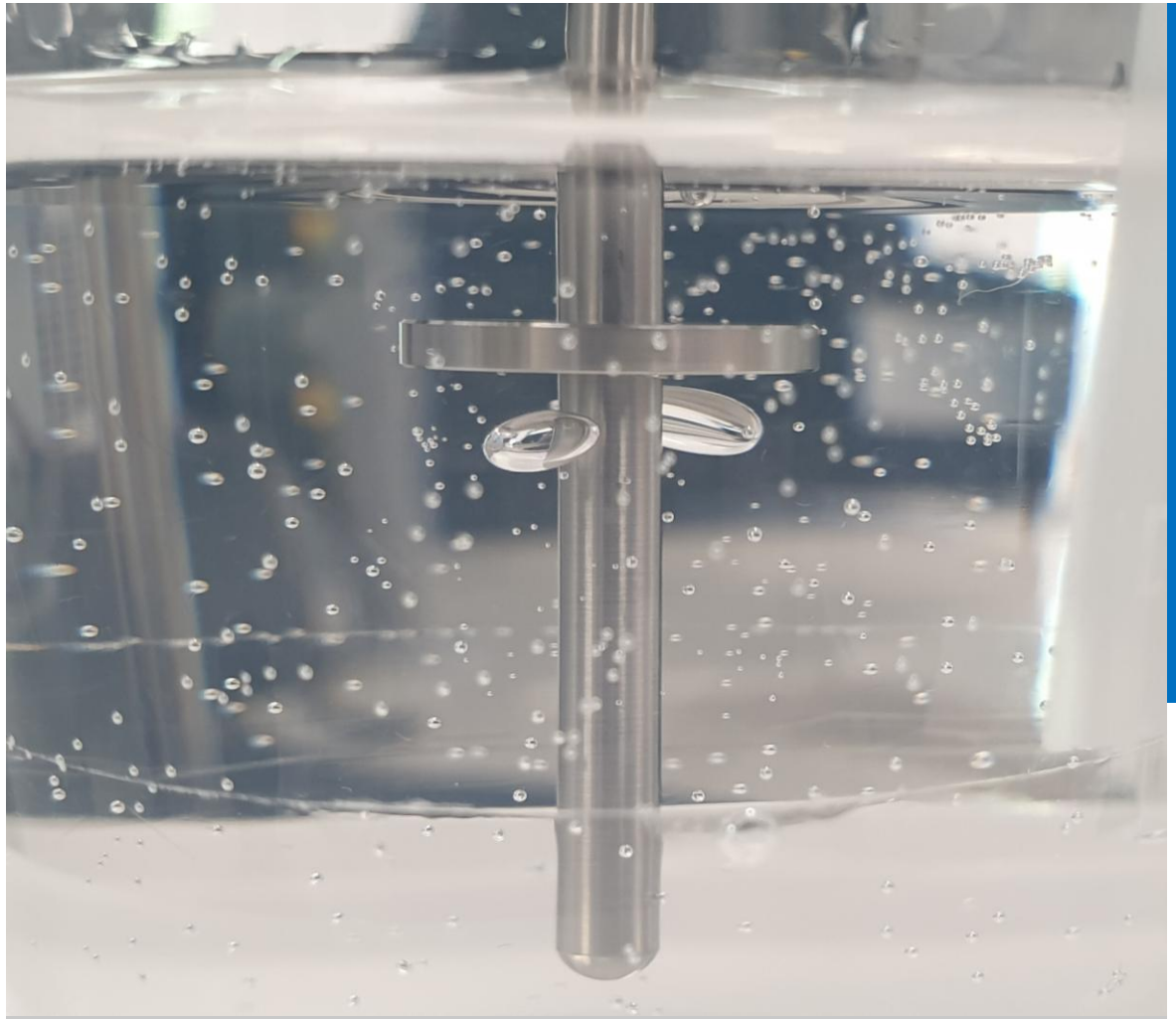

Rheological Optimization of Latex Paints with Balanced Key Coating Properties

Artur Palasz, Ph.D.
Spektrochem Coatings Laboratory, LLC

CTT Summit (Coatings Trends & Technologies)
Lombard, IL, US, September 4th, 2025

Coatings Trends & Technologies SUMMIT

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Your speaker

Artur Palasz, Ph.D.
Formulation scientist
R&D director

Professional background

- Polymer latex chemist
- Formulating and testing of raw materials for waterborne paints
- ASTM testing

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Coatings Laboratory, LLC

- Waterborne Architectural Paint Formulation Development
- Raw Materials Performance Studies
- Independent Lab Services for the Coatings Industry
- Research, Consulting, Courses

Author of technical articles published by global coating journals

PCI Paint & Coatings Industry
European Coatings journal
Coatings World
Journal of Surface Coatings Australia
pitture e vernici european coatings formulation
PPCJ Polymers Paint Colour Journal
CoatingsTech Industry News, Science and Technology and Market Insights
OCCA The Oil & Colour Chemists' Association

Speaker at international conferences

Waterborne Symposium Celebrating 50 years!
AC American Coatings Show+ Conference
CTT Coatings Trends & Technologies
European Coatings Show 2025 Adhesives – Sealants – Construction Chemicals
Pacific Coatings Show Adhesives – Sealants – Construction Chemicals
WCS Western Coating Societies
PRA's 13th International Woodcoatings Congress
European Coatings conference

