

ELEMENTIS

SPECIALTIES

How to optimize flow behavior of waterborne protective coatings / 怎样优化水性工业防护涂料的流变性能

Walee Wang / 王全义
Technical Service Manager
May, 2013



Agenda/ 内容概要

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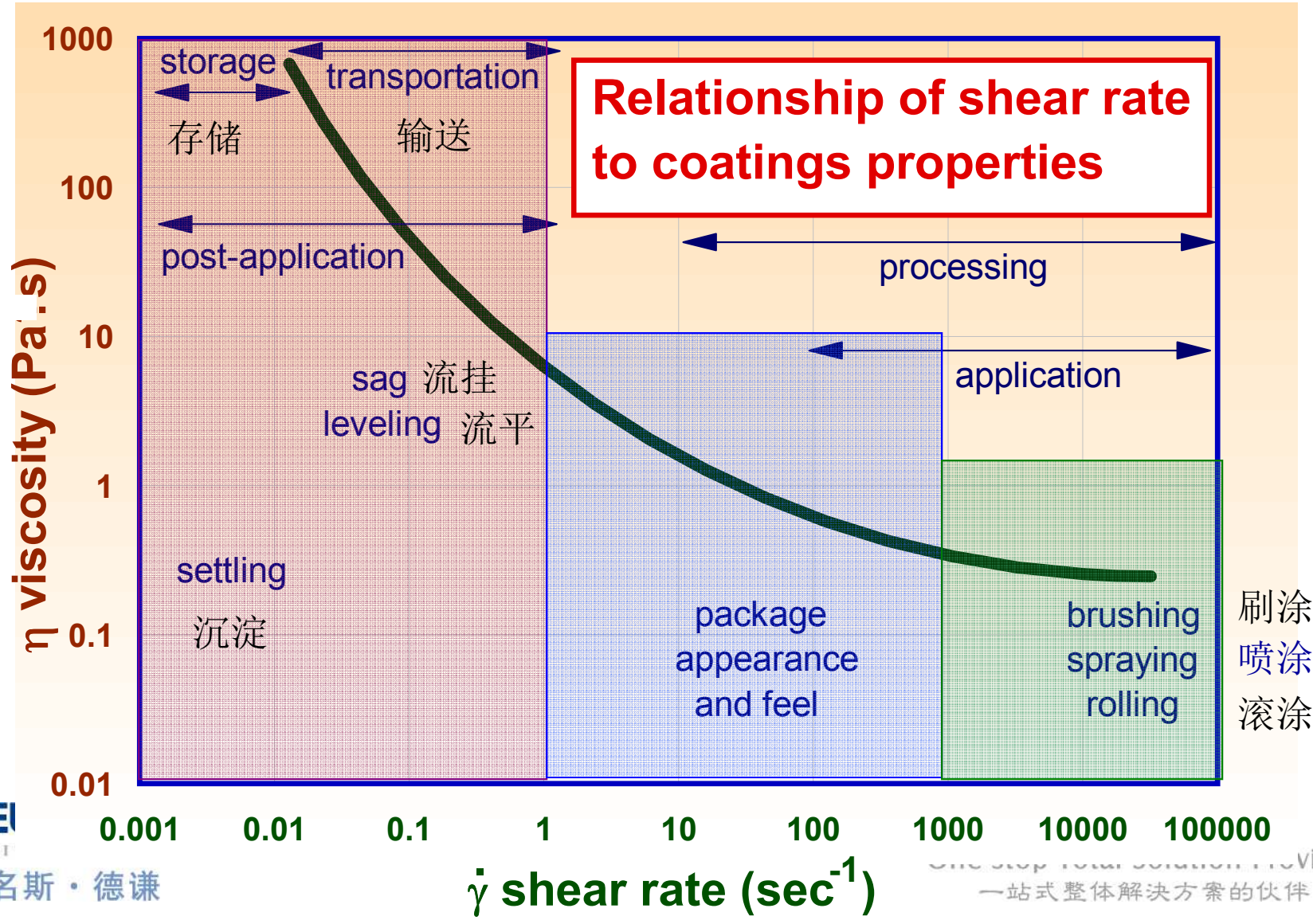
- Rheology basic/流变学基础
- Hectorite clay based rheology modifiers/锂蒙脱石类流变助剂与应用
- Nonionic associative polyurethane thickeners/非离子缔合型聚氨酯流变助剂与应用
- Waterborne 2K Polyurethane Coatings/水性聚氨酯涂料体系
- Waterborne 1K Polyurethane Coatings/水性单组分聚氨酯涂料
- Waterborne 2K Epoxy Coatings/水性环氧涂料体系

Rheology /流变

“The study of how materials deform and flow under the Influence of stress” /

研究物质在受外力作用时，所发生的形变和流动特性

流变曲线轮廓图

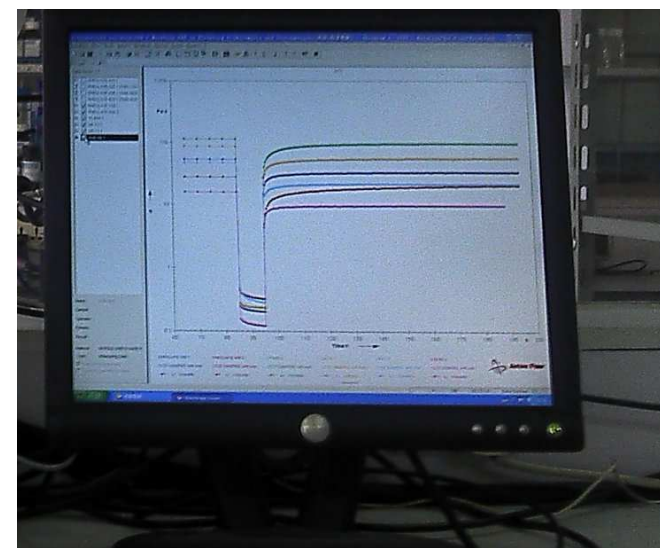


Rheometer/流变仪 (MCR-302)

