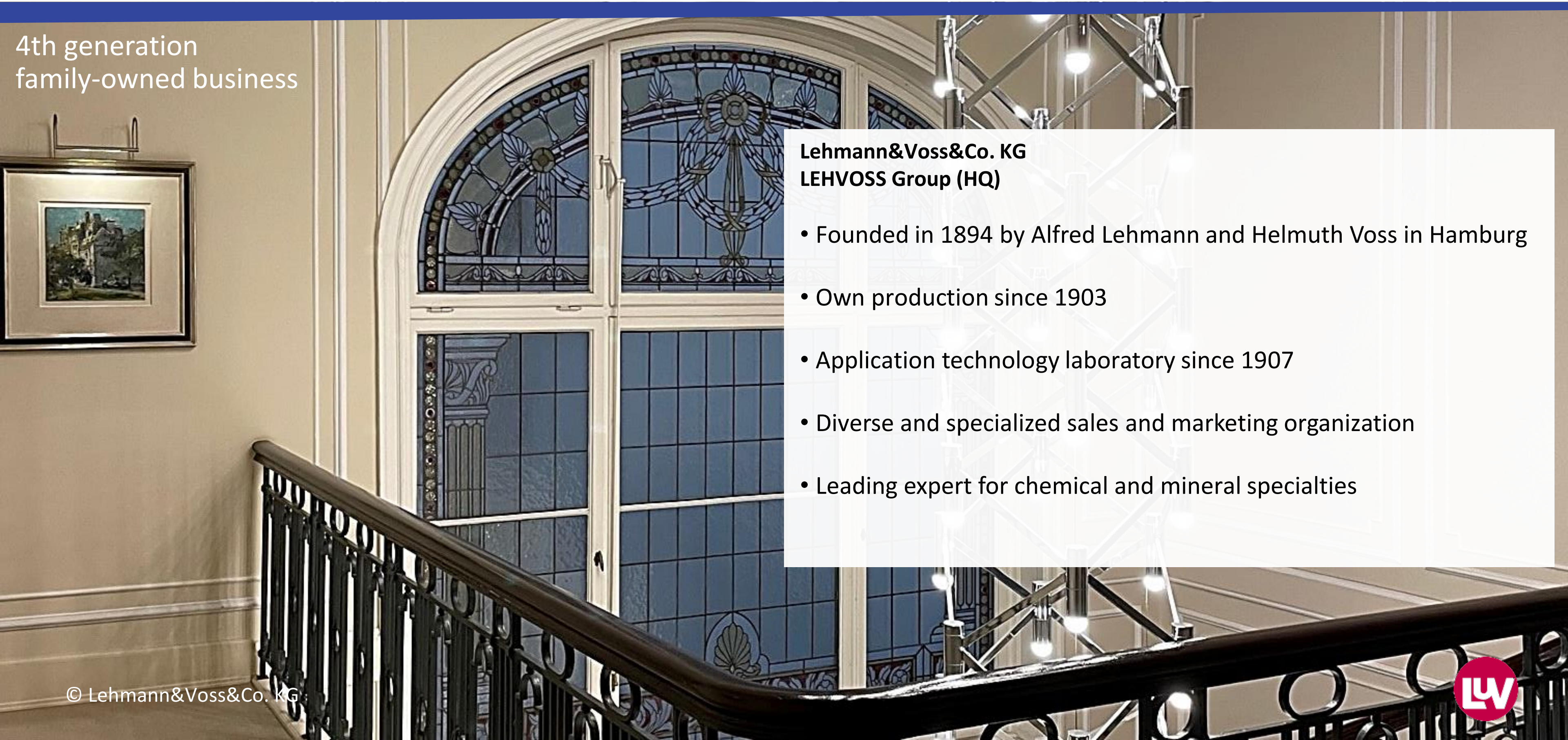
Your experts for high-performance chemical and mineral specialties. Since 1894.

LEHVOSS
Group

Lehmann&Voss&Co.
LEHVOSS Group

Excellence in Detail.



4th generation family-owned business

Lehmann&Voss&Co. KG
LEHVOSS Group (HQ)

- Founded in 1894 by Alfred Lehmann and Helmuth Voss in Hamburg
- Own production since 1903
- Application technology laboratory since 1907
- Diverse and specialized sales and marketing organization
- Leading expert for chemical and mineral specialties

Your experts for high-performance chemical and mineral specialties. Since 1894.

Lehmann&Voss&Co. KG
LEHVOSS Group (HQ)
Hamburg (Germany)

Subsidiaries and shareholdings

- LEHVOSS France
- LEHVOSS UK
- LEHVOSS Italia
- LEHVOSS Schweiz
- LEHVOSS Nederland
- Engredo, Dänemark
- LEHVOSS Iberia
- LEHVOSS Polska
- LEHVOSS North America
- LEHVOSS Shanghai
- LEHVOSS Korea

Network

- Global sales network of distribution partners and agents
- Worldwide sourcing by own procurement organization
- Worldwide logistics hubs

Your experts for high-performance chemical and mineral specialties. Since 1894.

LEHVOSS Group

500 Mio. €

2022 turnover (consolidated)

7.000

Customers

6.500

Products

665

Experts

18

Subsidiaries
in Europe, North America and China

4

Production sites worldwide
in Hamburg, Solingen (Germany); Pawcatuck (USA); Shanghai, Kunshan (China)

5

Laboratories
in Hamburg, Solingen (Germany); Origgio (Italy); Pawcatuck (USA); Shanghai, Kunshan (China)

1

Technology center
in Hamburg (Germany)

Business areas and product ranges

Plastics and Rubber

- High-performance compounds
- Technical compounds
- Masterbatches and additives
- Composite materials
- Raw materials for rubber

Special Chemicals and Industrial Minerals

- Magnesium compounds
- Rare earth / zirconium compounds
- Raw materials for paints and coatings, inks, construction chemicals, adhesives and sealants
- Additives for metal working fluids, lubricants and functional fluids
- Products for filtration and separation

Life Sciences

- Raw materials for personal care
- Nutrition minerals
- Nutraceuticals
- Pharmaceutical raw materials
- Products for filtration and separation

Next generation organic rheology modifiers

higher performance

easier and more reliable processing

Organic rheology additives

For solventborne and 100-% systems

- Various chemistries
- May be natural or synthetic
- Require shear and temperature for activation
- Best for low-shear viscosity control

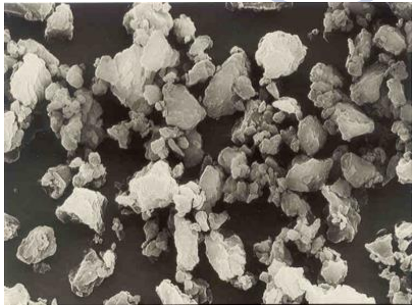
  - Castor oil derivatives
  - Natural waxes
  - Polyamides
  - Hybrids
  - Synthetic waxes (polyolefins)

