



Bermocoll® FLOW

—
Next generation rheology
control for decorative paint



Bermocoll® in decorative paint applications

Bermocoll cellulose ethers are manufactured by a unique, solvent-free process, ensuring you a reliable product with a low carbon footprint.

Bermocoll makes a difference with reliable rheology

We have been serving the paint industry around the world for more than 60 years with our brand Bermocoll, a range of non-ionic cellulose ethers. Bermocoll is used as a rheology modifier, stabilizer and water retaining agent for water-based decorative paints. Bermocoll cellulose ethers are manufactured by a unique, solvent-free process, ensuring our customers a low carbon footprint. They are available in all required viscosities and a range of modifications to ensure we meet every customer's needs.

Bermocoll – a sustainable choice

Sustainability is a cornerstone of Nouryon's overall strategy. We focus on expanding our portfolio of eco-premium products, which have a significant sustainability benefit over common alternatives. Within a LCA (Life Cycle Analysis) study*, we have calculated the contribution from the thickener system to the carbon footprint of 1 ton of paint to be 40 % lower with Bermocoll FLOW compared to a corresponding paint using a synthetic HEUR** thickener system, showing that Bermocoll FLOW provides significant sustainability benefits.

Rheology of coatings

Rheology is the science of deformation and flow of materials. Every material is influenced by external forces. For paint, these forces can range from gravitational forces, which influence phenomena such as sedimentation, leveling and sagging, to the very high shear forces that act on the paint when it is brushed, rolled or sprayed. Viscosity is a measure of a material's resistance to flow, which can be illustrated in a flow curve (figure 1).

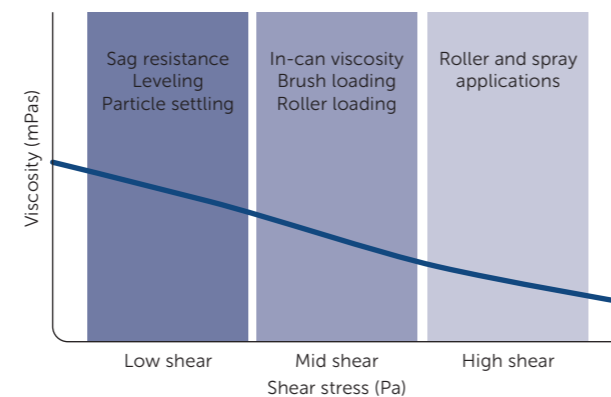


Figure 1: Flow curve

*) available upon request
 **)HEUR= Hydrophobically modified polyurethane

The carbon footprint of the paint thickener system is 40 % lower for Bermocoll FLOW compared to a synthetic HEUR thickener system.

Bermocoll® FLOW

A natural replacement for associative synthetic thickeners in decorative paint

Bermocoll FLOW is a new type of hydrophobically modified cellulose ether for use as a rheology modifier in decorative all acrylic latex paints for interior or exterior use. Bermocoll FLOW is a highly associative, ultra-low viscosity cellulose ether with exceptional flow created to bridge the gap between associative synthetic thickeners and hydrophobically modified cellulose ether (HM-CE) thickeners. It maintains the stabilizing character of a cellulosic thickener while incorporating the flow and leveling properties of synthetic thickeners, making it especially suited for high-end, low VOC formulations where the carbon footprint is important. Depending on the formulation, Bermocoll FLOW is intended to provide improved flow and leveling and eliminate complex combinations of

thickeners to achieve the optimal paint rheology profiles.

Bermocoll FLOW:

- is a new type of hydrophobically modified Bermocoll with exceptional flow which can replace associative synthetic thickeners (e.g. HEUR thickeners)
- combines the flow and leveling properties of an associative synthetic thickener with the stability properties of a cellulosic thickener
- can reduce cost and formulation complexity
- performs particularly well in acrylic and vinyl acrylic formulations for interior and exterior use
- is especially suited for low-VOC formulations and airless spray applications