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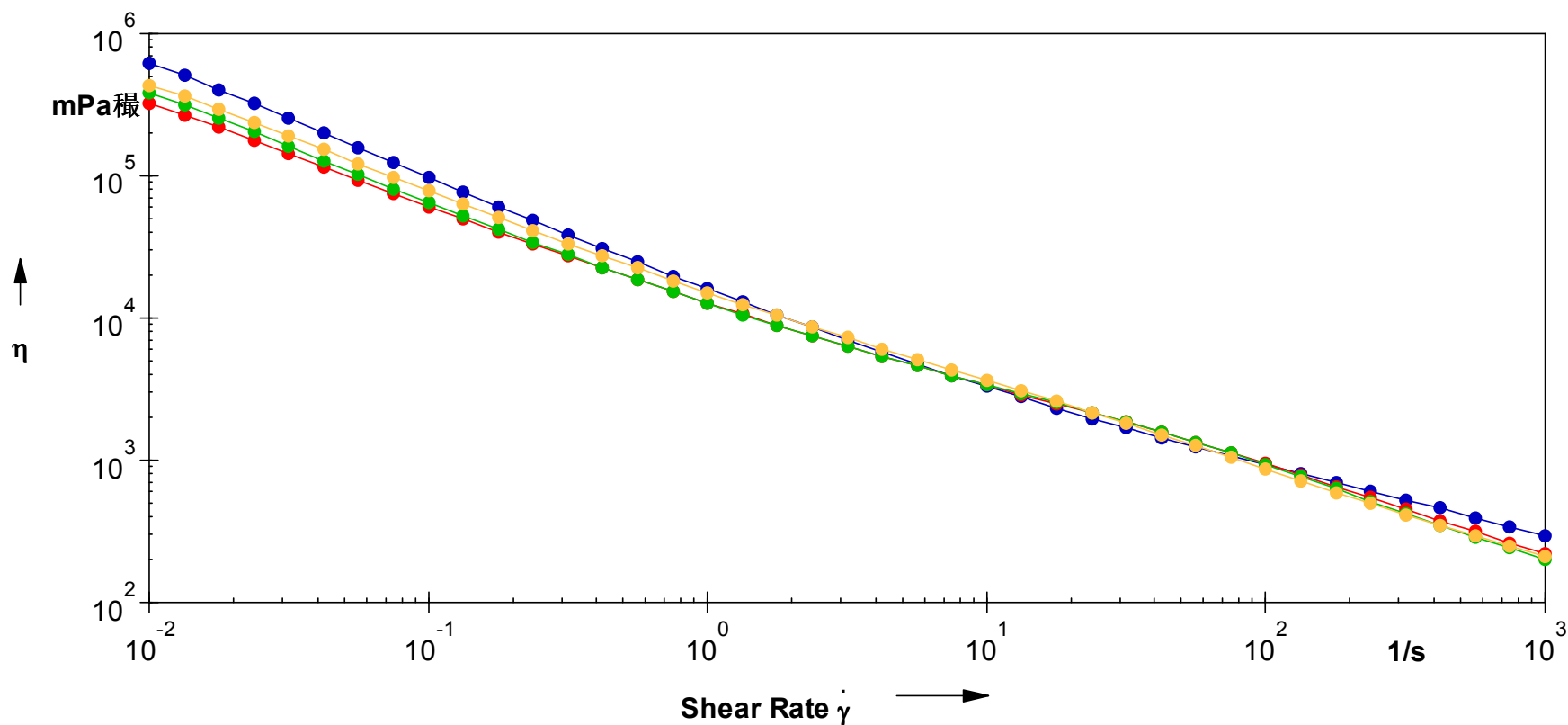


一站式整体解决方案的伙伴

Flow Behavior/剪切稀化图

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viscosity with shear rate



RHEOLATE AP 425

RHEOLATE 475

competitor 1

competitor 2

● η Viscosity

● η Viscosity

● η Viscosity

● η Viscosity

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SPECIALTIES

DEUCHEM
ADDITIVE + RESIN

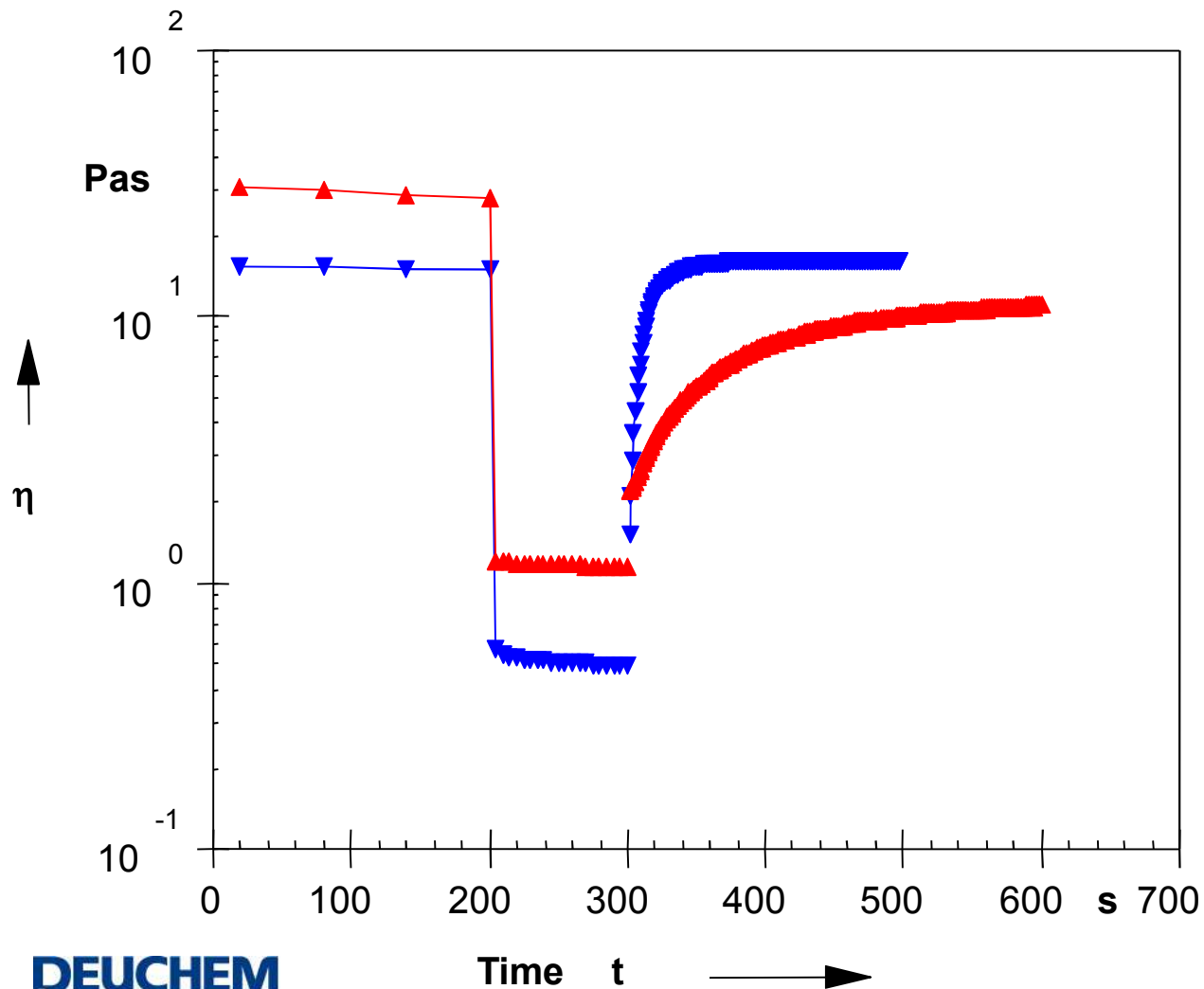
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Thixotropy Comparison/触变测试