Organic rheology additives

For solventborne and 100-% systems

- Castor oil derivatives
- Natural waxes
- Polyamides
- Hybrids
- Synthetic waxes (polyolefins)

Many such additives are based on renewable raw materials



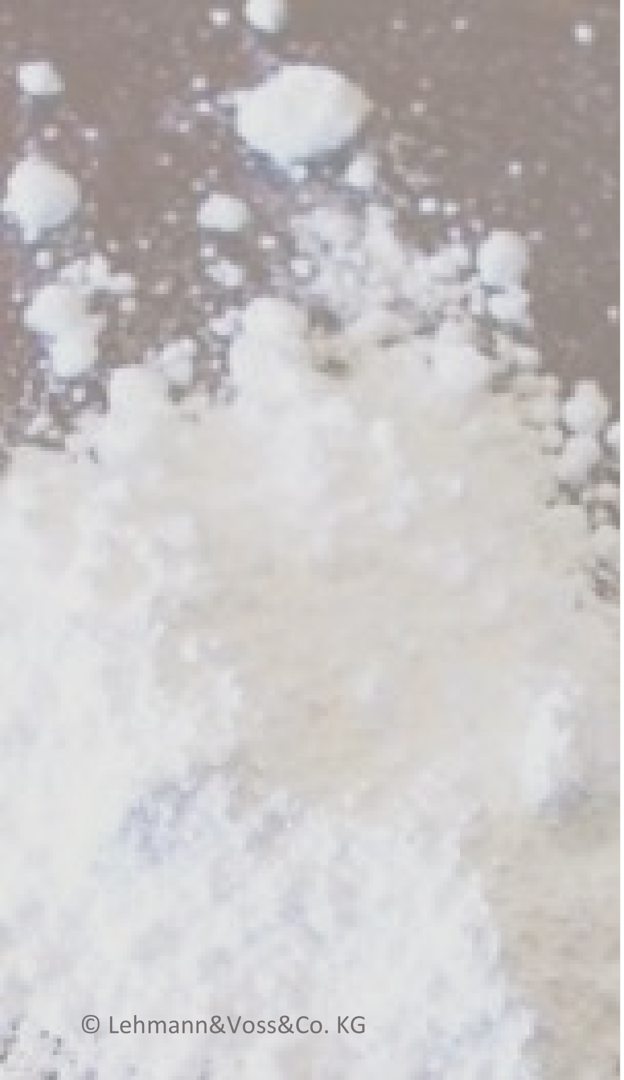
Next generation organic rheology modifiers

Objectives of this work

Focus on organic rheology additives for solventborne and 100-% systems

What did we set out to address?

- Easier activation
- Improved HS&E profile



Activation of organic rheological additives

The activation process depends on

- Physicochemical nature of the additive
- Polarity of the binders and solvents
- Particle size distribution of the powder
- Dispersion time and temperature
- Dispersion equipment
- Shear forces

Activation of organic rheological additives

How did we go about it?

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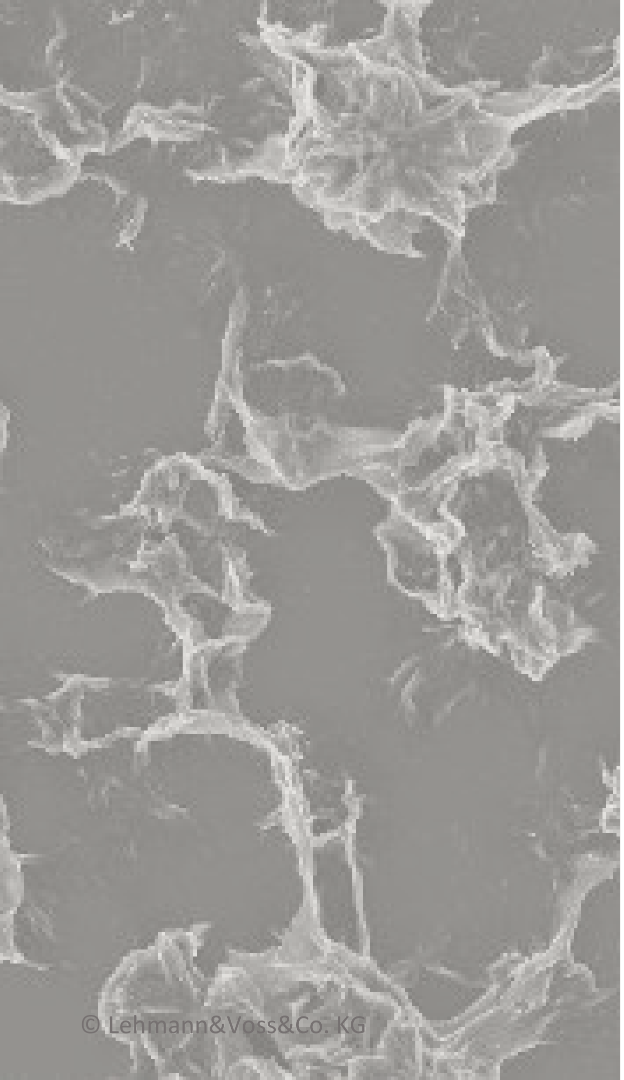
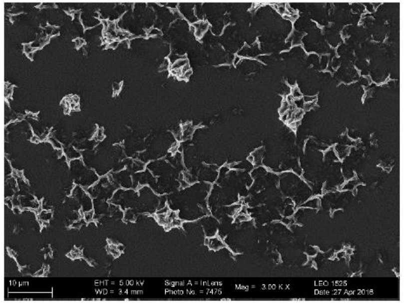
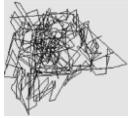
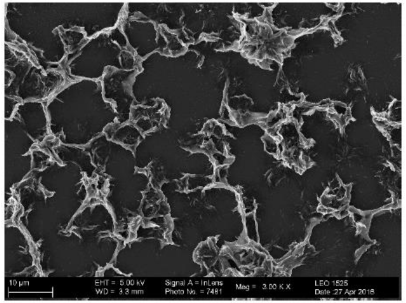