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One Paint – Many Painters

- DIYers vs Pros
- Brushes, rollers, sprayers
- Temperature shifts, tint load

One formula must handle all

Amateur Painters

Amateur Tools

Professional Painters

Professional Tools

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Rheology = Workability + Performance

Viscosity

Low-shear	→	makes or brakes your open time and leveling (film smoothness)
Mid-shear	→	where roller drag and flow are decided
High-shear	→	controls brush feel and spray pattern

Secondary rheological properties

Sagging	→	determines whether paint holds on vertical walls or starts sliding down
Leveling	→	shows up when rolling on ceilings or walls – clean job or a mess
Tintability	→	controls whether viscosity stays stabile after tinting

Performance

Washability	→	how easily everyday dirt wipes off without dulling the finish
Cleansability	→	the „real kitchen test” – greasy Ranch sauce or even late-night pizza – premium paints survive, budget ones surrender

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Our Base System – Eggshell Latex Paint

The core formulation was prepared via a let-down process by combining the all-acrylic binder with pre-prepared pigment and extender slurries containing compatible dispersing agents, defoamers, and preservatives

Ingredients	Pounds per 100 gallons	Function
Let-down		
All-Acrylic Polymer Latex	469.4	Binder
TiO_2 Slurry	260.8	Prime pigment
Kaolin Slurry	208.7	Extending filler
Nepheline Syenite Slurry	121.7	Reinforcement filler
Coalescing Agent	15.6	Film-forming
Water	32.3	Dilution/adjusting
Rheology Additive	3.5	Rheology modifier
Total:	1,130 lbs	

Formulation contstants:

PVC: 34.6% CPVC: 55.6% Q (PVC/CPVC): 0.62%

Volume solids: 42.8% Weight per gallon: 11.3 lbs/gal

Contrast ratio: 97.8% (Drawdown 450 sq.ft/gal)

The resulting paint formed a coating consistent with MPI #52 specifications for gloss level 3 (eggshell finish):

- Gloss: 10 – 25 @60°
- Sheen: 10 – 35 @85°

All test formulations were evaluated in direct comparison to a market-available U.S. interior eggshell paint labeled as *REFERENCE EGGSHELL INTERIOR PAINT*.

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HEUR Thickeners

Hydrophobically Modified **E**thoxylated **Ur**ethane (HEUR)
Very effective, nonionic, water-soluble polyurethanes with terminal hydrophobic groups

Chemical backbone (schematic):

$$HO–(CH_2–CH_2–O)_n–[\textit{Urethane Linkage}]–(CH_2–CH_2–O)_m–OH$$

Hydrophobic end group | Hydrophilic core | Hydrophobic end group

- Depending on the chain length, molecular weight, and hydrophobicity, they can be responsible for rheological modification in the full range of shear forces
- Stable over the full pH range
- Depending on the degree of polarity, they are more soluble in water or a mixture, e.g. water/glycol
- They may affect the dirt retention of the coating, color compatibility drift (rub-out), etc.

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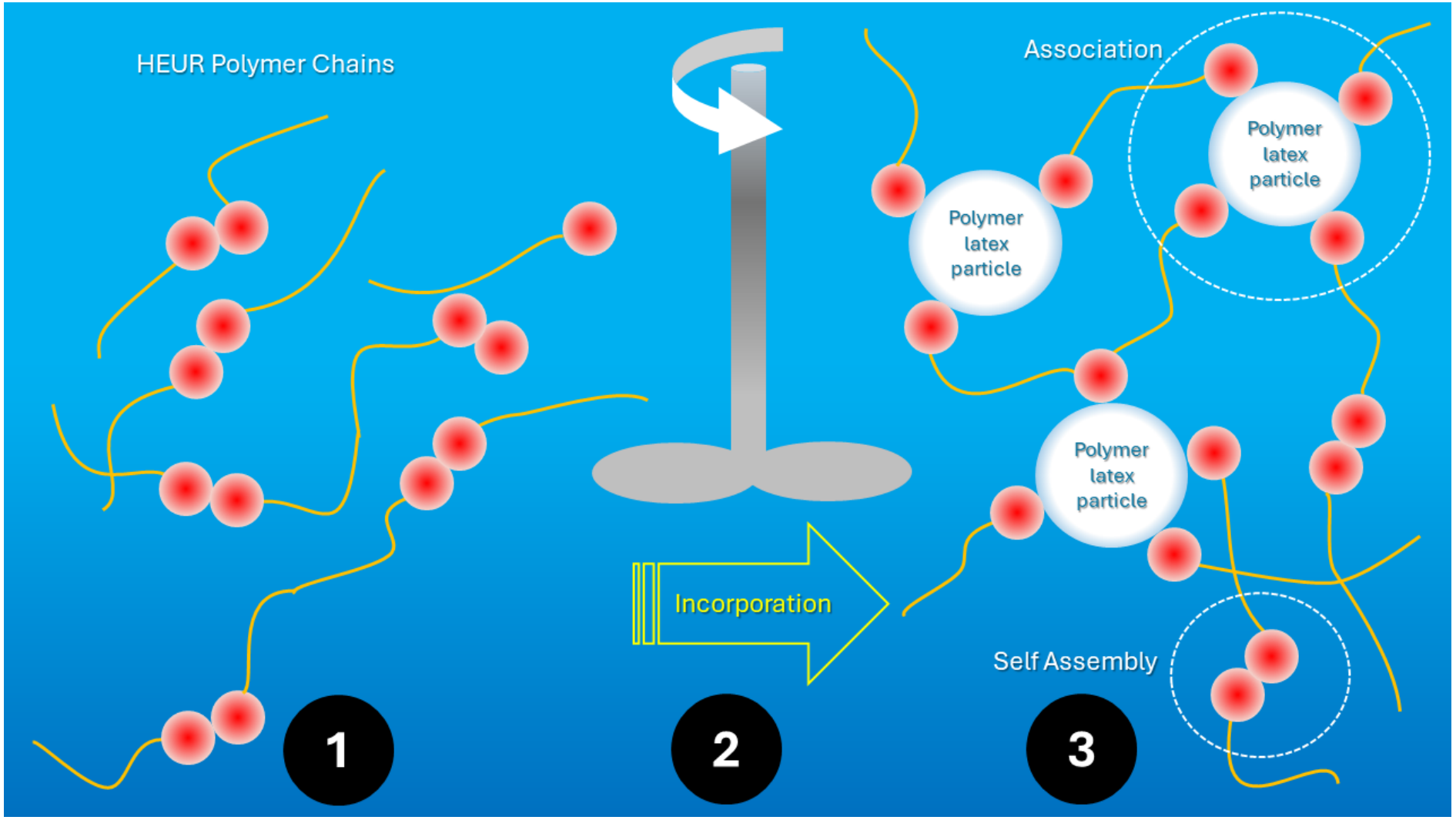
HEUR Thickeners: Thickening Mechanism