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Coating K

—▼— η Viscosity

Coating M

—▲— η Viscosity

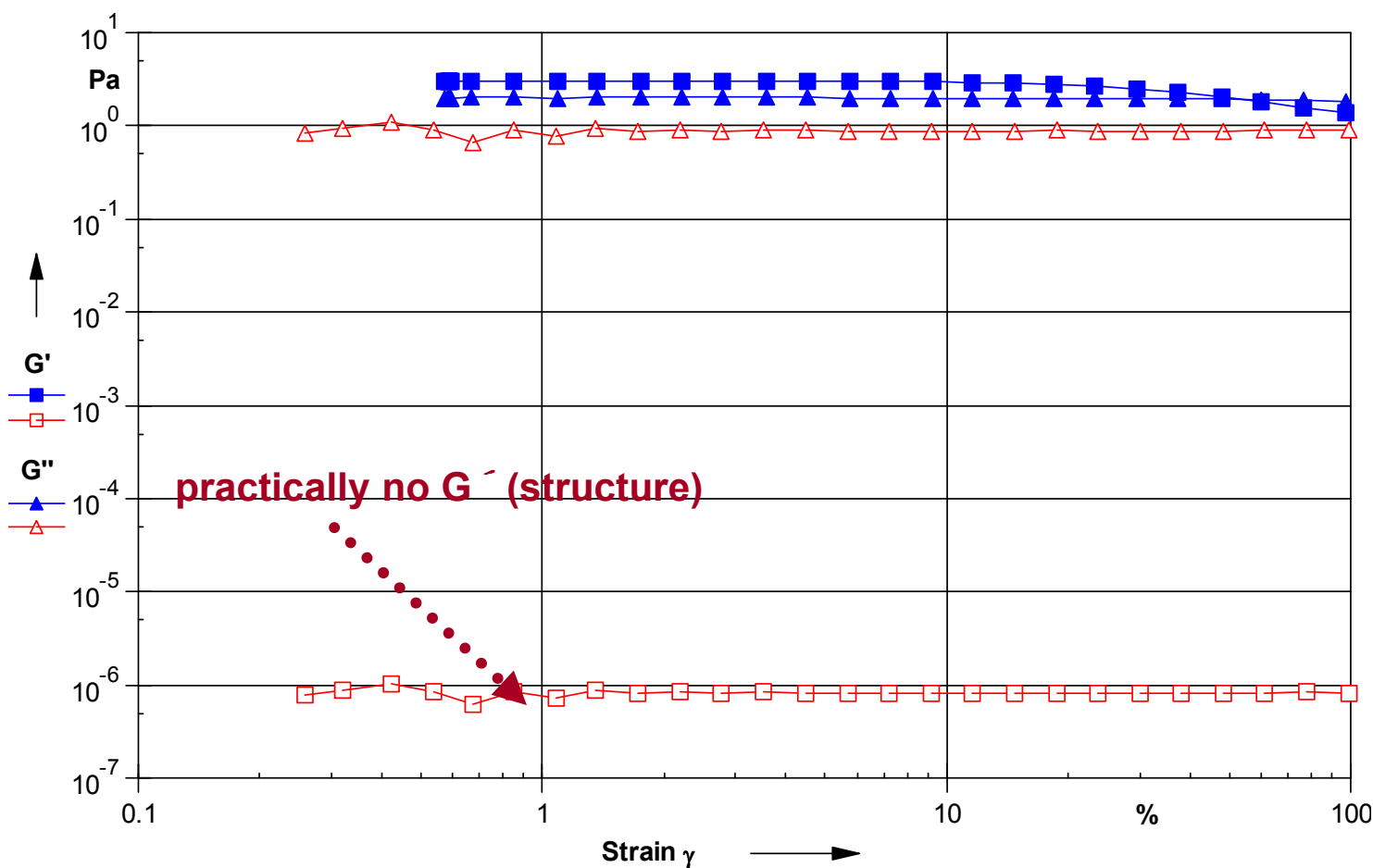
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Viscoelasticity - Amplitude sweep /振幅扫描

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色拉调味品

橄榄油

■ G' Salad dressing

□ G' Olive oil

▲ G'' Salad dressing

△ G'' Olive oil

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RHEOLATE®

BENTONE®

THIXATROL®

**NUOSPERSE
®**

RHEOX®

DAPRO®

TINT-AYD®

BENTONE® Hectorite Clay Based Thickener / 锂蒙脱石增稠剂



Key characteristics/主要特性

- Give thixotropic flow and yield point /优异的触变性及屈服值
- Highest suspension properties/最佳的悬浮性
- Key Properties/性能
 - Improved pump ability/提高泵送能力
 - Excellent sag control & suspension properties
/优异的抗流挂及悬浮性
 - Improved Syneresis/改善分水
 - Reduces viscosity change with change in temperature/降低涂料由于温度引起的粘度变化

Hectorite clays/锂蒙脱石流变助剂

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Hectorite clays/ 锂蒙脱石类流变助剂

ELEMENTIS
SPECIALTIES

BENTONE® EW -

- 精细型锂蒙脱石粘土
- 提供低剪切粘度
- 极佳的雾化性能
- 极佳的抗流挂及悬浮性
- 极佳的铝粉防沉与定向排列性能
- 适合于水性工业涂料

BENTONE® LT -

- 有机改性锂蒙脱石土
- 提供中低剪切粘度
- 优异的抗流挂性能
- 优异防沉与储存稳定性
- 适合于水性工业涂料、高档建筑涂料、水性色浆

BENTONE® DE

- 超易分散锂蒙脱石
- 提供低剪切粘度
- 可制成10%-14%预凝胶
- 提高抗流挂及悬浮性能
- 极佳的铝粉定向与排列性能
- 适合于水性工业漆等



14% Pregel BENTONE® DE

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BENTONE® DE -易分散性能

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SPECIALTIES

Ease of Dispersion / 易分散

	Spray Dried Hectorite Clay	BENTONE® DE
Milling Time (mins)	4% pregel	14% pregel
2	65µm	12µm
5	65µm	12µm
20	50µm	12µm
40	30µm	12µm
60	25µm	12µm

