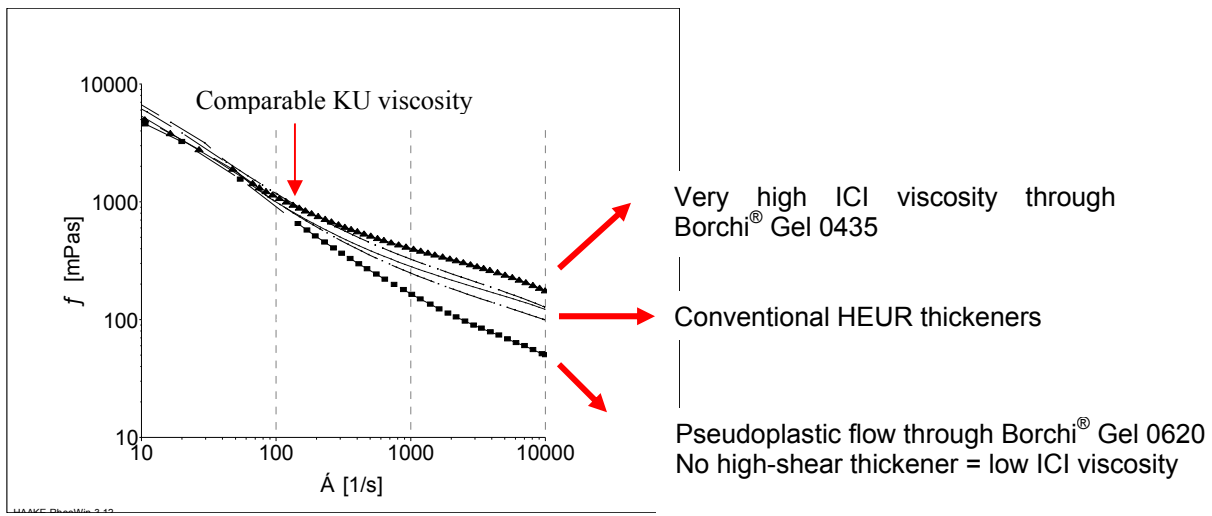
Inadequate viscosity, especially in the high shear range, generally results in poor leveling properties and inadequate hiding power. In the left-hand picture, this can be seen in the fact that the brush marks have not completely disappeared and that the depth of color on the substrate is uneven. The higher the ICI viscosity, the better the hiding power and the better the leveling properties (middle and right-hand picture). The ICI viscosity should, however, not exceed a value of 3. In many basic binders, BorchGel<sup>®</sup> 0435 specifically affects viscosities in the high-shear range, which means that the product can be added without problem.

## Combinations with suitable low-shear thickeners

Borchi® Gel 0435 is noted for its particularly high effectiveness in the high-shear range and its pronounced Newtonian flow. To improve shelf life and to control the settling behavior of a formulation, the product should ideally be combined with non-Newtonian (pseudoplastic) Borchi® Gel rheology additives, allowing non-Newtonian flow behavior to be freely adjusted. Suitable products are Borchi® Gel associative thickeners such as Borchi® Gel PW 25 and Borchi® Gel 0620 and acrylic-based Borchi® Gel ALA.

Fig. 5 shows an example of how the ICI viscosity of a styrene acrylate dispersion can be specifically controlled and adjusted through a combination of the highly pseudoplastic Borchi® Gel 0620 with various high-shear associative thickeners. In all cases, the same amount of active substance was added.

**Fig. 5:** Rheological behavior as a function of the chosen high-shear associative thickener.



- Borchi® Gel 0620 develops a highly pseudoplastic flow, with high viscosity at low shear rates and low viscosity at higher shear rates. Flow properties of this kind are particularly important for spray application.
- ▲ The combination with high-shear associative thickeners allows adjustment of the viscosity at shear rates above  $1000\text{s}^{-1}$ . In contrast to conventional HEUR thickeners, Borchi® Gel 0435 develops a strong Newtonian flow with exceedingly high ICI effectiveness. This makes it possible, by adding the same or even a smaller amount than of conventional HEUR thickeners, to adjust the ICI viscosity perfectly to the application requirements.