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The Players: HEUR Thickeners

Modifications – layered viscosity building with *HEUR A* – main thickener, *HEUR B* – supplementary thickener

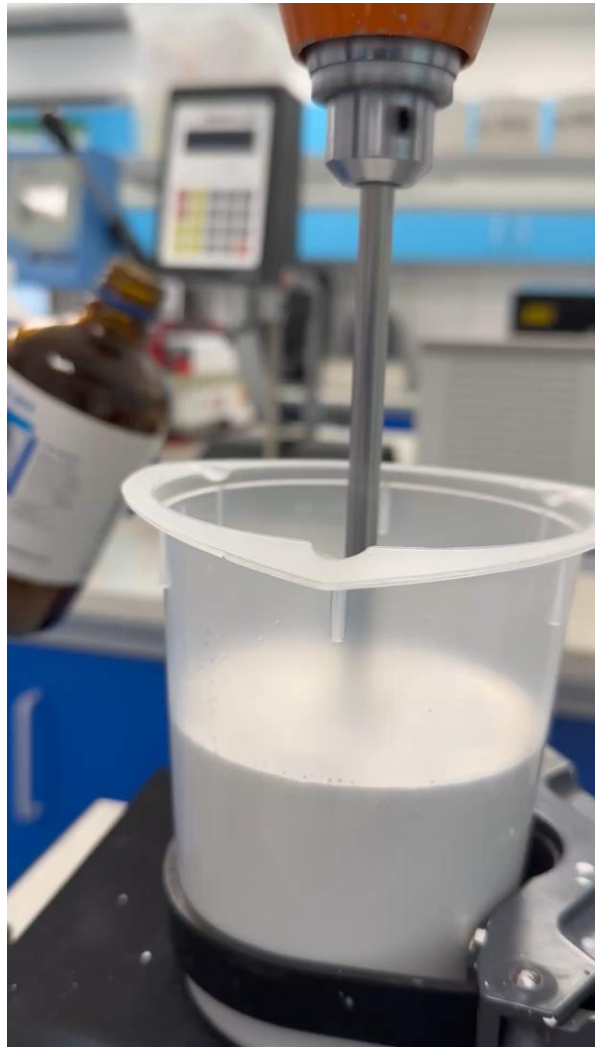
HEUR Thickener		Active content (as supplied)	Dosage (active on total paint formulation)
#1	A	45%	**0.086%**
	B	30%	**0.035%**
#3	A	40%	**0.514%**
	B	45%	**0.180%**
#4	A	30%	**0.115%**
	B	45%	**0.208%**
#5	A	40%	**0.077%**
	B	45%	**0.104%**
#6	A	17.5%	**0.054%**

The target Stormer viscosity for all formulations was set in the range of **90–110 KU** (after 1 week equilibration*).