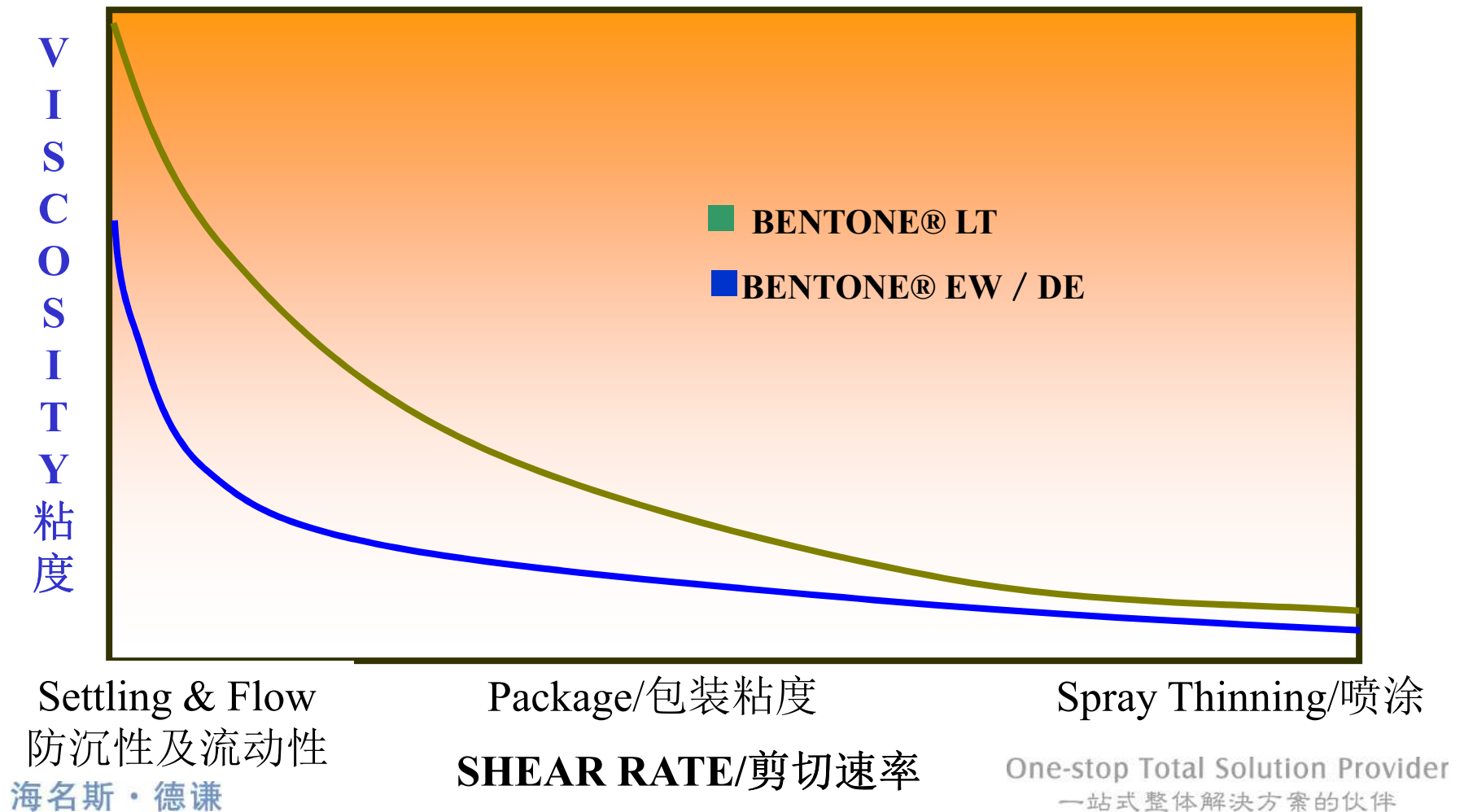
Dispermat 40mm @ 3000rpm

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Hectorite clays/ 锂蒙脱石流变助剂

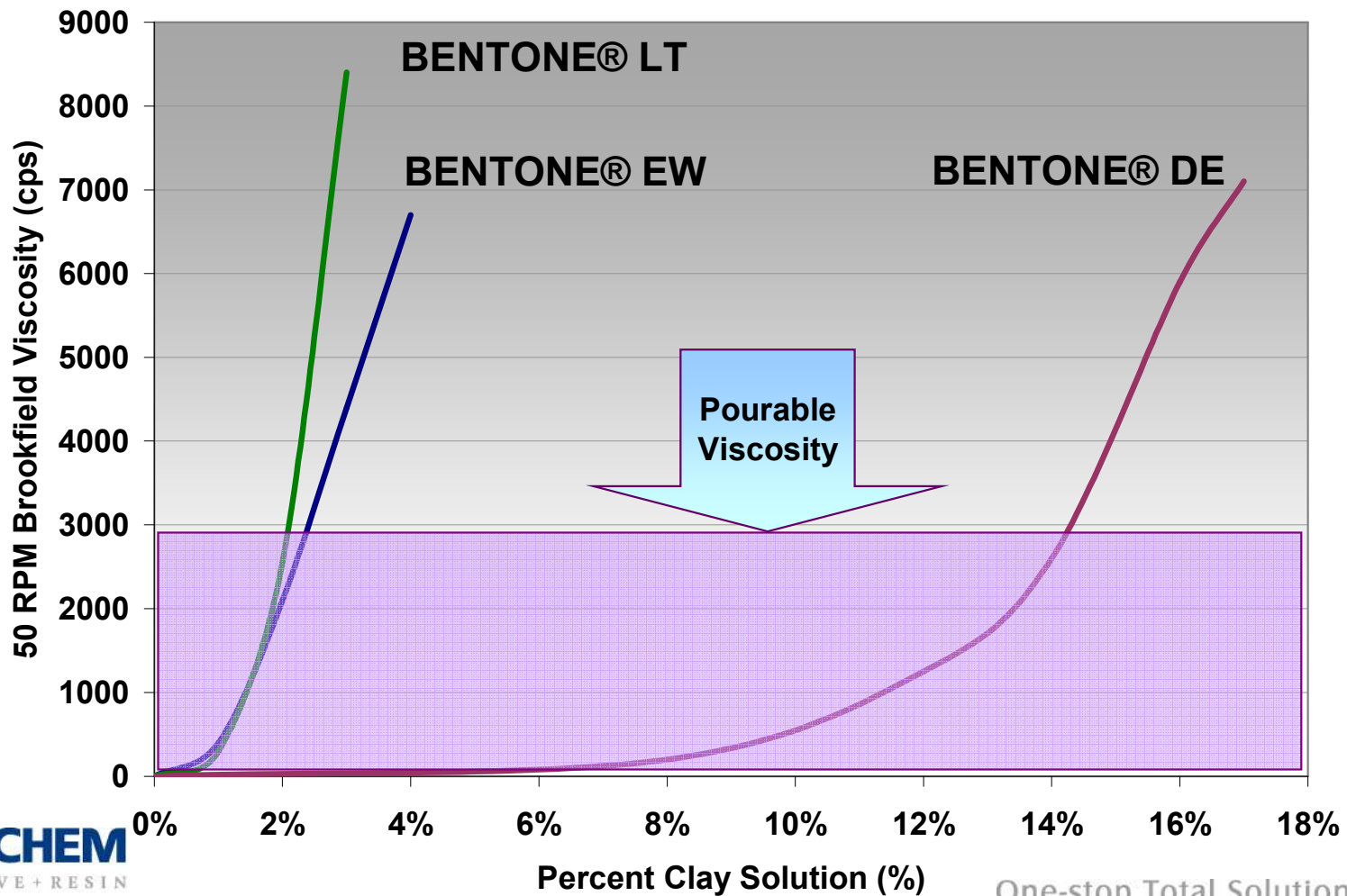
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Hectorite clays/ 锂蒙脱石类流变助剂

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SPECIALTIES

Reduce Water Demand: Clay Water Gels



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Hectorite clays/ 锂蒙脱石类流变助剂

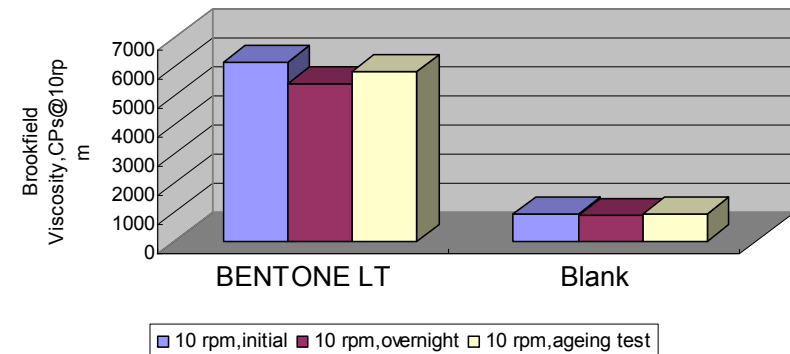
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BENTONE® LT

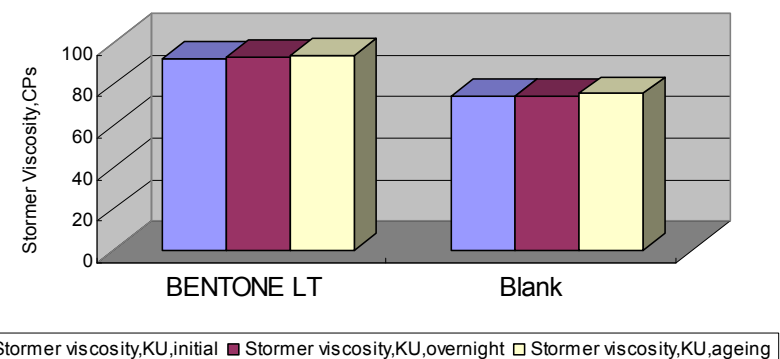
BENTONE® LT

- ✓ highly efficient / 高效
- ✓ imparts high viscosity / 较高的中低剪切粘度
- ✓ provides thermostable aqueous
- ✓ phase / 优异的储存稳定性