**Table 2:** Recommended combinations of Borchi® Gel 0435 with OMG Borchers low-shear associative thickeners:

Borchi® Gel 0435 to	
Borchi® Gel 0620	Ratio 4:1
Borchi® Gel PW 25	Ratio 1:2
Borchi® Gel LW 44	Ratio 1:2

## Application examples

### Trade and DIY decorator paint based on an aqueous alkyd emulsion

Guide formulation B1 in the annex

With decorator paints, the optical aspects are just as important as the application properties. The selection of suitable rheology additives makes an important contribution to this. Its outstanding application properties and effectiveness together with its Newtonian flow with a high resultant ICI viscosity make Borchi® Gel 0435 the ideal basis for obtaining optimal product properties.

Fig. 6 shows the flow curves of an aqueous white decorative alkyd emulsion using two different high-shear associative thickeners. The addition of active substance is identical in both cases (0.1 %). Enlarged on the right is the higher shear rates ( $> 1000\text{s}^{-1}$ ) range.

Fig. 6: Flow diagrams of an aqueous white alkyd emulsion for trade use

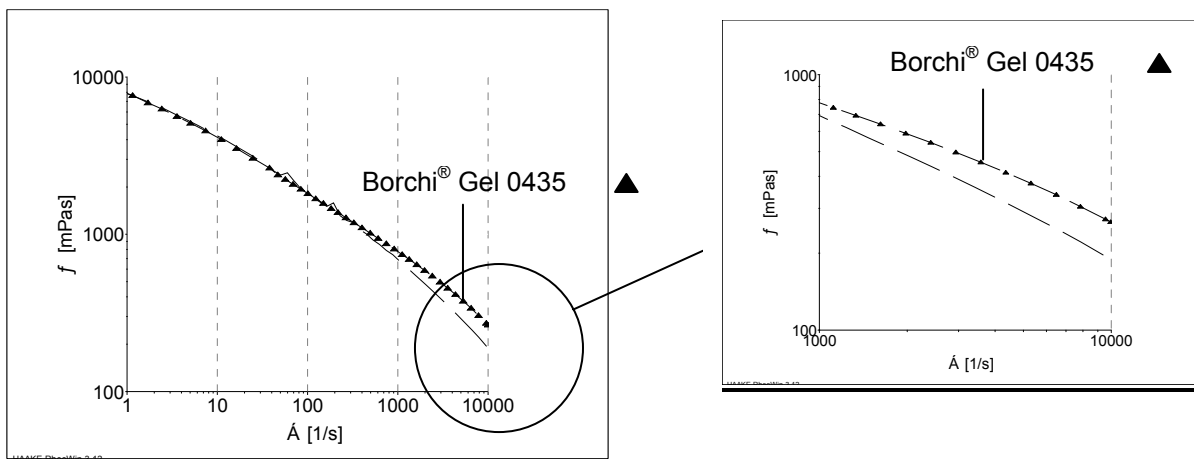
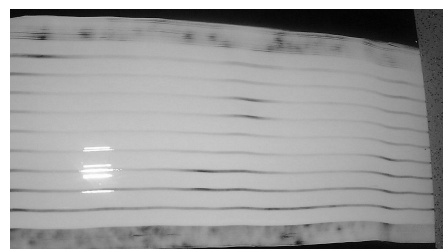


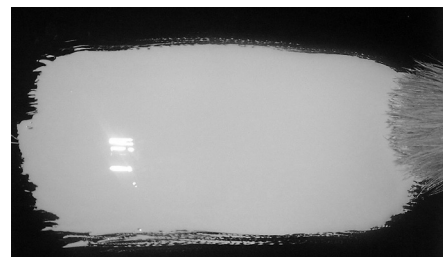
Table 3 shows the measurements for the formulation. The leveling behavior under standard application (Erichsen test doctor blade) and brush application on cardboard is shown in Fig. 6:

Vertical flow (40 – 300  $\mu\text{m}$ ) :

White trade paint (alkyd emulsion)	Borchi® Gel 0435
Gloss, 60°	92
Brookfield, $10.3\text{s}^{-1}$ [mPas]	4100
Krebs Stormer Units	90
<b>ICI viscosity</b>	<b>2.6</b>



