

Rheological Additives

FOR WATERBORNE COATING SYSTEMS



INTRODUCTION

Additives with a thickening effect have a significant influence on the shelf life and application properties of liquid coating systems and have always been an important component in the formulation of coatings.

Even during coating production, they improve the introduction of energy into the mill base, and thus optimize dispersibility (Figure 1).

At the same time, rheological additives improve shelf life by reducing the settling and separation of the coating formulation. Without adequate rheological control, these systems very often show syneresis effects (Figure 2).

In industrial applications of such systems, rheological additives ensure optimal flow and leveling properties combined with minimum sagging tendency. Inappropriate rheological control might be the reason for the building up of so-called "curtains" or "runners" that strongly impact the quality of the resulting film (Figure 3a/3b).



Figure 1
Mill base for a coating

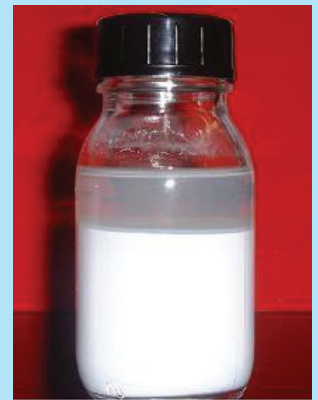


Figure 2
Syneresis in an emulsion coating

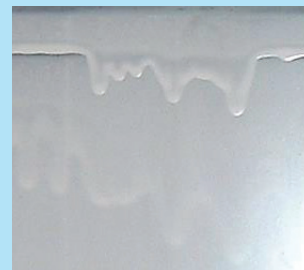


Figure 3a
Spraying varnish for industrial coatings showing 'curtains'



Figure 3b
Waterborne emulsion coating with 'runners'

VISCOSITY

Without suitable thickeners introducing a sufficient coherence despite high mechanical stresses (so-called high shear thickeners), coating particles are very easily flung away from the brush or roller due to centrifugal forces. This significantly increases the spattering tendency (Figure 4a) of the coating.

The viscosity setting of a liquid phase affected by high shear forces plays a decisive part in film formation, hiding power, spattering, and brush and roll resistance. When brushing or rolling, for example, good results can only be achieved if the viscosity of the applied coating remains high even at a high shear rate (brush drag). If the brush drag is inadequate, a considerable proportion of the coating material applied to the surface is pushed along in front of the brush or roller without sticking to the substrate (Figure 4b). This results in poor coverage, uneven application, and poor leveling.

The phenomenon of edge marks (Figure 4c) and wetting defects may also be due to inappropriate rheology of the applied system.

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Figure 4a

Roller-coated coating without adequate high shear thickener

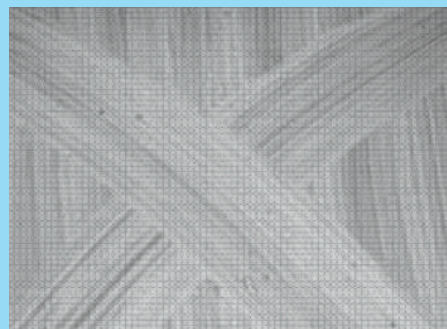


Figure 4b

Brush-applied emulsion coating with inadequate brush drag



Figure 4c

Inadequate edge coverage with a white coating on a metal substrate



RHEOLOGICAL CONTROL IN WATERBORNE COATINGS

Inadequate rheological control in the production of coatings can lead to a significant reduction in quality. Especially when switching from solvent borne formulations to waterborne alternatives, the selection of a suitable rheological additive is essential.

Apart from cellulosic and acrylic thickeners – to mention only the most common pseudoplastic thickeners for waterborne systems – associative thickeners also play an important part in the formulation.

In terms of their structure, associative thickeners are polymer compounds with hydrophilic and hydrophobic segments, which, because of their segmented structure, are able to form fairly stable associates with each other and/or with the other components of the coating formulation (binder, pigment, filler particles, etc.).

By modifying the chemical structure, it is possible to vary the stability of the associations, and thus the rheological properties of a coating system.

The most important associative thickeners are produced on a polyurethane basis. Unlike cellulosic or polyacrylic thickeners, these polyurethane thickeners affect neither the water sensitivity nor the lightfastness of a formulation and, depending on the type, provide pseudoplastic or Newtonian flow properties.