Next generation organic rheology modifiers





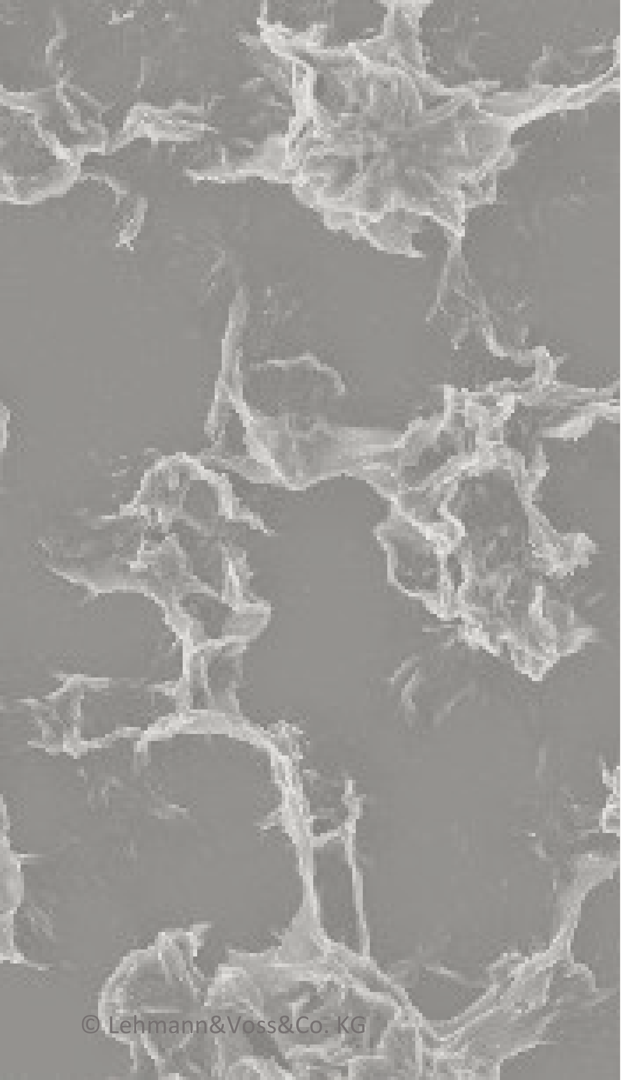


Classic technologies

- e.g., hydrogenated castor oil wax derivatives, polyamides or blends
- strong shear forces AND temperature control required for activation

Next generation

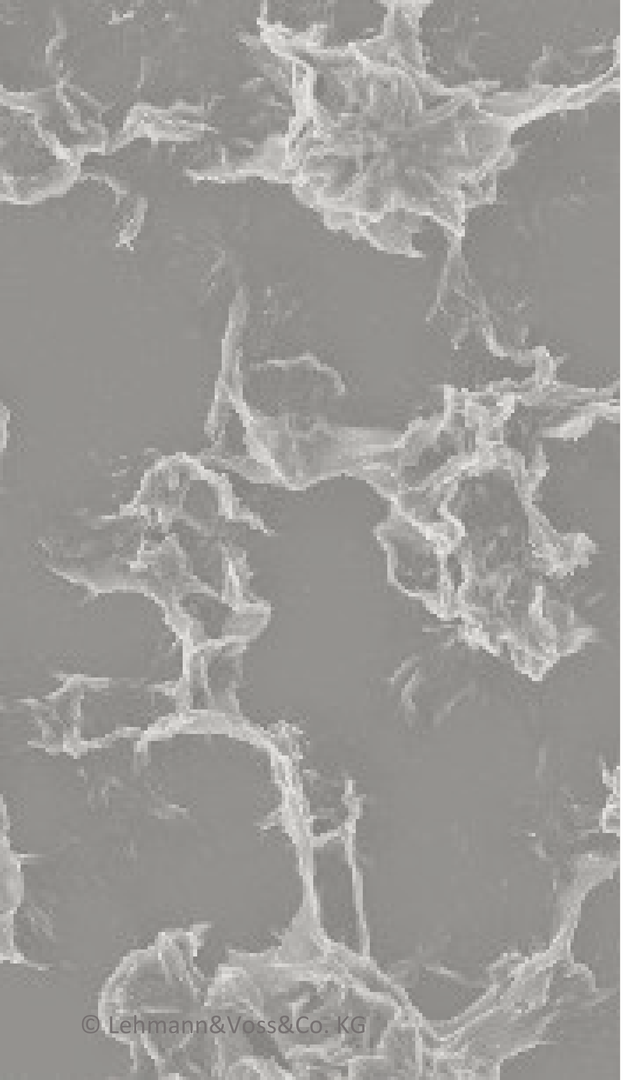
- rheology modifier is dissolved in a wax matrix
- shear is required for activation, but no temperature



Next generation organic rheology modifiers

What’s different in an additive?

Material	Characteristics
AB **Polyamide**	▪ Chemical structure ▪ Crystallization process ▪ Micronization
VP **Hybrid chemistry**	▪ Chemical structure ▪ > 80 % biosourced ▪ Crystallization process ▪ Micronization ▪ CFR 175.300-compliant grade available (FDA)



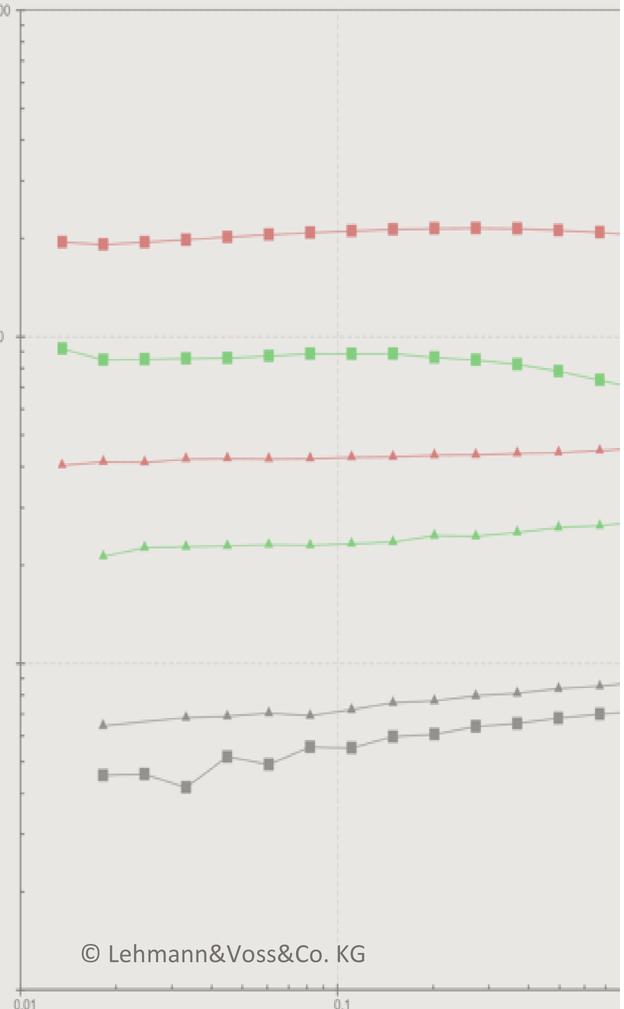
Next generation organic rheology modifiers

Scope of the work

Type of formulation	▪ High-gloss 2K polyester topcoat ▪ 2K epoxy primer, solventborne ▪ 2K epoxy primer, 100-% solids
Rheology additives	▪ Commercial polyamide (reference) ▪ Alternative polyamide, coded AB ▪ Hybrid chemistry, coded Hybrid VP
Evaluation	▪ Rheological profile ▪ Sag resistance ▪ Gloss ▪ Pendulum hardness