Thickners incorporation:

- Let-down
- Mixing by anchor stirrer
- Equalization time ~20 minutes

* Ambient conditions
(lab enviromnent): 73.5 °F ± 3.5 °F



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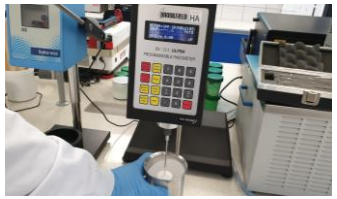
Tools & Methods

ASTM-Backed Measurements

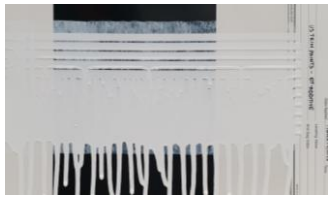


Low-Shear Viscosity
Brookfield HA DVIII with disc spindles
ASTM D2196 method A
Measurement at 73 °F

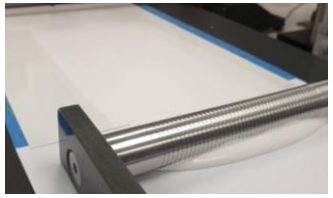
Mid-Shear Viscosity
Byko-visc Digital Stormer Viscometer
ASTM D562 method B (paddle spindle)
Measurement at 73 °F

High-Shear Viscosity
BYK CAP 2000+L (cone & plate)
ASTM D4287, shear rate 12,000 s^{-1}
Measurement at 75 °F

Spattering Test
Notch spool roller
ASTM D4707
Automatic drawdown

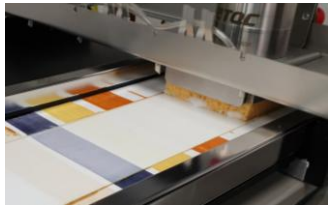


Sag Test
Leneta Anti-Sag Meter ASM-4 (4 – 24 mils gaps)
ASTM D4400
Automatic drawdown, pre-shearing



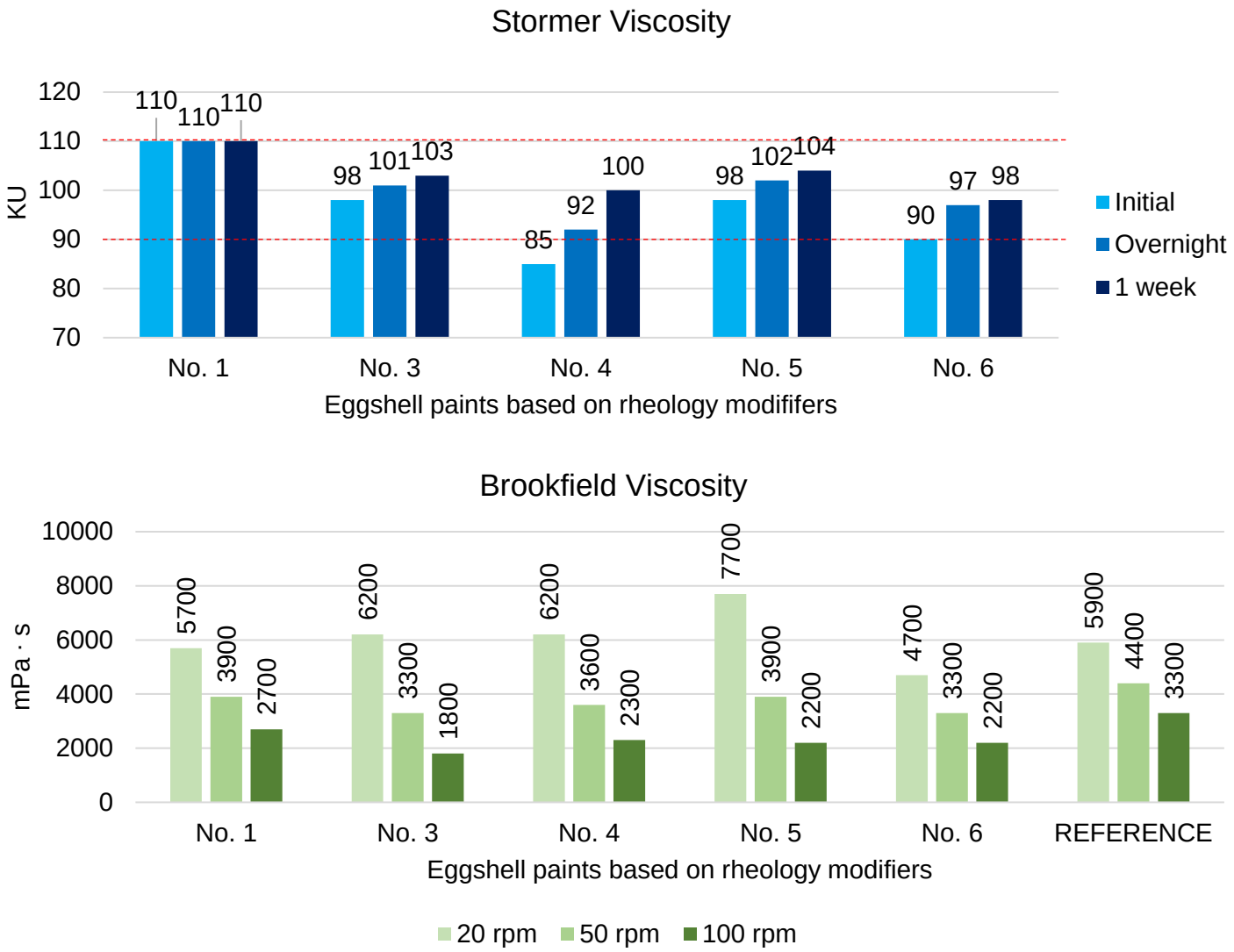
Leveling
Leneta LTB-2 Logicator
ASTM D4062
Automatic drawdown, pre-shearing

Tintability (Viscosity Stability + Rub-Out)
Colorant (liquid pigment concentrate)
Determination of ΔKU and color acceptance
ASTM D562, ASTM D2244