Brush application on cardboard :



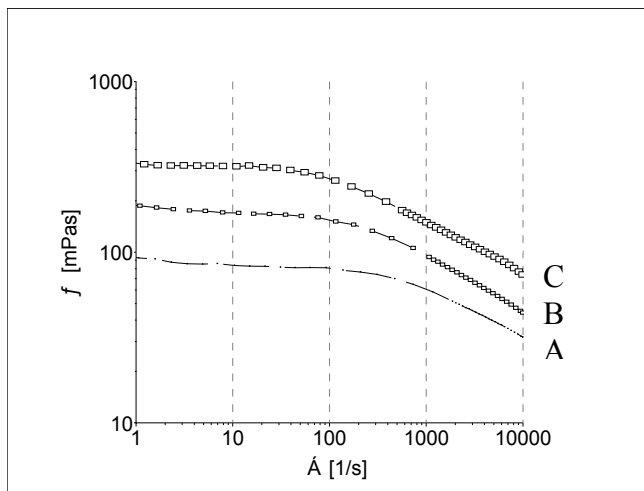


## Wood finish based on a fatty acid-modified polyurethane

Guide formulations A1 and A2 in the annex

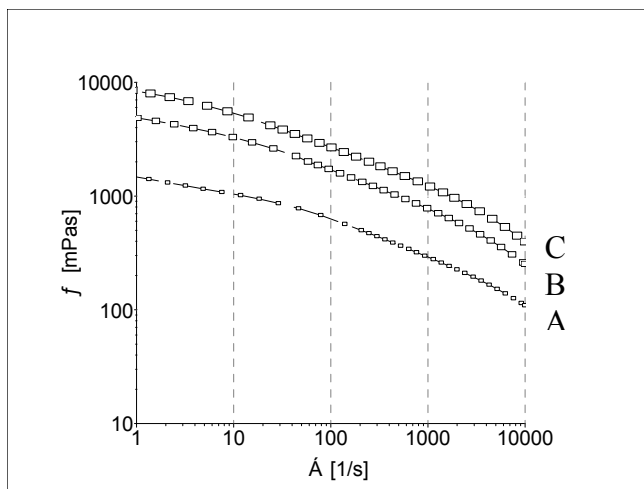
With waterborne decorative wood finishes, a high application viscosity (ICI viscosity) is also a decisive criterion for the quality of the coating. Depending on the desired application method and product properties, Borch<sup>®</sup> Gel 0435 can be used to produce pronounced Newtonian flow properties, or – through combination with Borchers low-shear associative thickeners – non-Newtonian flow properties.

Fig. 7 shows by way of example how, through different additions of Borch<sup>®</sup> Gel 0435, the ICI viscosity of the system can be specifically regulated in a clear finish for coating wood (fatty acid modified polyurethane). Table 4 gives an overview of the resultant viscosities in the low and high shear ranges.



Addition [%] Borch <sup>®</sup> Gel 0435	Brookfield, 10.3 s <sup>-1</sup> [mPas]	ICI 10,000 s <sup>-1</sup>
A 0.4	80	0.5
0.8 B	120	0.7
1.2 C	300	1.0

In pigmented systems, a much higher ICI viscosity is normally achieved than in clear finishes due to the possible associative bond with pigments and fillers. Fig. 8 demonstrates this fact taking the example of a white pigmented wood finish based on the same fatty acid polyurethane binder. The measurements are shown in Table 5:



Addition [%] Borch <sup>®</sup> Gel 0435	Brookfield, 10.3 s <sup>-1</sup> [mPas]	ICI 10,000 s <sup>-1</sup>
A 0.4	1000	1.1
0.8 B	3000	2.5
1.2 C	5000	3.8

## Annex

### Guide formulations and application examples

#### A.) Coatings for industrial application

A 1 : Clear finish for wood substrates based on a fatty acid modified polyurethane