Notes on rheological measurements

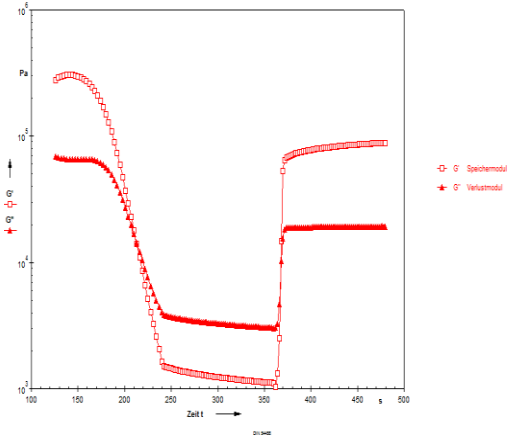
Evaluation of viscoelastic materials



Viscosity alone does not tell the whole story… structural strength of a viscoelastic material is related to G’

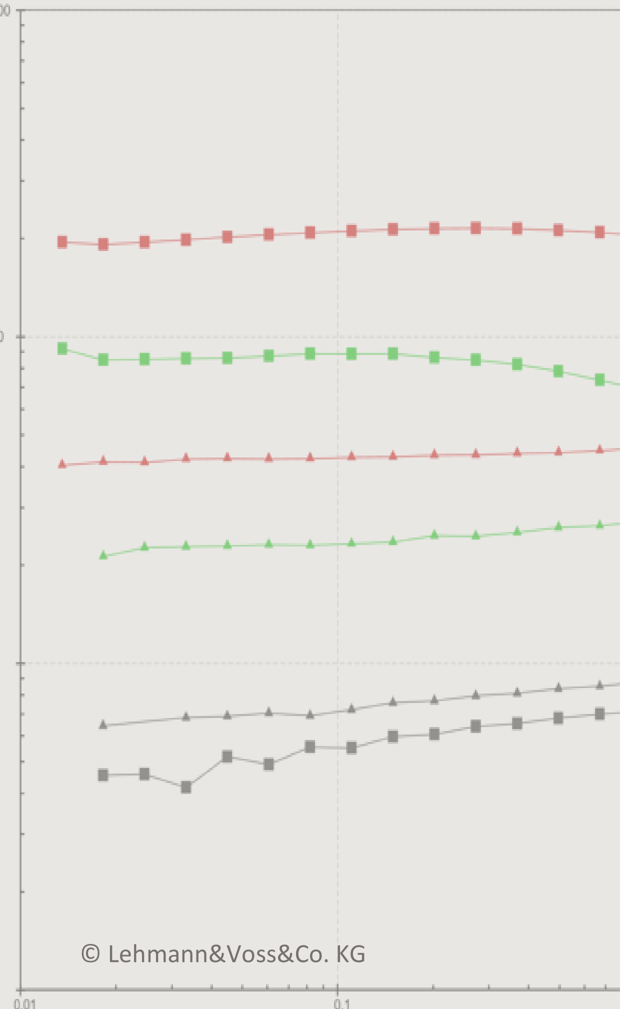
Example

Formulation #	G’ (kPa)	G” (kPa)	G* (kPa)
1	100	10	100.5
2	10	100	100.5



Formulations 1 and 2 have the same complex modulus (G*) and complex viscosity (η*) …BUT…

Formulation 1 has higher structure strength (G’)

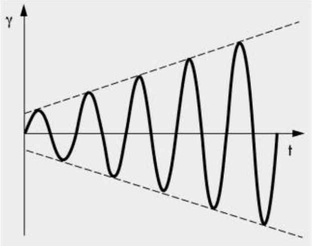


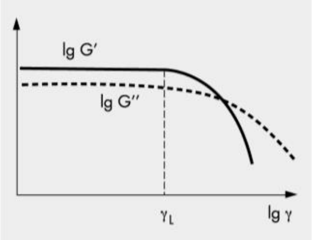
Notes on rheological measurements

Evaluation of viscoelastic materials

Measurements are performed via amplitude sweep

Preset:	variable deformation amplitude at constant frequency
Measurement:	shear stress amplitude
Result:	storage modulus G‘ and loss modulus G“ as a function of deformation γ