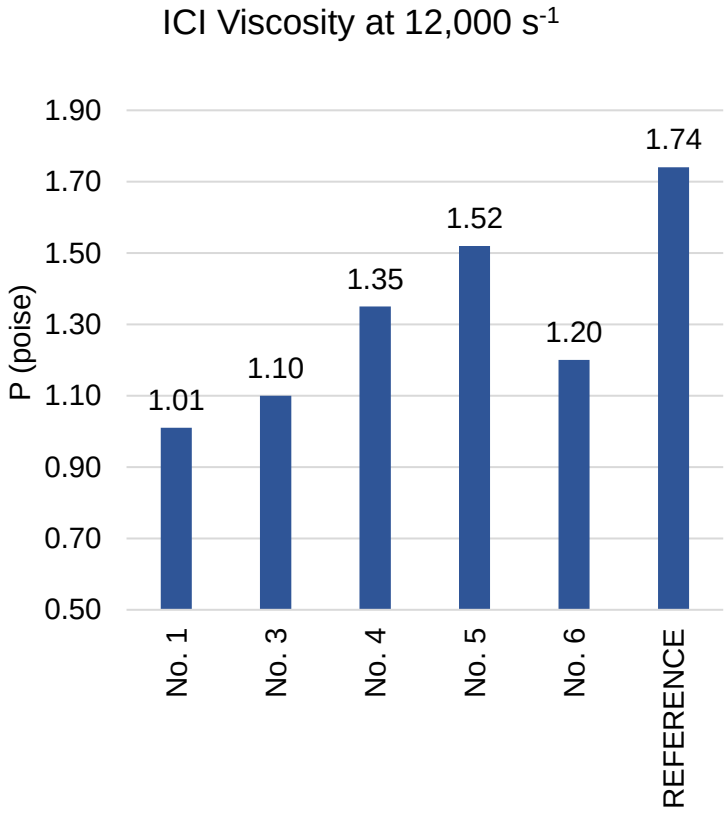
Washability / Cleansability
Scrub/washability tester
ASTM D3450 / ASTM D4828
Standard soilant / daily stains (kitchen + kids)

Low-Shear, Mid-Shear vs. High-Shear: Balance is Everything



Eggshell Reference Paint: **108 KU**

(on the day of measurement of the remaining samples)



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Sag, Spat, Level – Paint Beyond the Can