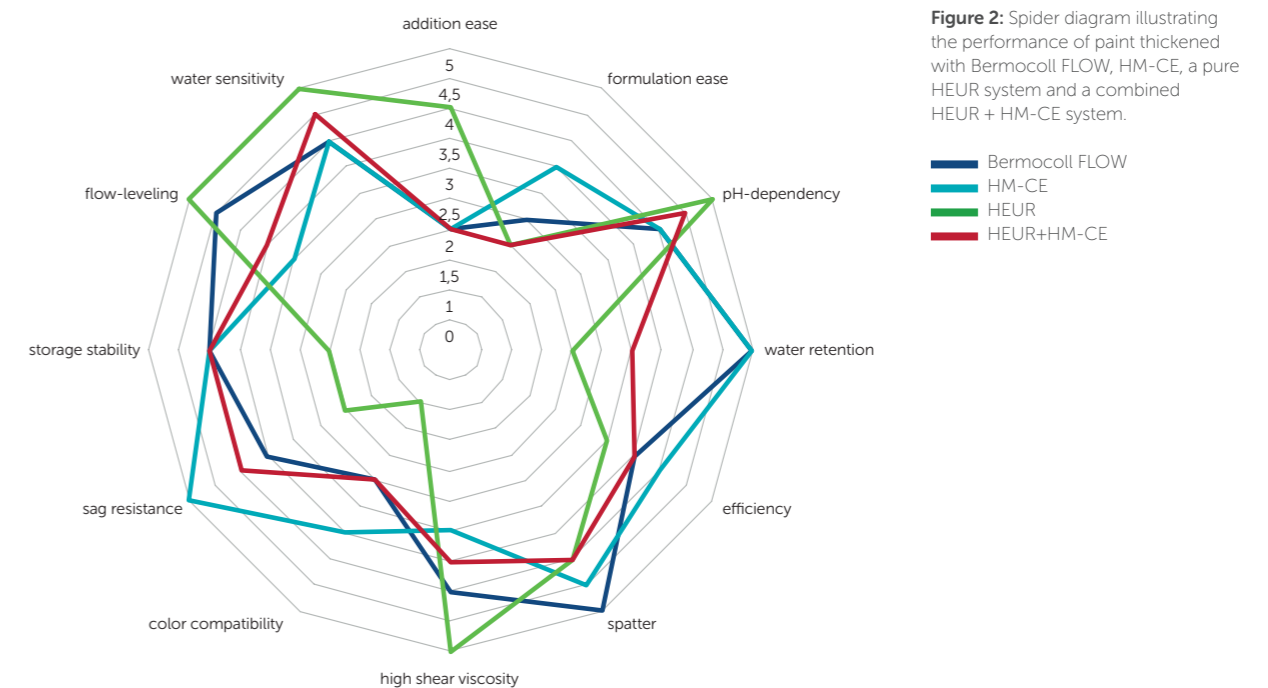


Figure 2: Spider diagram illustrating the performance of paint thickened with Bermocoll FLOW, HM-CE, a pure HEUR system and a combined HEUR + HM-CE system.

— Bermocoll FLOW
 — HM-CE
 — HEUR
 — HEUR+HM-CE

Bermocoll® FLOW

Paint performance

Optimized sag/leveling balance

The main benefit of Bermocoll FLOW is the optimized sag/leveling balance compared to a HM-CE or an associative synthetic thickener (e.g. HEUR) system which allows for reduced formulation complexity and cost. Compared to a HM-CE, the leveling properties are hugely improved and close to those of a pure HEUR system, but with a greatly improved sag resistance (figure 3 and 4).

Bermocoll FLOW shows leveling almost on par with a pure HEUR system, which is normally not

possible to obtain with a thickener combination of HM-CE and HEUR traditionally used to improve the sag/leveling balance.

Application properties

Bermocoll FLOW shows excellent spatter resistance even exceeding the performance of HEUR or HM-CE thickeners (figure 5). Compared to HM-CE containing systems, the hiding power is much improved approaching the hiding of the HEUR system (figure 6).