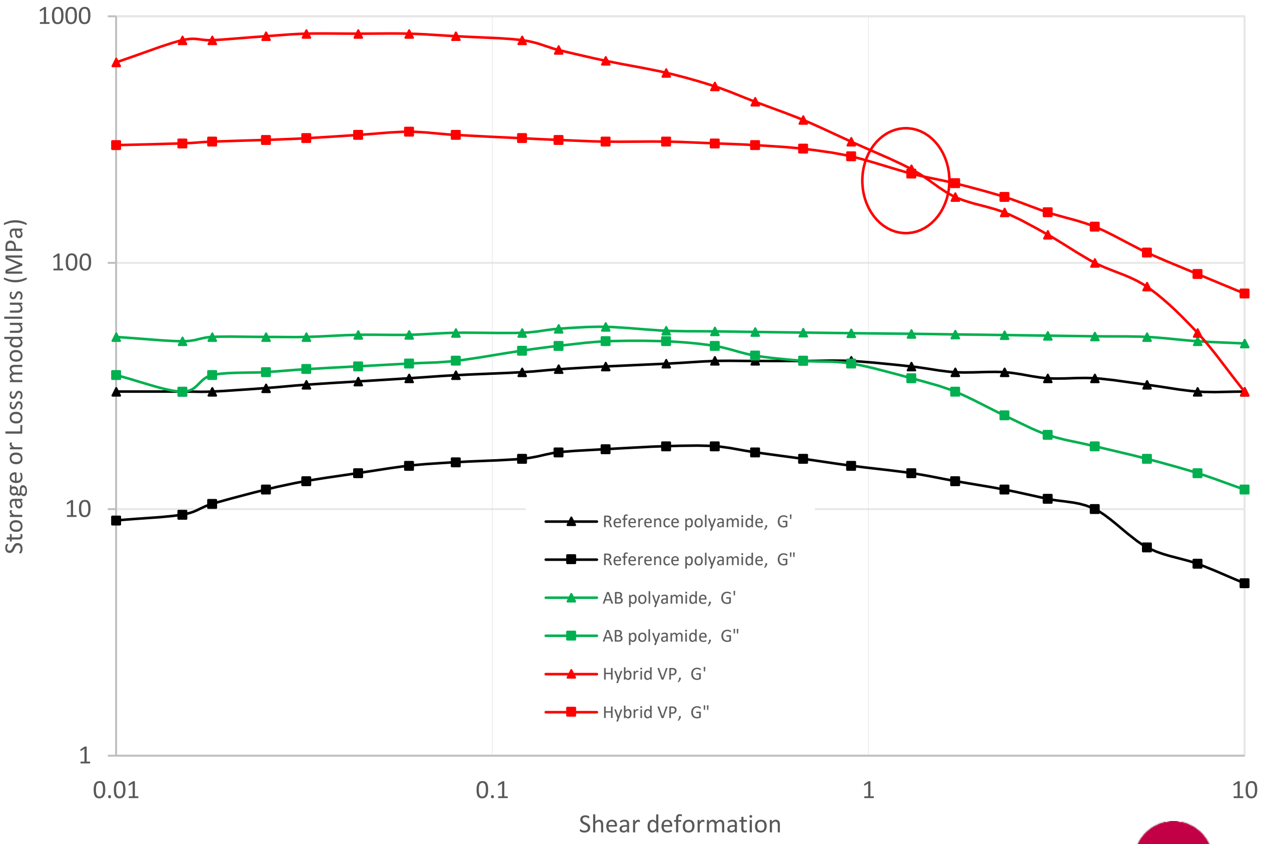
2K high-gloss polyester-PU topcoat

Dispersion at 55 °C

Base	Material		Parts
	OH-functional polyester		31.0
	Rheology additive		1.0
	TiO_2		25.8
	Methoxypropyl acetate		7.2
	Processing pearl mill, 15 min @ 55 °C		
	OH-functional polyester		18.6
	Surface-active ingredient		3.1
	Methoxypropyl acetate		7.0
	Butyl acetate		6.3
		TOTAL PART A	**100.0**
Hardener	Isocyanate	**TOTAL PART B**	**39.2**

2K high-gloss polyester-PU topcoat

Modulus (dispersion at 55 °C)



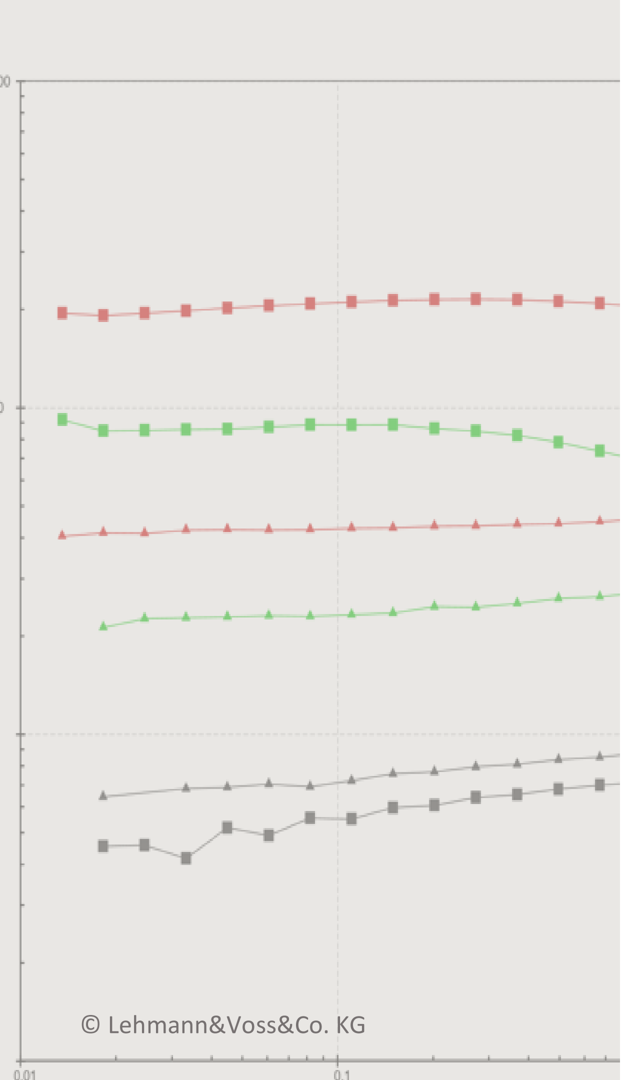
2K high-gloss polyester-PU topcoat

Performance (dispersion at 55 °C)

Additive		Reference polyamide	AB	Hybrid VP
Sag resistance (µm)		225	300	625
Sag resistance (mils)		9	12	25
Gloss, 100 mm film	60	93	31	87
	85	98	32	81
Pendulum hardness (König) after 7 days		141	82	134

2K high-gloss polyester-PU topcoat

Conclusions



- The stronger the network structure in the formulation, the higher its sag resistance
  - Considerably stronger rheological structures were obtained when using Hybrid VP and AB in comparison to the reference polyamide wax
- With Hybrid VP, gloss and pendulum hardness are slightly lower compared to the reference
- With AB, gloss and pendulum hardness are significantly reduced, thus, in this formulation, additive AB was less suitable

2K epoxy primer

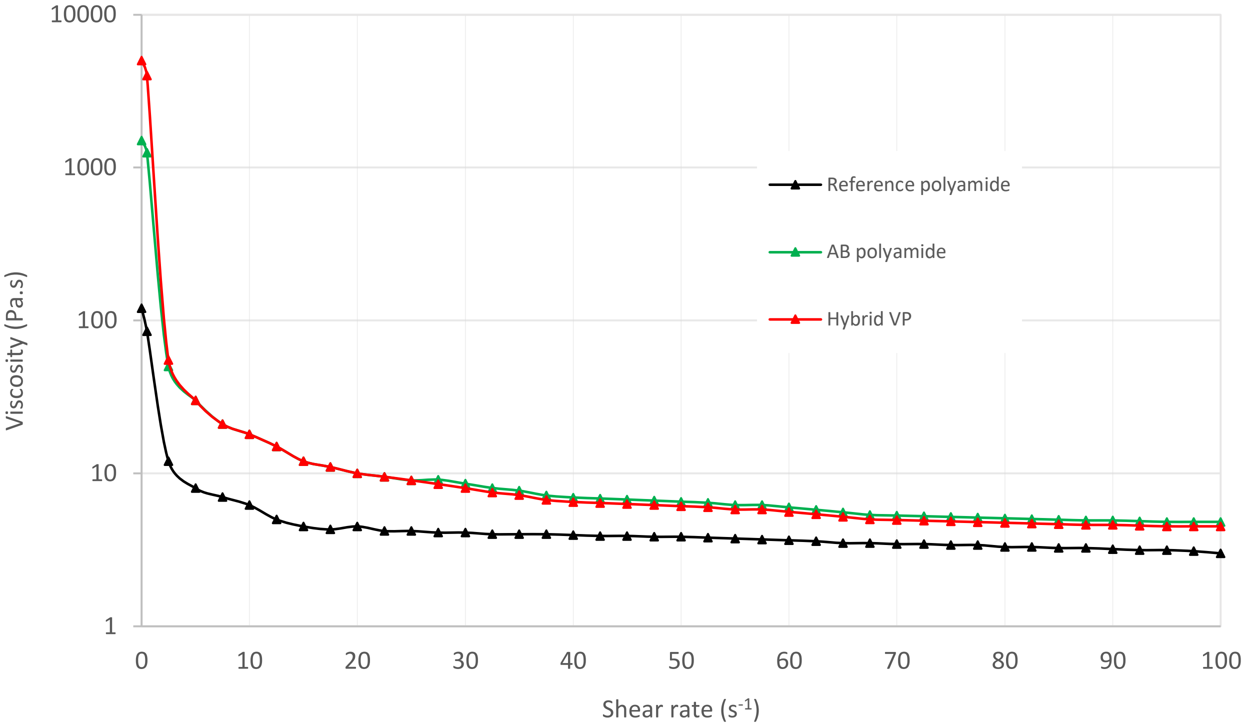
Solventborne (dispersion at 45 °C)