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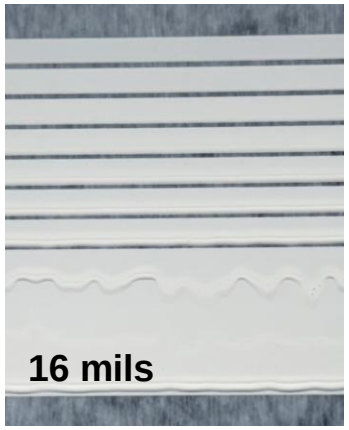
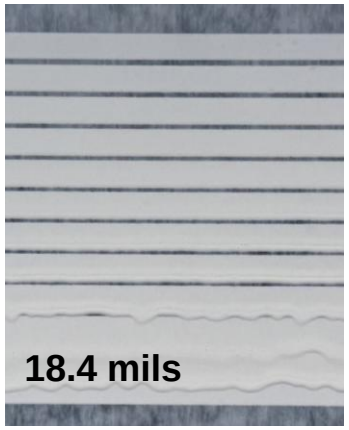
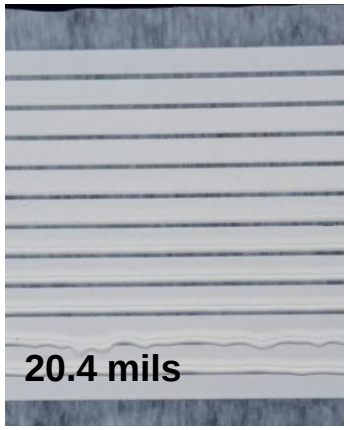
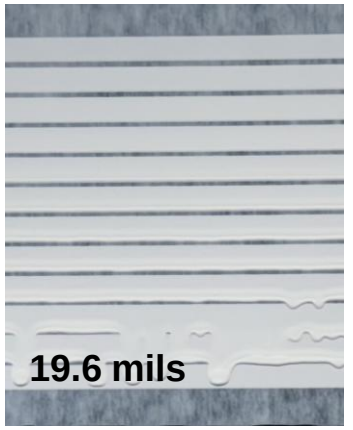
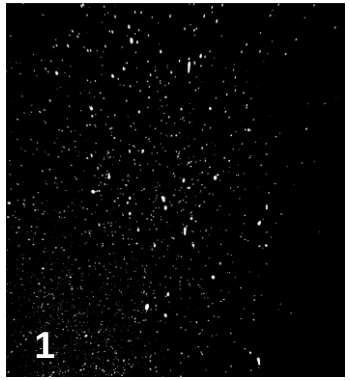
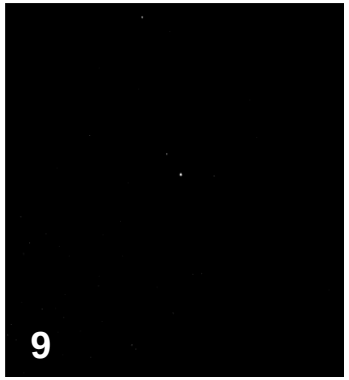
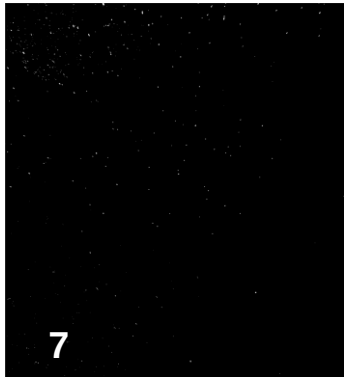
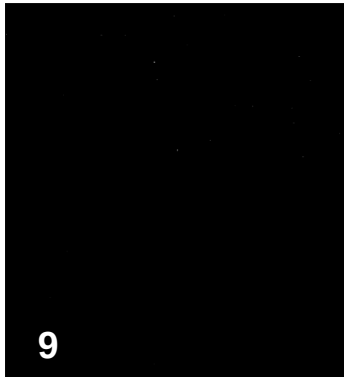
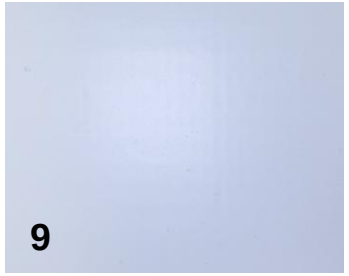
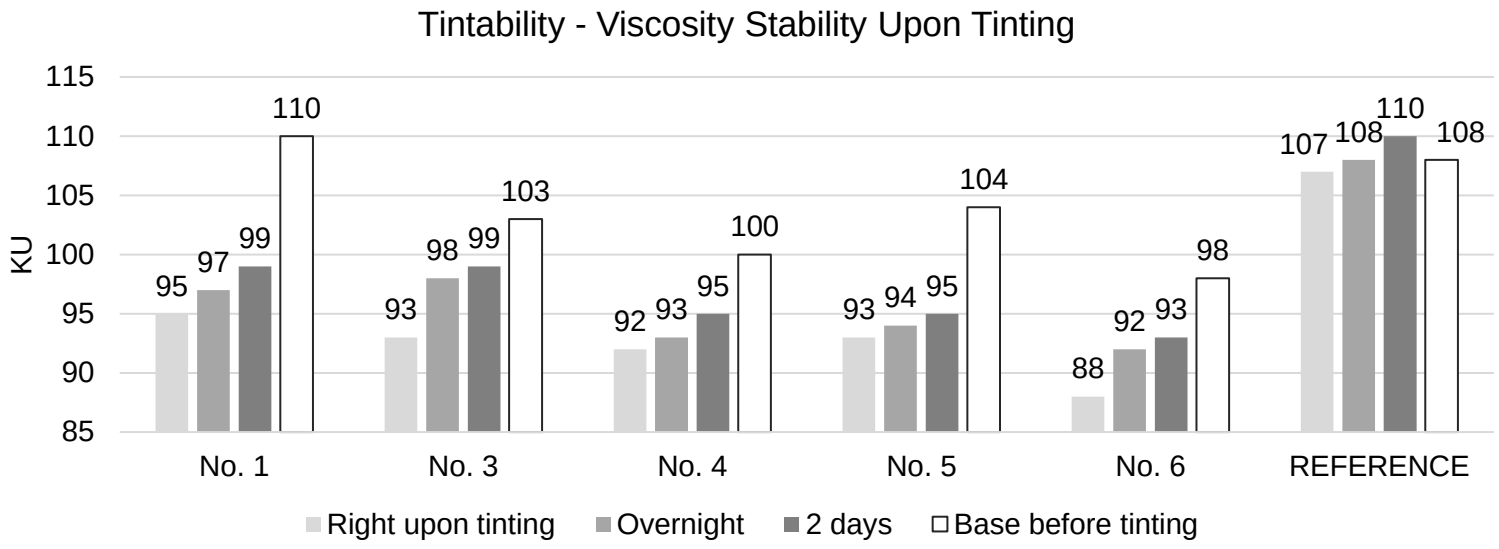
	Paint No. 1	Paint No. 3	Paint No. 4	Paint No. 5	Paint No. 6	REFERENCE
Sag Test	 16 mils	 24 mils	 18.4 mils	 20.4 mils	 18 mils	 19.6 mils
Spat Test	 8	 1	 9	 7	 8	 9
Level Test	 9	 4	 9	 9	 9	 10

Tintability and KU Stability



Colorant: Liquid Pigment Concentrate PBk7 (Carbon Black)