Brookfield Viscosity, CPs@10rpm,
In Waterborne Protective Coatings Primer



Stormer Viscosity, KU
in Waterborne Protective Coatings Primer



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Sag Control-优异的抗流挂性能

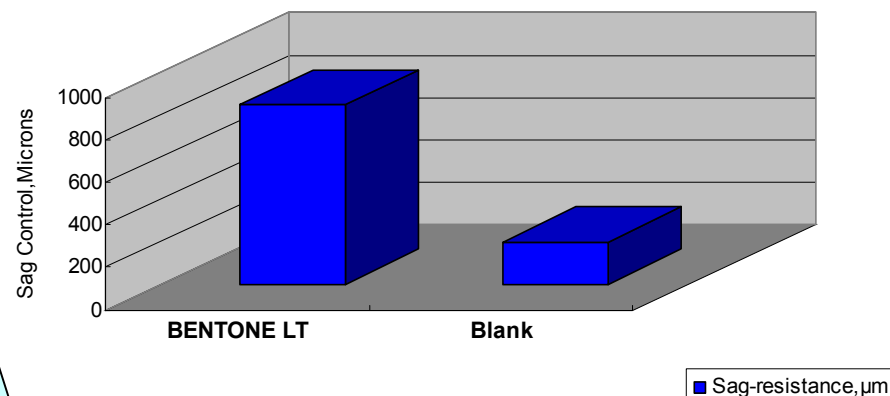
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SPECIALTIES

BENTONE® LT

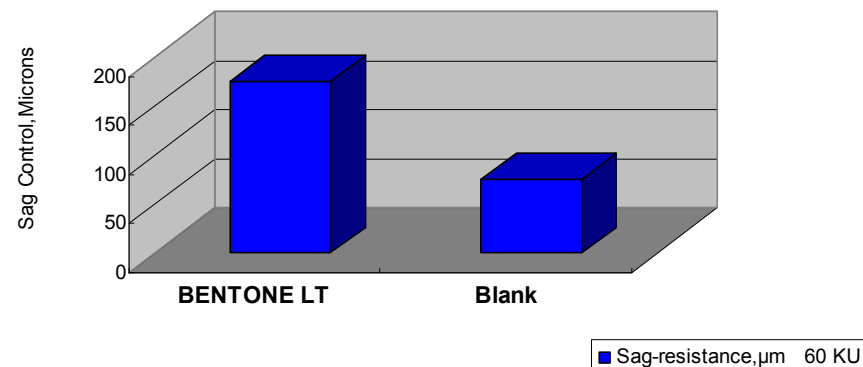
✓ Superior sag control
/优异的抗流挂性能

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Sag-resistance, Microns, Original Waterborne
Protective Coatings Primer



Sag resistance, Microns,
,in Waterborne Protective Coatings Primer



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Storage Stability/优异储存稳定性

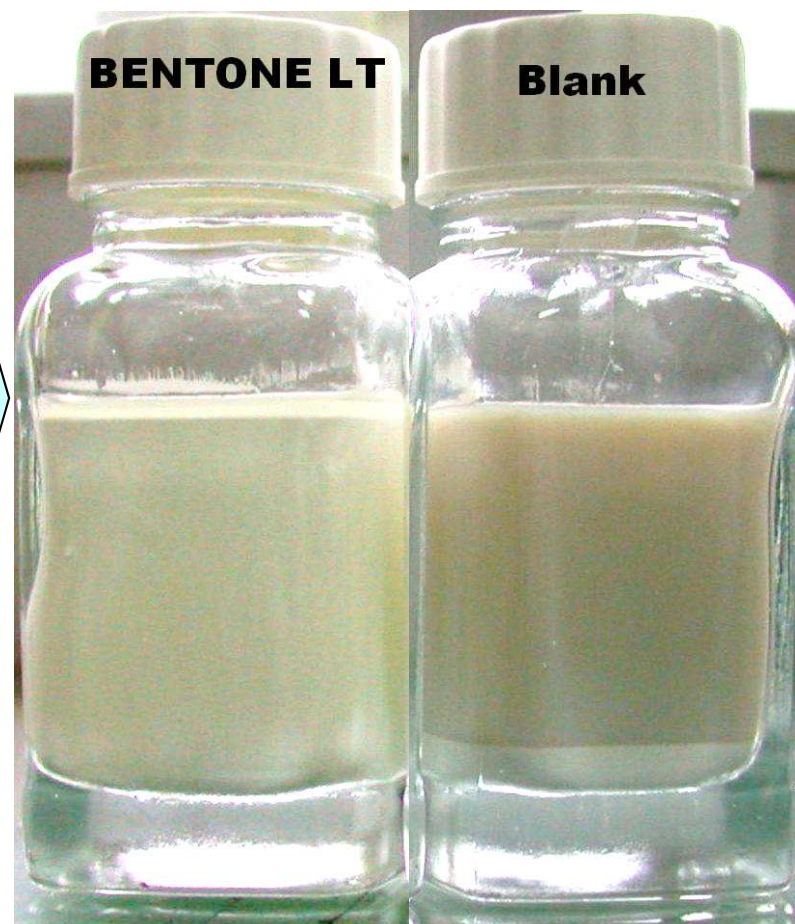
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SPECIALTIES

BENTONE® LT

- ✓ Prevents hard settlement
/防止硬沉淀
- ✓ Reduces syneresis/抗分水

BENTONE® LT

对比样



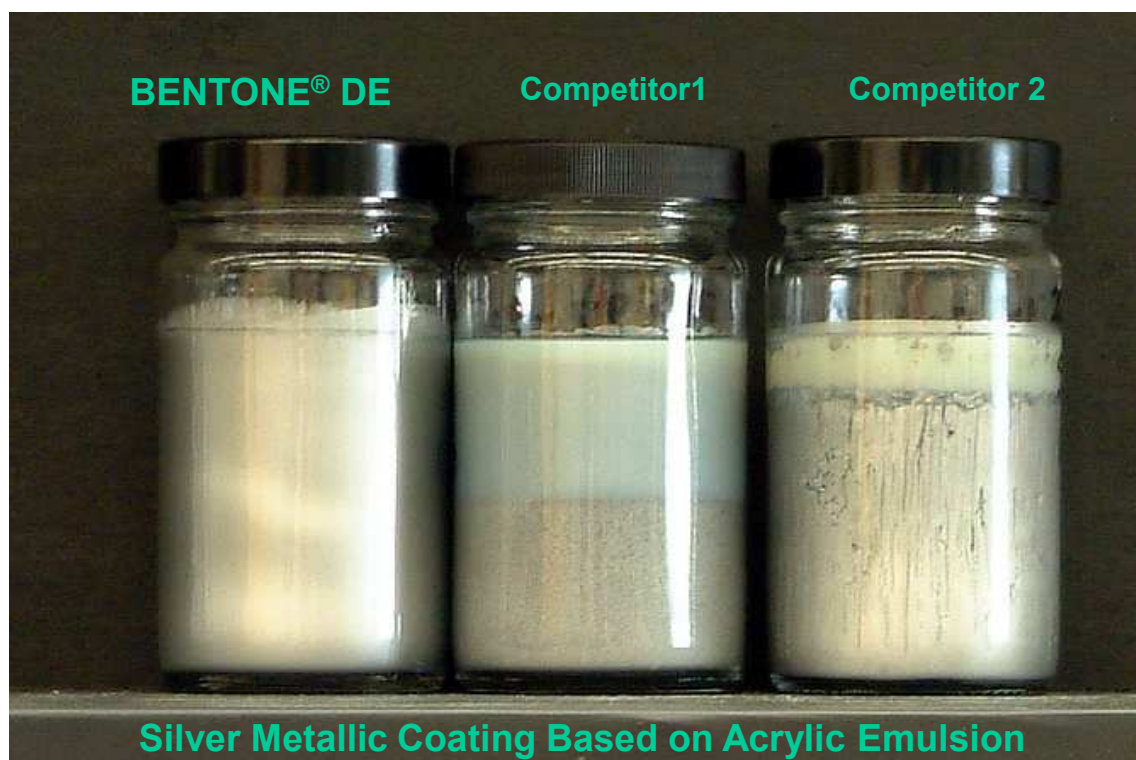
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一站式整体解决方案的伙伴