Base	Material		Parts
	Bisphenol A/f epoxy resin		40.0
	Rheology additive		0.9
	TiO_2		6.6
	Butanol / xylene (1:3)		6.6
	Zinc phosphate		19.7
	Talc		13.1
	Barium sulphate		13.1
	Processing pearl mill, 15 min @ 45 °C*		
		TOTAL PART A	**100.0**
Hardener	Polyamidoamine	**TOTAL PART B**	**23.7**

* Hybrid VP can be activated starting at 35 °C

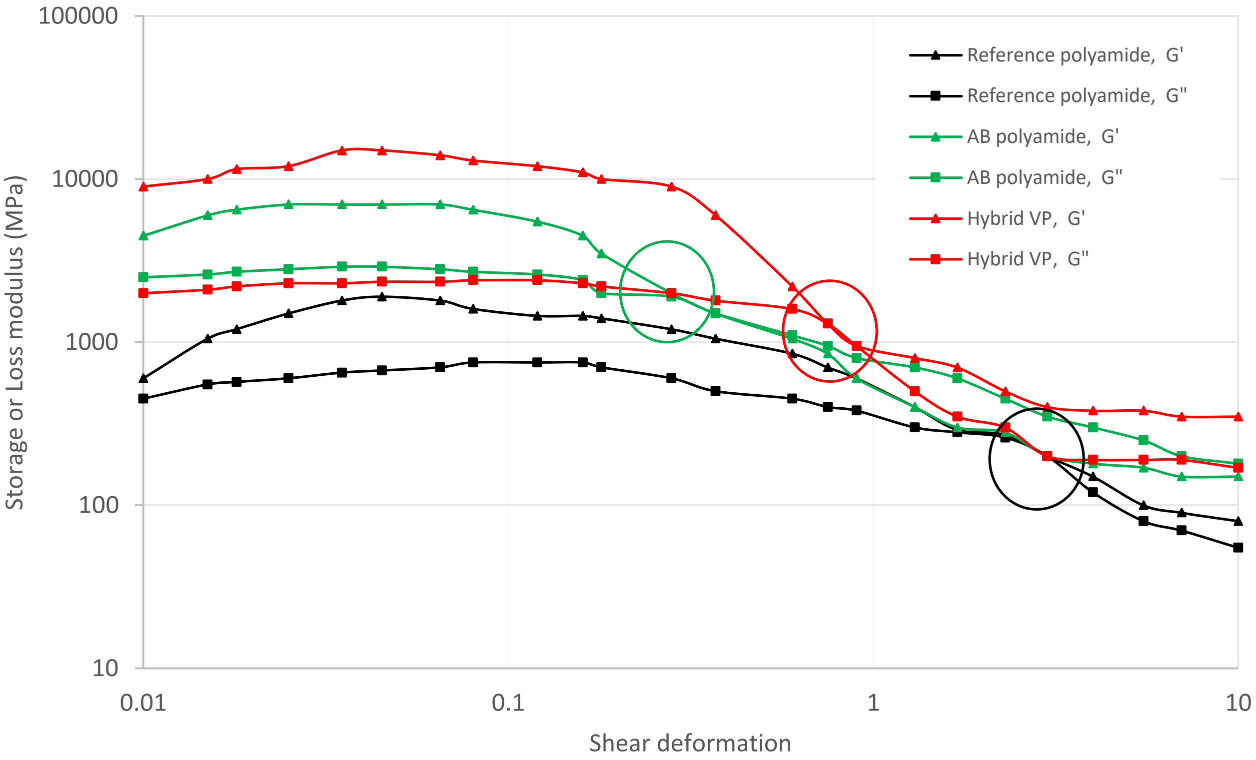
2K epoxy primer, solventborne

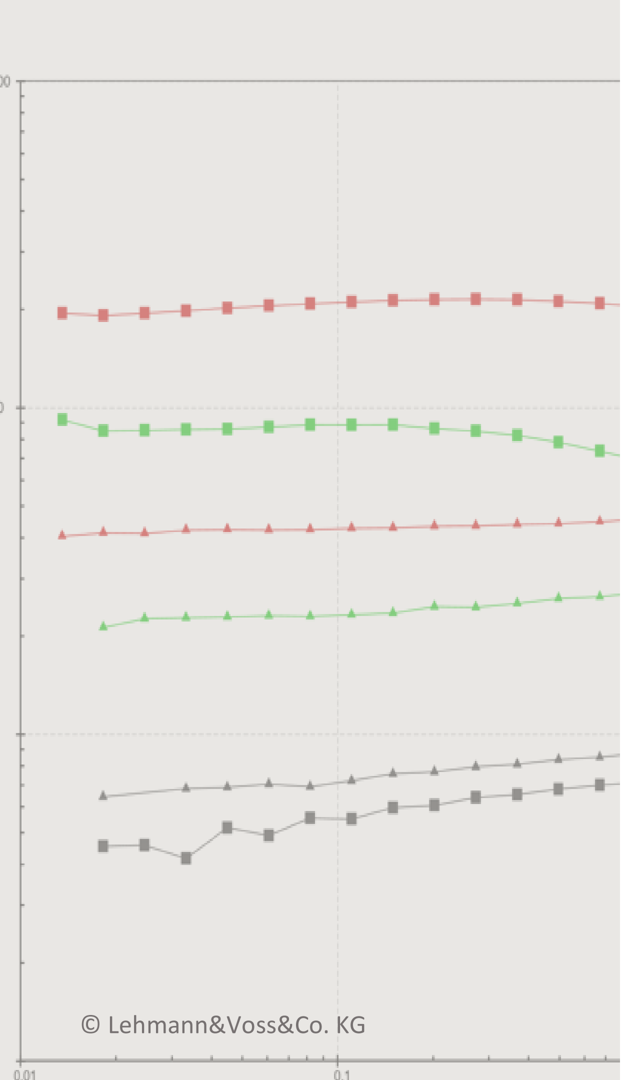
Viscosity (dispersion at 45 °C)



2K epoxy primer, solventborne

Modulus (dispersion at 45 °C)