Tinting: 5 fl.oz./gal

Shaking: 2 minutes

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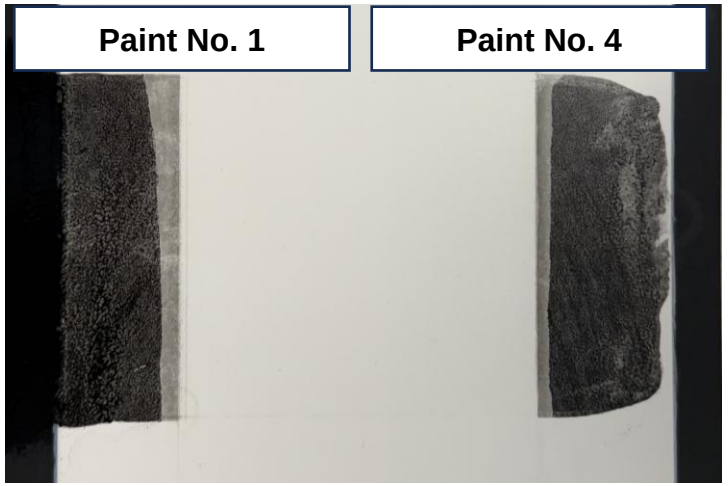
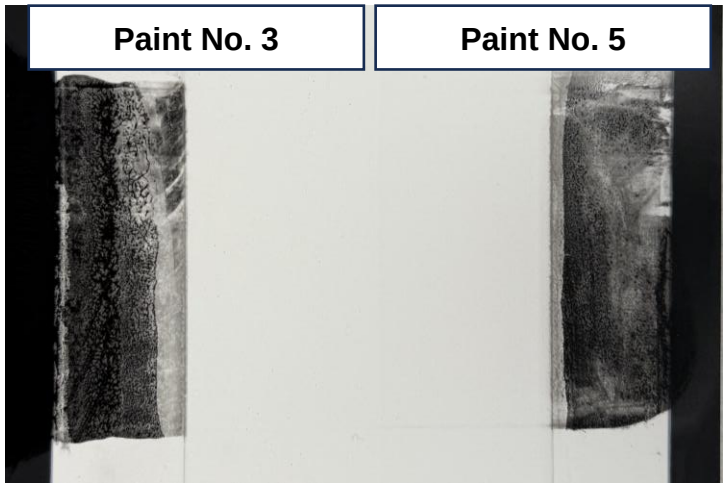
Washability

Percentage Reflectance Recovery and Assessment of Coating Erosion (after 4 x 25 Washability Cycles)