Improved Stability/提升储存稳定性

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SPECIALTIES

Two Weeks Syneresis /优异的防沉性能



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RHEOLATE®

BENTONE®

THIXATROL®

NUOSPERSE
®

RHEOX®

DAPRO®

TINT-AYD®

RHEOLATE® PU Thickeners

Green Polyurethane Associative Thickeners

APE-free and Organic tin-free

/不含有机锡和APE



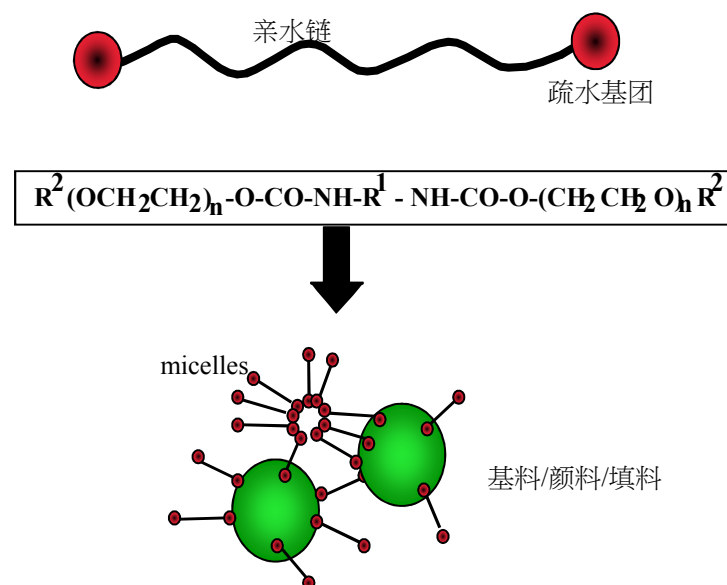
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PUR Thickeners / PUR 增稠剂

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SPECIALTIES

Key features/ 特征

- pH independent (2-12) 不受pH 影响 (2-12)
- Excellent flow & leveling 优异流态与流平
- Excellent spatter resistance 优异抗飞溅性能
- Easy to use and not affected gloss 易添加, 同时不影响光泽
- Flowable liquid 流动液体
- Provide High shear viscosity build 主要提供中高剪切粘度
- Water resistance 优异的耐水性

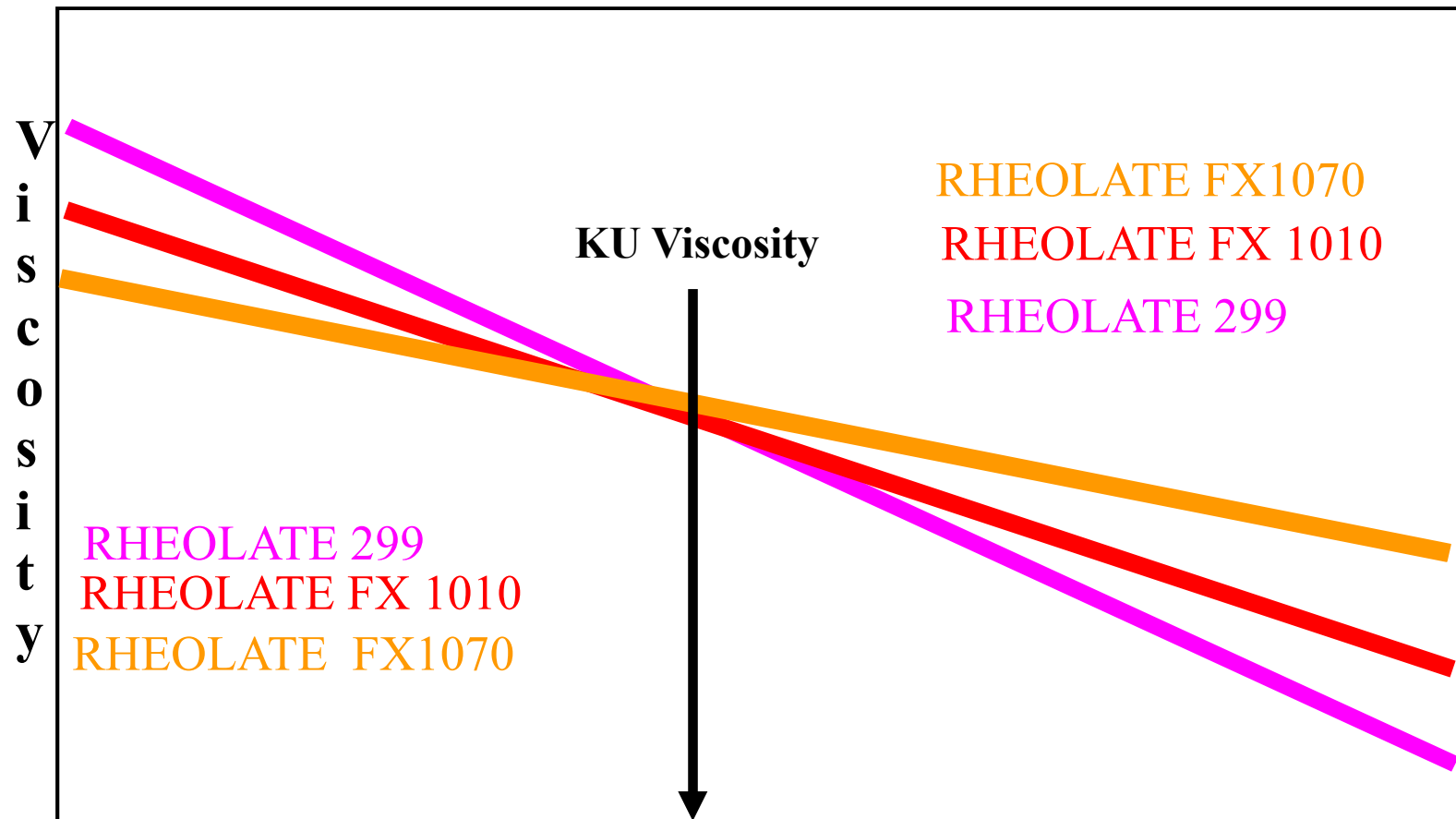


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RHEOLATE® PU Thickeners

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SPECIALTIES



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一站式整体解决方案的伙伴

RHEOLATE® PU 增稠剂

ELEMENTIS
SPECIALTIES

水性工业涂料用
环保型聚氨酯型缩合型流变助剂

PUR thickeners/ 聚氨酯缩合型	有效 成分%	有机锡 (Y/N)	特性
RHEOLATE® FX 1010	50%	No	提供中低剪粘度，高光泽，无色透明，提高喷涂及刷涂施工性
RHEOLATE® FX 1070	40%	No	提供中高剪粘度，高光泽，易添加，无色透明，优异的漆膜丰满度及流平
RHEOLATE® 299 (New)	25%	No	提供低剪粘度，高光泽，透明性佳，易添加，优异的抗流挂与雾化性能