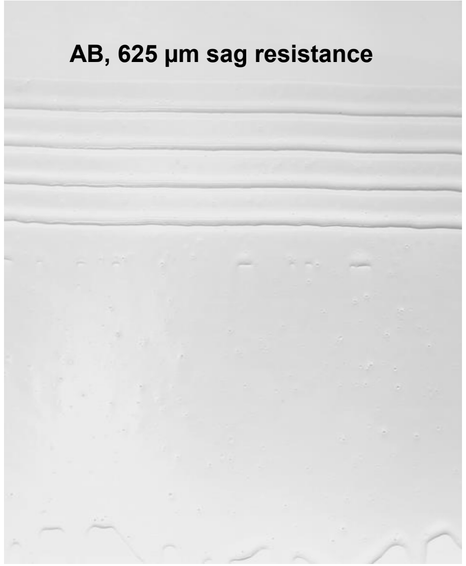




2K epoxy primer

Solventborne – sag resistance

Additive	Reference polyamide	AB	Hybrid VP
Sag resistance (µm)	375	625	1500
Sag resistance (mils)	15	25	59


AB, 625 µm sag resistance


Hybrid VP, 1500 µm sag resistance

2K epoxy primer

Solventborne – Conclusions

- Both Hybrid VP and AB were fully activated at 45°C
    - The reference polyamide did not fully activate under the same conditions

- The viscosity curves of Hybrid VP and AB are very similar
    - Differences are more noticeable in the amplitude sweep

- Hybrid VP develops the strongest viscoelastic network structure in this formulation

2K epoxy coating

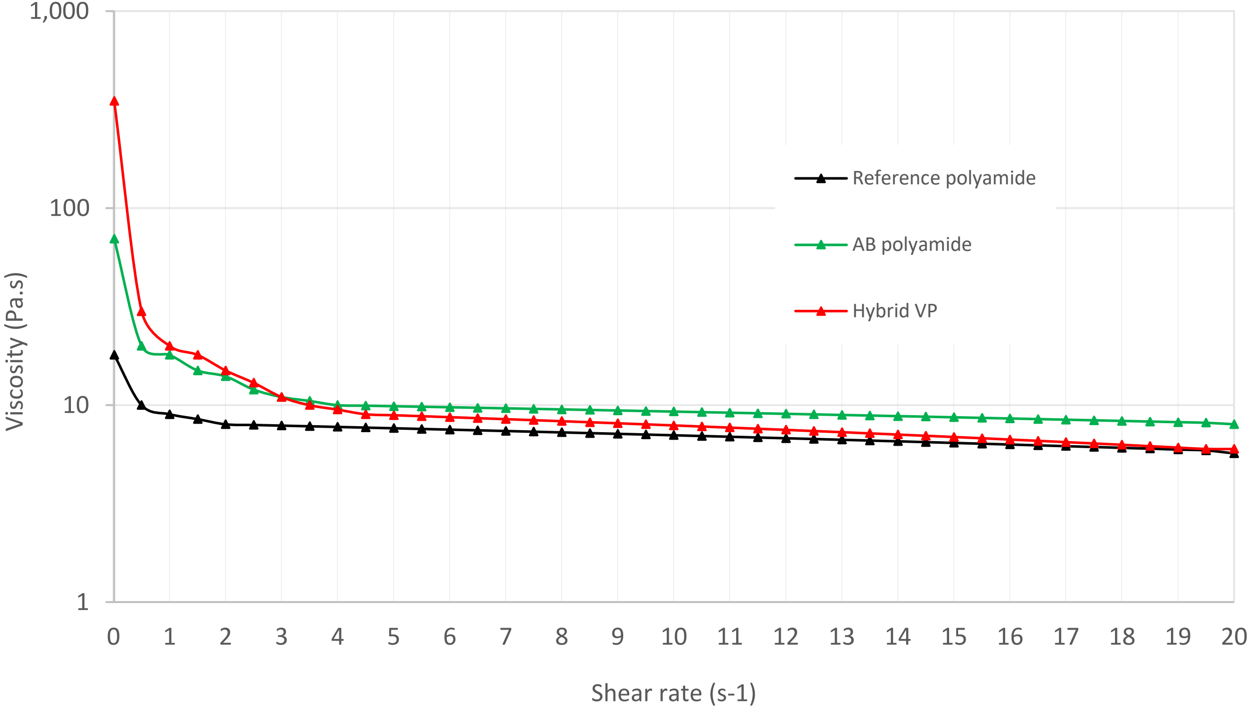
100-% solids (dispersion at 45 °C)

Function	Material		Parts
	Bisphenol A/f epoxy resin		42.2
	Benzyl alcohol		8.0
	Rheology additive		1.3
	TiO_2		4.5
	Polyolefin solution		0.8
	Talc		20.0
	Modified mica		22.5
	Processing pearl mill, 15 min @ 45 °C*		
		TOTAL PART A	**100.0**
Hardener	Polyamidoamine	**TOTAL PART B**	**25.0**

* Hybrid VP can be activated starting at 35 °C

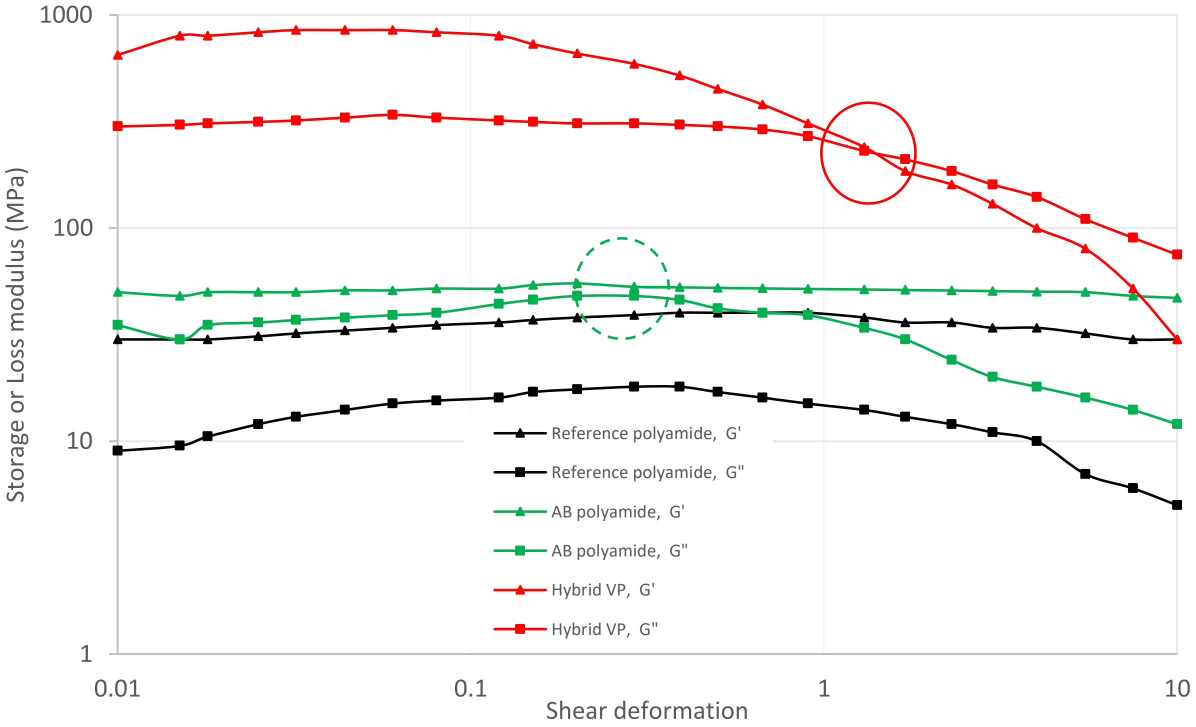
2K epoxy coating, 100-% solids

Viscosity (dispersion at 45 °C)