The large number of commercially available binders with different properties does, however, make it difficult to select the most suitable polyurethane thickener. It is therefore important to have a sufficiently wide range of suitable products available that can achieve any desired rheological profile, either individually or in combination with one another. It is a question of carefully considering which rheological additives are suitable in what quantity for a particular application without adversely affecting other properties.

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Viscosity and Shear Rate

Borchi® Gel rheology modifiers:

LW 44, PW 25

0620, 0620 DFP, 0621, A LA, 0630

LW 44, PW 25

L 75N, L 76, 0625, 0626

0435

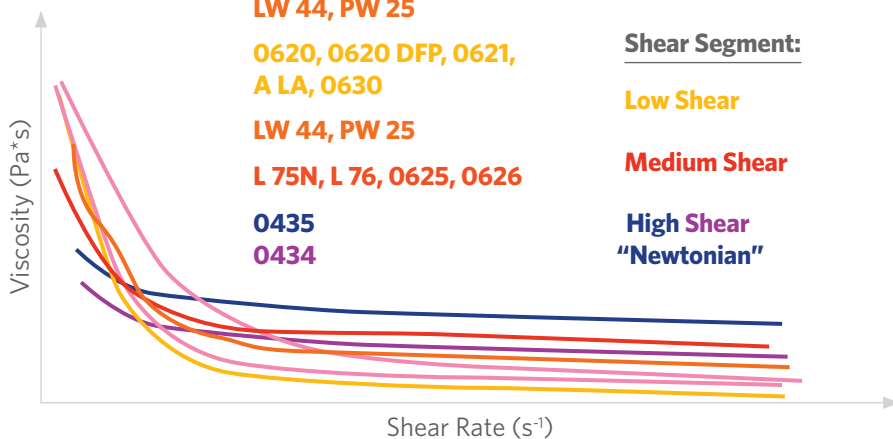
0434

Shear Segment:

Low Shear

Medium Shear

High Shear
"Newtonian"





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ENHANCING SUSTAINABILITY IN COATINGS

Modern waterborne coating systems are formulated as “low-VOC” or “VOC-free” (VOC = volatile organic compound), which means that the rheological additives must comply with strict, modern-day requirements on environmental compatibility. In addition to the already known problems with VOCs, there has been debate for some time now on the usability of some glycol derivatives (e.g., ethylene glycol, butyl glycol) and certain emulsifier types (e.g., alkylphenol ethoxylates, a.k.a. “APEOs”).

In the USA, for example, a number of glycol ethers are regarded as HAPs (Hazardous Air Pollutants), which are known or suspected to cause serious health damage. Their use is restricted by thresholds under the “Clean Air Act” (in the revised version of 1990).

These kinds of critical substances should be avoided in today’s polyurethane thickeners without compromising the technical properties or products.

Borchers: A Milliken Brand strives to produce quality thickeners that are aligned with VOC, HAP, APEO, glycol, and organic tin compound requirements. Check out our product specifications for additional information.

Borchers thickeners allow the specific modification of the rheology of a coating system so that it can be tailored to application conditions. Product properties such as vertical flow, leveling, gloss, film thickness, covering power, spattering tendency, brush and roll resistance, sedimentation tendency, and pigment stabilization can be specifically optimized. In most cases, only small quantities

between 0.1 and 0.4 % thickener, calculated on the overall formulation, are sufficient.

In addition, such additives also have an influence on the properties of the coating after its application, for example, on adhesion and elasticity as well as on the resistance to soiling, abrasion, water and corrosion.

PRODUCTS AT A GLANCE

The **Borchi® Gel** product group contains polyurethane-based thickeners that work associatively through the formation of a non-covalent network, as well as non-associative thickeners. Therefore, the natural paint characteristics (e.g., stability) will be improved, as well as application properties (e.g., leveling, anti-sag, hiding power, spatter resistance). Depending on their efficacy in the referring shear segment, the products can be divided into groups of low shear (Brookfield), mid shear (KU), and high shear (ICI) thickeners.