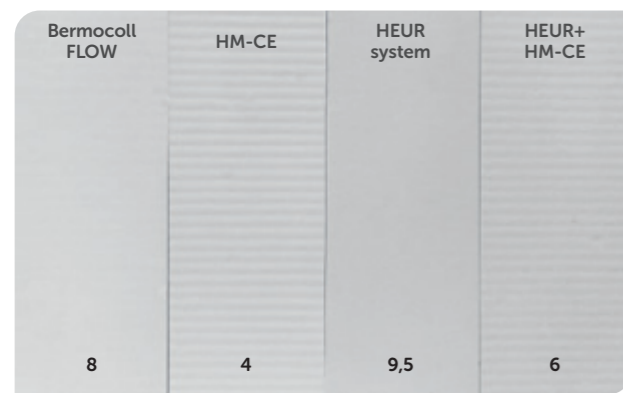


Figure 3: Leveling

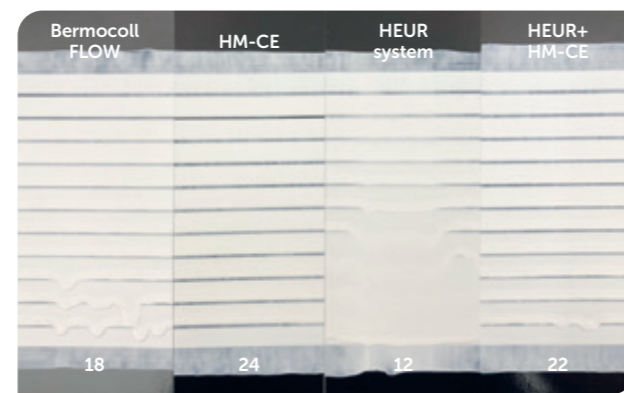


Figure 4: Sag resistance

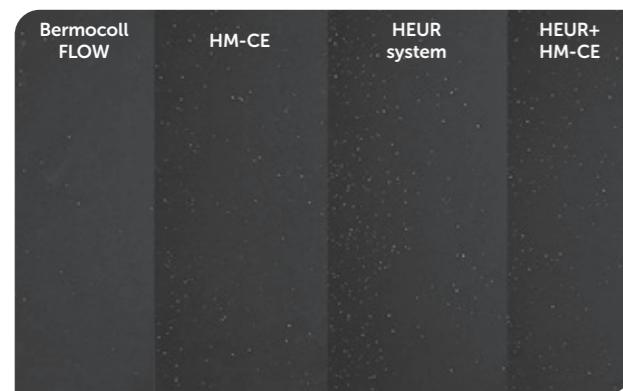


Figure 5: Spatter properties

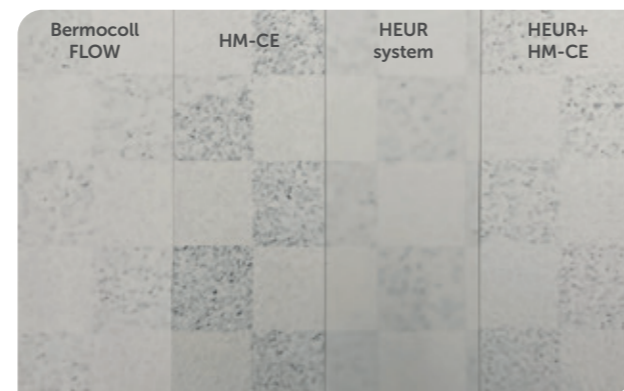


Figure 6: Hiding properties

Rheology explains the performance

The flow properties of Bermocoll FLOW are explained by its rheology profile (figure 7). The low shear viscosity is higher than for HEUR, offering an improved sag to leveling balance (1). Compared to HM-CE, the low shear viscosity is reduced, offering excellent leveling (2). At high shear rates (ICI region), Bermocoll FLOW has a higher viscosity than HM-CE which gives improved hiding power (3).

Efficiency and stability

The paints in the study have been formulated to the same Stormer viscosity using a PVC 30 semigloss all acrylic formulation (table 1). Bermocoll FLOW is added at a slightly higher level than HM-CE, but the dosage is substan-

tially lower than for a pure HEUR system or a combined HM-CE/HEUR system.

Table 3 shows stability data for storage and tinter addition. After 4 weeks of storage at 50 °C/120F, the syneresis of the paint thickened with Bermocoll FLOW is on par with the paints containing HM-CE or HM-CE/HEUR and much improved compared to the HEUR thickened paint. Stormer stability after storage is good for all paints. Upon addition of tinter, the Bermocoll FLOW paint shows the same viscosity drop as the HM-CE/HEUR containing paint and clearly less than the pure HEUR paint. The pure HM-CE paint shows the smallest viscosity drop on tinter addition.

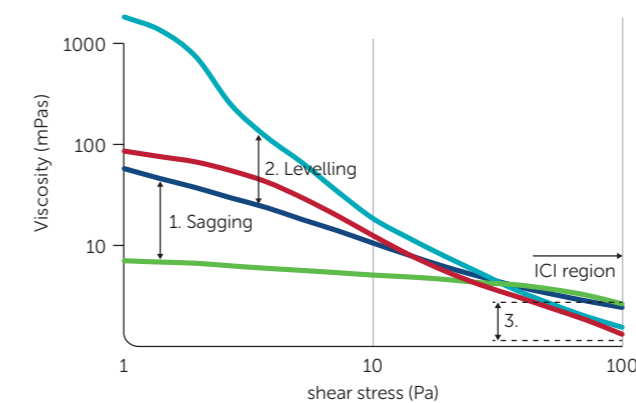


Figure 7: Flow curves of Bermocoll FLOW, HEUR system, HM-CE and combined HEUR/HM-CE thickener system.

| Thickener (% w/w) | Bermocoll FLOW | HM-CE | HEUR system | HEUR+HM-CE |
|--------------------------------|----------------|------------|-------------|------------|
| HM-CE | 0,7 | 0,6 | | 0,2 |
| Bermocoll FLOW | | | | |
| Low/mid-shear HEUR | | | 0,4 | 0,2 |
| High-shear HEUR | | | 1,5 | 0,4 |
| Total thickener (% w/w) | 0,7 | 0,6 | 1,9 | 0,8 |