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一站式整体解决方案的伙伴

RHEOLATE ® 299_ WB Sliver Metallic Coating / 水性铝粉漆

ELEMENTIS
SPECIALTIES

Raw materials	Sample 1	Sample 2
Water	15.52	14.52
DPnB	3.7	3.7
BCS	3.7	3.7
Alberdingk AS 2615	55	55
DAPRO DF1760	0.5	0.5
BENTONE DE (10%)	5	5
RHEOLATE 299	2	/
RHEOLATE FX1010 (50%)	/	3
Dispersing for around 10 minutes, then add below ALUMINIUM PIGMENT Paste		
PM *	4.5	4.5
Water*	2.6	2.6
NUOPERSE FX365*	0.28	0.28
Hydrolan S2156*	7	7
Levelol W-469	0.2	0.2
Total	100	100

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一站式整体解决方案的伙伴

RHEOLATE ® 299_ WB Sliver Metallic Coating/ 水性铝粉漆



RHEOLATE 299 和 BENTONE DE 搭配使用，获得良好的雾化效果和铝粉排列效果

RHEOLATE ® 299_ WB PU Coatings/ 水性聚氨酯涂料

ELEMENTIS
SPECIALTIES

Raw Materials	weight %	Function/Supplier
Bayhydrol UH 245	15	Resin/Bayer
DAPRO DF 7015	0.2	Deformer/ELEMENTIS
NUOSPERSE FX 365	0.1	Wetting agent/ELEMENTIS
NUOSPERSE FX 600	0.3	Dispersing agent/ELEMENTIS
DI water	10.3	Local
20% DMAE	0.75	Neutralizer/ELEMENTIS
RHEOLATE 299/FX 1010	0.1	Rheological additive/ELEMENTIS
Premix the above ingredients and then disperse for 10mins		
APW-2	14	Anti-corrosion pigment/Local
Iron oxide yellow	8	Pigment/Local
MS-K 200	6	Filler/Local
Add these materials under agitation, then disperse for 10min, finally grind until achieve desired fineness		
DAPRO U-99	0.2	Leveling agent/ELEMENTIS
Bayhydrol UH 245	44	Resin/Bayer
20% DMAE	0.75	Neutralizer/ELEMENTIS
RHEOLATE 299/FX 1010	0.1	Rheological additive/ELEMENTIS
NALZIN FA 179	0.2	Anti-corrosion inhibitor/ELEMENTIS
Add the remaining ingredients under agitation, then disperse until homogeneous		
Total	100	

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一站式整体解决方案的伙伴

RHEOLATE ® 299_ 1K WB PU Coatings/ 单组分水性聚氨酯涂料

ELEMENTIS
SPECIALTIES

Test results	RHEOLATE 299	RHEOLATE FX 1010
Overnight Test at 25° C		
Brookfield viscosity, cPs		
Spindle, #	5	5
10 rpm	5440	2800
20 rpm	4500	2480
50 rpm	3256	1944
100 rpm,	2356	1600
Sag resistance, microns	300	225
Aged Test at 25° C		
Brookfield viscosity, cPs		
Spindle, #	5	5
10 rpm	8080	4520
20 rpm	6580	4000
50 rpm	4336	3112
100 rpm	2890	2432
Sag resistance, microns	400	325
Anti-settling properties	Excellent	Excellent

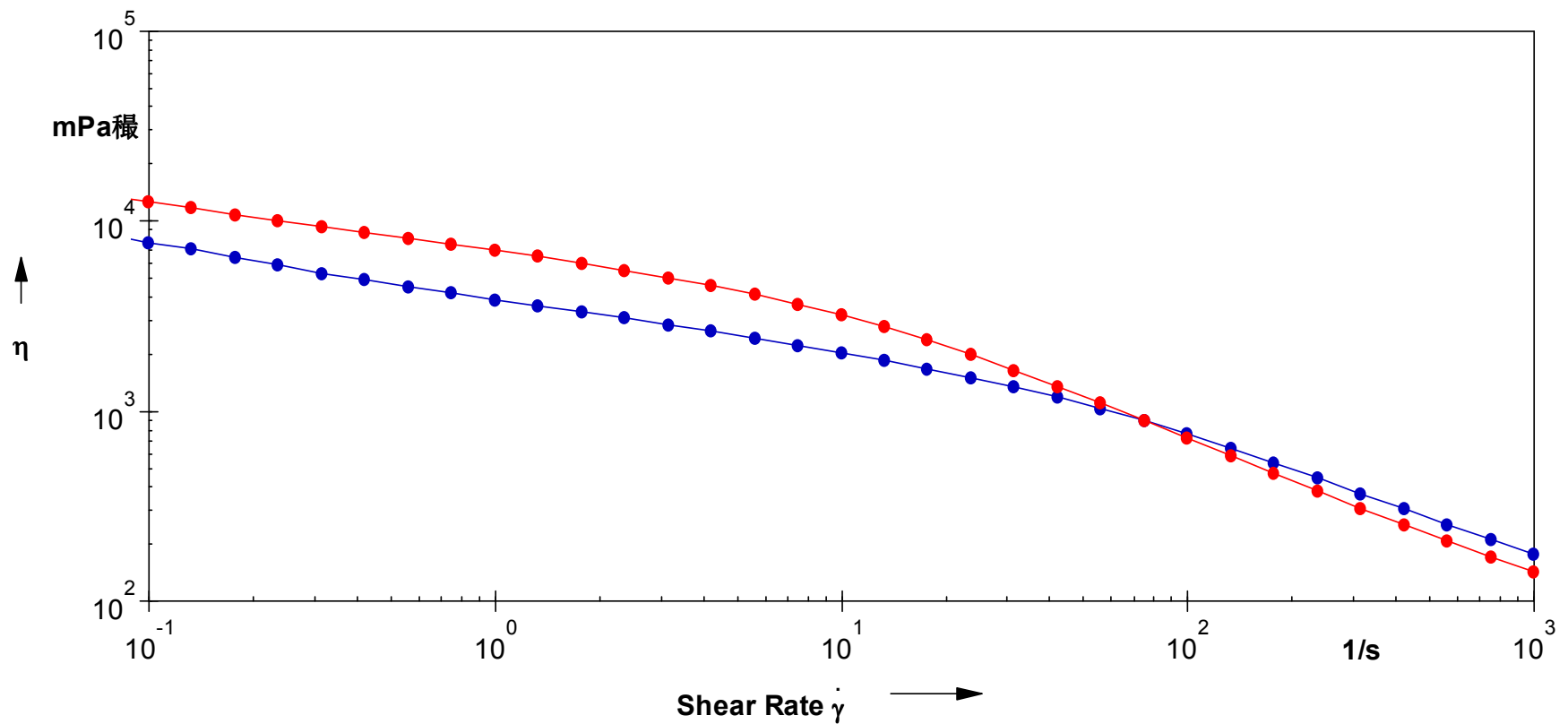
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一站式整体解决方案的伙伴