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Product	Distinguishing Properties
Borchi® Gel 0620	Shear thinning HEUR thickener for the viscosity adjustment in the low shear segment; particularly suitable for industrial and decorative varnishes that are applied via spray gun or dip application; suitable for brush and roll application when used with a Newtonian thickener.
Borchi® Gel 0620 DFP	Shear thinning , very strongly pseudoplastic HEUR thickener; 20% in water/2-Butoxyethanol; Tin- and APEO-free; easy incorporation into coating; enables application of thick surfaces on vertical layers and effectively prevents sagging; effective in the low shear range.
Borchi® Gel 0621	Shear thinning HEUR thickener; VOC-free solution for viscosity adjustment in the low shear segment; particularly suitable for industrial and decorative varnishes that are applied via spray gun or dip application; suitable for brush and roll application when used with a Newtonian thickener.
Borchi® Gel THIX 921	Shear thinning HEUR thickener; thixotropic behavior in many binders; highly efficient in the low shear range, preventing settling of pigments and sagging; ideal flow behavior for spray application; suitable for brush and roll application when used with a Newtonian thickener.
Borchi® Gel 0630	Shear thinning very strongly pseudoplastic HEUR thickener; 25% in (2-methoxymethylethoxy) propanol + 1.2 Propanediol; tin-free, APEO-free and butyl-glyol-free; easy incorporation into coating; enables application of thick layers on vertical surfaces; effectively prevents sagging; does not yellow or cause chalking in the cured film.
Borchi® Gel A LA	Shear thinning , non-associative ASE thickener; highly efficient at pH > 8, 10% in water.
Borchi® Gel 0800	Shear thinning , very strongly pseudoplastic ASE thickener; 10% anionic acrylate polymer in water; APEO-free and tin-free; builds viscosity in the low shear range.
Borchi® Gel PN Borchi® Gel NA	Shear thinning thickener; thixotropic behavior in many binder systems; highly efficient in low shear range, preventing sagging and settling; may be added alone or in combination with Newtonian thickeners. Borchi® Gel PN: organic Zirconium complex; neutralized with ammonia Borchi® Gel NA: organic Zirconium complex; neutralized with sodium hydroxide; low odor
Borchi® Gel PW 25	Shear thinning HEUR thickener; 25% polyurethane in water/propylene glycol; emulsifier-free and DBTL-free; especially effective in the low shear range.
Borchi® Gel LW 44	Shear thinning HEUR thickener; 24% polyurethane; 46% solids; especially effective in the low shear range; promotes pigment wetting; DBTL-free and VOC-free.
Borchi® Gel 0625	Universal HEUR thickener with well-balanced efficiency in medium and high shear range; 25% polyurethane; 34% solids; APEO-free, HAP's-free, VOC-free and tin-free; for universal application
Borchi® Gel L 75 N	Universal HEUR thickener with well-balanced efficiency even in medium and high shear range; 25% polyurethane; 50% solids; for universal application; promotes pigment wetting and pigment stabilization; DBTL- free and VOC- free.
Borchi® Gel L 76	Universal HEUR thickener for waterborne systems; high compatibility and efficacy in the low and mid shear (KU) segment; good price-performance ratio; provides good leveling in latex paints; DBTL-free and VOC- free.
Borchi® Gel 0626	Universal HEUR thickener with good efficiency in high shear range; 25% polyurethane; 37% solids; APEO- free, HAP's-free, VOC-free and tin-free; for universal applications.
Borchi® Gel 0434	Strong Newtonian high shear thickener (HEUR); for universal application; improves paint stability; displays strong hue by tinting with pigment concentrates; fulfills highest environmental demands.
Borchi® Gel 0435	Newtonian high shear thickener (HEUR) for waterborne coatings, clear or pigmented; especially suitable in high gloss resin binders with small particle size, as well as in waterborne decorative paints; high compatibility with most resin binders; extremely economical.

Want more info on unique zirconium complex thickeners?

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For more information, please visit:
www.borchers.com/contact

PLEASE NOTE: As each customer's use of our product may be different, information we provide, including without limitation, recommendations, test results, samples, care/labeling/processing instructions or marketing advice, is provided in good faith but without warranty and without accepting any responsibility/liability. Each customer must test and be responsible for its own specific use, further processing, labeling, marketing, etc. All sales are exclusively subject to our standard terms of sale posted at www.milliken.com/terms (all additional/different terms are rejected) unless explicitly agreed otherwise in a signed writing.