Table 2: Addition level for different thickener systems

Legend for Figure 7:
 — Bermocoll FLOW (blue)
 — HEUR System (green)
 — HM-CE (cyan)
 — HEUR+HM-CE (red)

| Raw material | g/1000 g |
|------------------|-------------|
| Water | 264 |
| BYK 022 | 5 |
| Kathon LXE | 1 |
| Dispex N40 | 4 |
| Kronos_2190 | 177 |
| Hydrocarb | 108 |
| Bermocoll FLOW | 7 |
| Texanol | 10 |
| Mowilith LDM7717 | 424 |
| Sum (g) | 1000 |

Table 1: PVC 30 all acrylic formulation

| Properties | Bermocoll FLOW | HM-CE | HEUR system | HEUR+HM-CE |
|---------------------------------------------|----------------|-------|-------------|------------|
| Stormer (KU) | 104 | 103 | 104 | 102 |
| ICI (P) | 0,9 | 0,8 | 0,9 | 0,8 |
| Storage stability 4 weeks 50 °C/120F | | | | |
| Stormer (KU) | 106 | 105 | 102 | 100 |
| ΔStormer (KU) | 2 | 2 | -2 | -2 |
| syneresis (mm) | 12 | 10 | 32 | 11 |
| Tinting stability* | | | | |
| Stormer (KU) | 99 | 101 | 89 | 93 |
| ΔStormer (KU) | -7 | -4 | -13 | -7 |

Table 3: Stability data *)tinted with 3% (4 ounces/gallon) Colortrend Lamp Black 807-9957

Bermocoll® FLOW

Low VOC formulations/airless spray study

Bermocoll FLOW has a low carbon footprint and is a sustainable choice for rheology control in low VOC paints. It performs particularly well with the Nouryon wetting agents and dispersants as well as with commercial alternatives. For example, the hydrophobic character of the Nouryon Alcosperse 787 dispersant will enhance the associative behavior of Bermocoll FLOW, improving the KU build and providing increased water resistance. Viscosity and color acceptance may be fine-tuned with the Nouryon narrow-range alcohol ethoxylates, giving consistent batch-to-batch performance.

Four low VOC all acrylic formulations of different types were prepared with Bermocoll FLOW as the sole thickener, formulated with well-known latexes, Nouryon wetting agents and dispersants and commercially available

alternatives. All paints showed excellent flow and leveling properties while retaining sag resistance (table 4).

The exterior paint was subjected to a weathering study giving top results for gloss and color retention, chalk, cracking and checking (table 5).

The exterior and interior flat paints were tested in an airless spray study including commercial alternatives and showed excellent ease of atomization and back rolling. Scores were high or excellent for flow and leveling, gloss difference and touch up properties (airless spray/back rolling), visible spray lines and sag lines. More study details can be found in a Technical Bulletin available at www.nouryon.com or on request.

| Formula | Interior Flat | Interior Satin | Interior Semigloss | Exterior Flat |
|----------------------------|----------------|---------------------|---------------------|-------------------|
| Latex | Rhoplex VSR 50 | Rhoplex VSR-1049LOE | Rhoplex VSR-1049LOE | Acronal EDGE 4247 |
| Dispersant | Alcosperse 787 | Tamol 165A | Tamol 165A | Alcosperse 787 |
| Surfactant | Berol 185 | Ethylan 1008 | Ethylan 1008 | Berol 185 |
| Leveling Leneta ASTM D4062 | 7 | 9 | 9 | 8 |
| Subjective, Brushed | 6 | 7 | 7 | 7 |
| Subjective Rolled | 7 | 8 | 8 | 7 |
| Sag Resistance, ASTM D4400 | > 24 | 12 | 10 | > 24 |

Table 4: Flow, leveling and sag resistance of low VOC all acrylic formulations for airless spray applications

| QUV weathering ASTM D4587 100 hours | | |
|-------------------------------------|---------|--------|
| Exterior Flat | Utinted | Tinted |
| Gloss 60, % retained | 78 | 78 |
| Gloss 85, % retained | 73 | 84 |
| ΔE00 | 0,2 | 0,4 |

Table 5: Selected weathering properties
No chalk, cracking or checking (ASTM methods)

| Physical data | |
|---------------|------------------|
| Appearance | yellowish powder |
| Particle size | 98 % ≤ 500 μm |
| Water content | ≤ 4 % |
| Salt content | ≤ 4.5 % |

| Characteristics of aqueous solutions | |
|--------------------------------------|------------------|
| Solution appearance | opaque |
| pH (1 % solution) | 4 - 7 |
| Surface activity | weak |
| Viscosity at 20°C (Brookfield LV) | |
| 2 % solution | 500 - 1500 mPa.s |

Table 6: Physical data and characteristics of Bermocoll FLOW



Figure 8a: Airless spray gun



Nouryon

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About Nouryon

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 7,900 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.

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