2K epoxy coating, 100-% solids

Modulus (dispersion at 45 °C)



2K epoxy coating

100-% solids – evaluation

Additive		Reference polyamide	AB	Hybrid VP
Sag resistance (µm)		< 350	500	1500
Sag resistance (mils)		14	25	59
Gloss, 100 mm film	60	34	39	36
	85	60	60	53
Pendulum hardness (König) after 7 days		66	65	63

2K epoxy coating

100-% solids – Conclusions

- In this formulation, the new rheology additives developed stronger structures and higher viscosities and outperformed the reference polyamide

- The new rheology additives present no significant influence on the pendulum hardness

- The gloss reduction observed with Hybrid VP is negligible
  - It may be caused by the higher formulation viscosity (potential for optimization)

Next generation organic rheology modifiers

Objectives of this work

Focus on organic rheology additives for solventborne and 100-% systems

What did we set out to address?

- Easier activation ACHIEVED!
- Improved HS&E profile ACHIEVED!

Next generation organic rheology modifiers

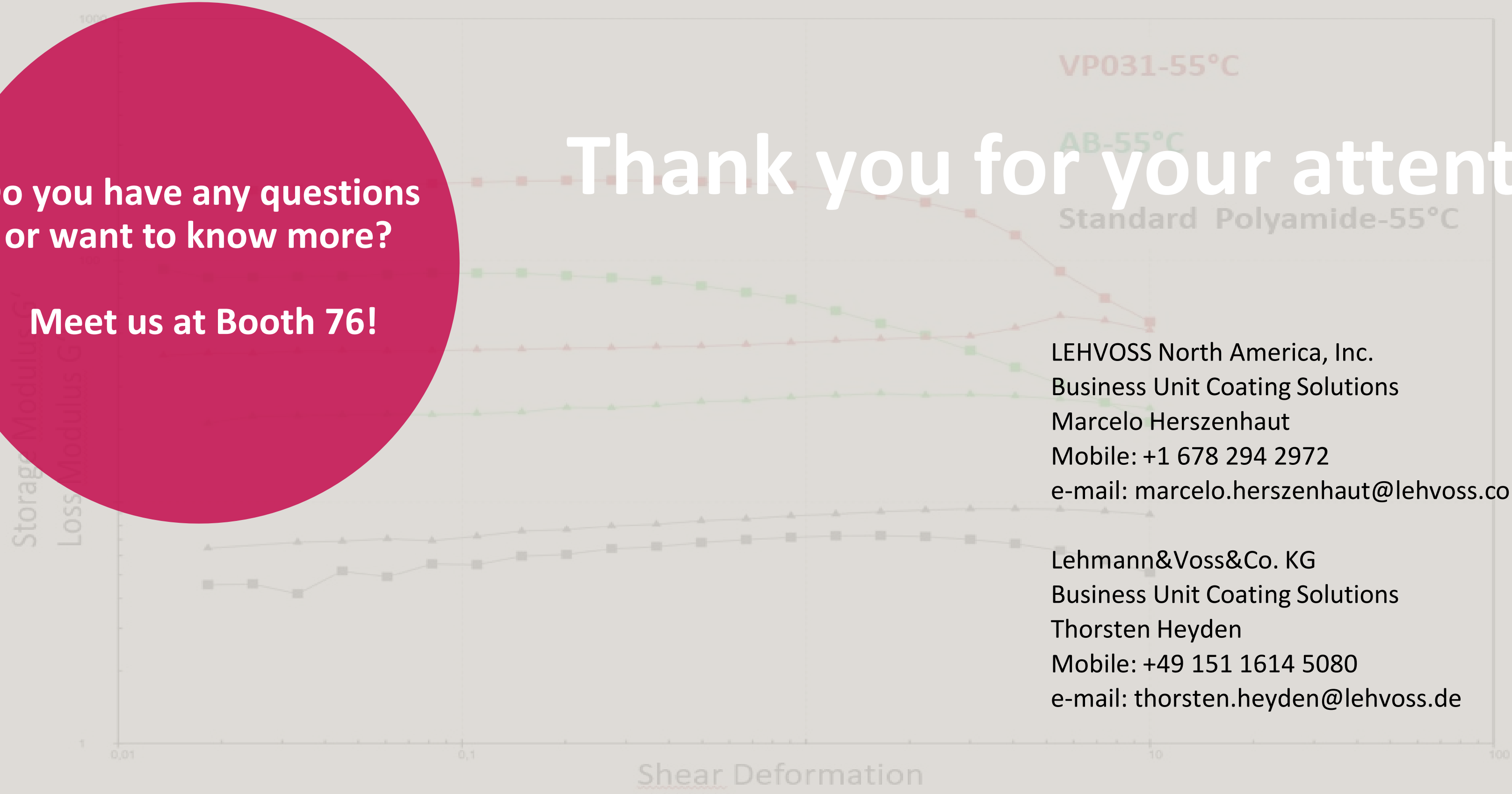
Conclusions

- Both AB and Hybrid VP rheology additives are easier to activate at lower temperatures (35 – 45 °C) and outperform reference amide waxes (55 °C)
- Performance is formulation-dependent and must be optimized for every case
- Hybrid VP additive is FDA compliant, is non-hazardous, and is > 80 % biobased
- In addition to the formulations in this work, Hybrid VP has been successfully tested in silane-terminated, energy-curable, and polyaspartic systems, as well as pigment dispersions

Thank you for your attention!

Do you have any questions or want to know more?

Meet us at Booth 76!



LEHVOSS North America, Inc.
Business Unit Coating Solutions
Marcelo Herszenhaut
Mobile: +1 678 294 2972
e-mail: marcelo.herszenhaut@lehvoss.com

Lehmann&Voss&Co. KG
Business Unit Coating Solutions
Thorsten Heyden
Mobile: +49 151 1614 5080
e-mail: thorsten.heyden@lehvoss.de