Components		Addition [g]	Manufacturer
	Bayhydrol VP LS 2342	90.55	Bayer Material Science AG
	Water	2.4	
	Butyl diglycol	2.4	
	Baysilone® 3466	0.2	OMG Borchers GmbH
	Baysilone® 3468	0.5	OMG Borchers GmbH
	Aquacer 535	1.9	Byk Cera b. v.
	<b>Borchi® Gel 0435</b>	0.8	OMG Borchers GmbH
	<b>Total</b>	100	

An antifoam may be necessary, e.g. Byk 024 (Byk Chemie)

<b>Characteristic data</b>	Solids [%]	33 +/- 1
	Flow time DIN cup 4mm [sec]	38

A 2 : Pigmented topcoat for wood substrates based on a fatty acid modified polyurethane

Components		Addition [g]	Manufacturer
	Water	8	
	Disperbyk 190	1.6	Byk Chemie
	Antifoam*	0.4	
	Ti Pure 902	27.0	Dupont
	Disperse for 60 min at 3,000 rpm		
	Bayhydrol VP LS 2342	54.5	Bayer Material Science AG
	Water	3.5	
	Butyl diglycol	3.5	
	Baysilone <sup>®</sup> 3466	0.2	OMG Borchers GmbH
	Baysilone <sup>®</sup> 3468	0.5	OMG Borchers GmbH
	<b>Borchi<sup>®</sup> Gel 0435</b>	0.8	OMG Borchers GmbH
	<b>Total</b>	100	

\* if necessary, e.g. Byk 024 (Byk Chemie), Foammaster VL (Cognis)

<b>Characteristic data</b>	Solids [%]	57+/- 1
	Brookfield, 10.3 s <sup>-1</sup> [mPas]	3,000
	ICI viscosity, 10,000 s <sup>-1</sup>	2.5

## B.) Decorative coatings

B 1 : Decorative trade paint based on an aqueous alkyd resin emulsion

Components		Addition [g]	Manufacturer
	WorleeSol 65 A	9.0	Worlee Chemie
	Water	4.0	
	Antifoam*	1.0	
	AMP 95	0.2	Angus Chemie
	Kronos 2190	26	Kronos
	Disperse for 30 min. at 3,500 rpm		
	WorleeSol E 150 W	54.7	Worlee Chemie
	Water	2.0	
	Propylene glycol	2.3	
	Baysilone® 3466	0.2	OMG Borchers GmbH
	Baysilone® 3468	0.5	OMG Borchers GmbH
	<b>Borchi® Gel 0435</b>	0.4	OMG Borchers GmbH
	<b>Total</b>	100	

\* if necessary, e.g. Byk 024 (Byk Chemie), Foammaster VL (Cognis)

<b>Characteristic data</b>	Solids [%]	55+/- 2
	Brookfield, 10.3 s <sup>-1</sup> [mPas]	4100
	ICI viscosity, 10,000 s <sup>-1</sup>	2.6

B 2 : Pigmented topcoat for wood substrates based on a self-crosslinking acrylate

Components		Addition [g]	Manufacturer
	Water	8.0	
	Disperbyk 190	1.6	Byk Chemie
	Antifoam*	0.4	
	Ti Pure 902	30	DuPont
	Disperse for 60 min. at 3,000 rpm		
	Johncryl 1480	40.0	Johnson Polymer
	Johncryl U 4188	9.0	Johnson Polymer
	Jonwax 35	2.0	Johnson Polymer
	Water	3.0	
	Baysilone® 3466	0.2	OMG Borchers GmbH
	Baysilone® 3468	0.5	OMG Borchers GmbH
	Propylene glycol	2.3	
	Dowanol DPnB	2.0	Dow
	<b>Borchi® Gel 0435</b>	1.0	OMG Borchers GmbH
	<b>Total</b>	100	

\* if necessary, e.g. Byk 024 (Byk Chemie), Foammaster VL (Cognis)

<b>Characteristic data</b>	Solids [%]	51+/-2
	Brookfield, 10.3s <sup>-1</sup> [mPas]	2100
	ICI viscosity, 10,000s <sup>-1</sup>	2.0

**Borchi<sup>®</sup> Gel – Rheology additives from OMG Borchers GmbH**

**Do you have any more questions?**

**The OMG Borchers team  
will be pleased to help you.**

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