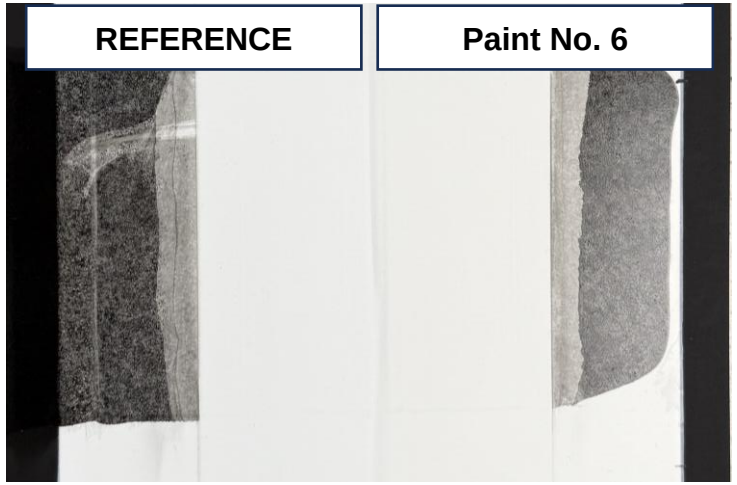
98.9% **99.2%**

No Erosion No Erosion



99.4% **99.2%**

No Erosion No Erosion



98.4% **98.7%**

No Erosion No Erosion

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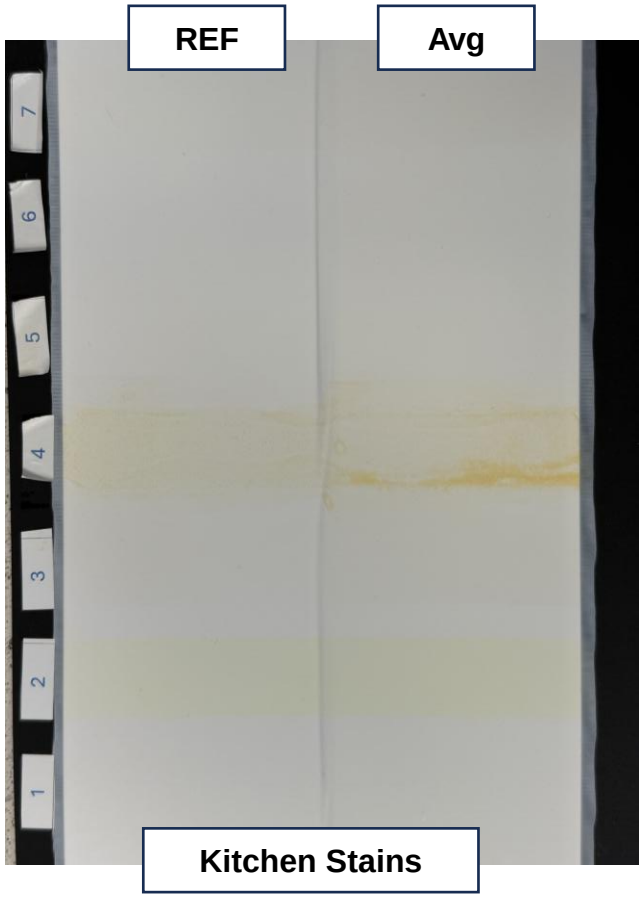
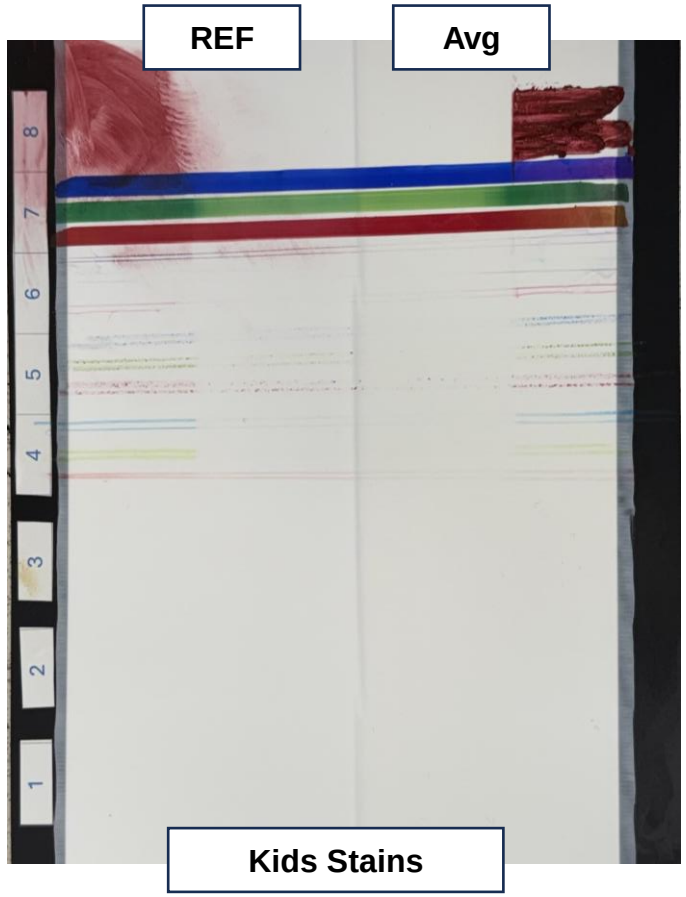
Cleansability

Full details on ΔE^*_{ab} available upon request

1 – Maple Joe (Maple Syrup)
2 – Espresso Coffee (Lavazza T!erra)
3 – Merlot Calofornia Red Wine
4 – Heinz Beanz BBQ (canned beans)
5 – Iodine
6 – Simply Orange Juice



1 – Heinz Ketchup
2 – Heinz Yellow Mustard
3 – Jak Daniels BBQ Sauce
4 – McInheny Tabasco
5 – Tomasto Paste
6 – Hidden Valey Ranch
7 – A1 Sauce



1 – Hershey Chocolate Syrup
2 – Nutella
3 – Reese's Peanut Butter
4 – Color pencil
5 – Crayon
6 – Pen
7 – Permanent Marker
8 – Lipstick

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Final Rheology Target Profile

Compared to the reference paint, the following conclusions were drawn regarding the obtained rheological parameters and coatings performance

Paint based on thickener	Brookfield Viscosity	Stomer Viscosity	ICI Viscosity	Spattering	Sagging	Leveling	Tint viscosity stability	Stain resist + washability
#1	★★★	★★★	★	★★★	★	★★	★	★★
#3	★★★	★★★	★	★	★★★	★	★	★★
#4	★★★	★★★	★	★★★	★★	★★	★	★★
#5	★★★	★★★	★	★★	★★	★★	★	★★
#6	★★★	★★★	★	★★	★★	★★	★	★★

★ To be improved ★ ★ Good enough ★ ★ ★ Very good

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Next steps

Modifications to improve high-shear viscosity (ICI area)
and tint viscosity stability (Stormer viscosity)

Paint based on thickener	ICI thickener	Dosage*	Tint viscosity stabilizer	ICI Viscosity at 12,000 s^{-1}	KU Viscosity upon tinting
#4	A	0.05%	0.3%	1.56 P	2 KU drop
		0.15%	0.3%	1.80 P	1 KU drop
	B	0.05%	0.3%	1.42 P	6 KU drop
		0.15%	0.3%	1.78 P	3 KU drop
	C	0.20%	0.3%	1.70 P	2 KU drop
	D	0.13%	0.3%	1.75 P	2 KU drop
	E	0.08%	0.3%	1.82 P	1 KU drop
Reference	--	--	--	1.74 P	1 KU drop

**active substances calculated on total formulation*

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Summary

When selecting HEUR thickeners you can’t just chase a KU number or a smooth viscosity curve. You need to look at ***the whole picture***.

- Start with ***the viscosity profile*** across shear rates – low shear keeps the paint from sagging, mid shear defines roller feel, and high shear controls brush drag and sprayability.

- Then look at ***the secondary rheological properties*** – does the HEUR balance spatter, sagging and leveling, or does it solve one problem but create another?

- Finally, never forget ***coating performance*** – some HEUR systems can soften the film, reduce scrub resistance or hurt cleanability. The best combinations support stain removal, gloss retention and long-term durability.

The real key is balance:
The right HEUR is not just the one that hits the KU target, but the one that delivers a paint that rolls smoothly, resists sagging, levels beautifully, and still lets you wipe off BBQ sauce, peanut butter or red wine without ruining the finish.

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Thank you for your attention

More to discuss?

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/arturpalasz

Let's Connect

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