RHEOLATE ® 299_ 1K WB PU Coatings/ 单组分水性聚氨酯涂料

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SPECIALTIES

viscosity with shear rate



RHEOLATE 1010

● η Viscosity

RHEOLATE 299

● η Viscosity

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SPECIALTIES

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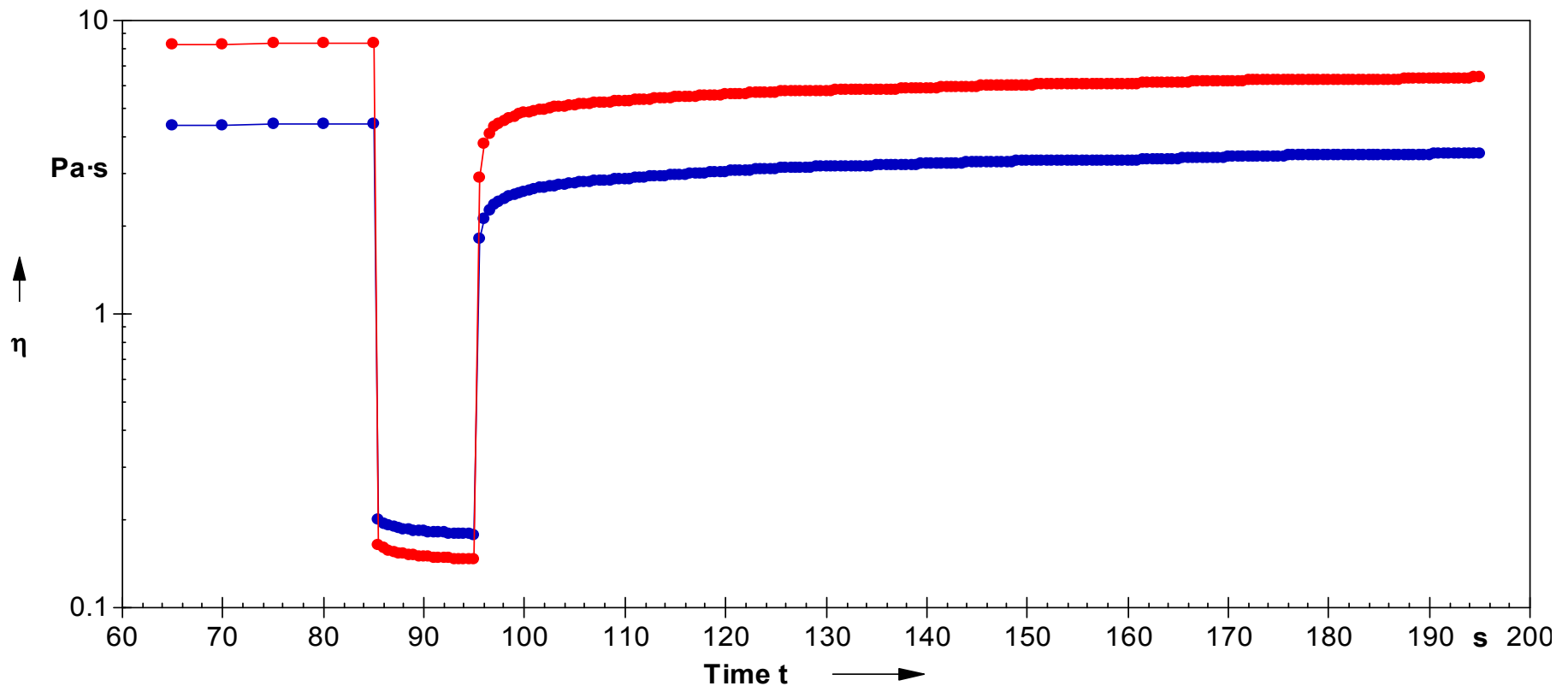
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一站式整体解决方案的伙伴

RHEOLATE ® 299_ 1K WB PU Coatings/ 单组分水性聚氨酯涂料

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SPECIALTIES

3ITT



RHEOLATE 1010

CC27-SN25763; d=0 mm

—●— η Viscosity

RHEOLATE 299

CC27-SN25763; d=0 mm

—●— η Viscosity

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SPECIALTIES

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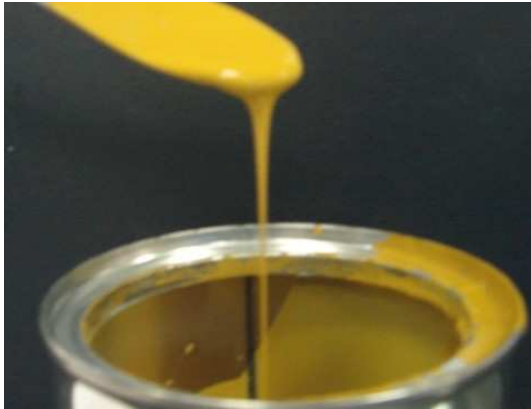
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RHEOLATE ® 299_ 1K WB PU Coatings/ 单组分水性聚氨酯涂料

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SPECIALTIES

RHEOLATE 299



当天

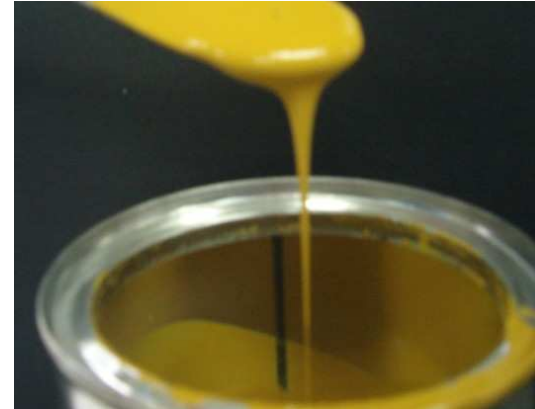
RHEOLATE 299



热储后

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RHEOLATE FX 1010



RHEOLATE FX 1010

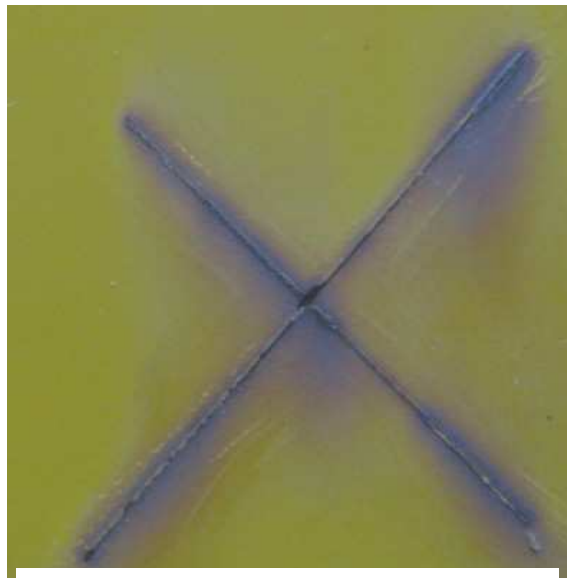


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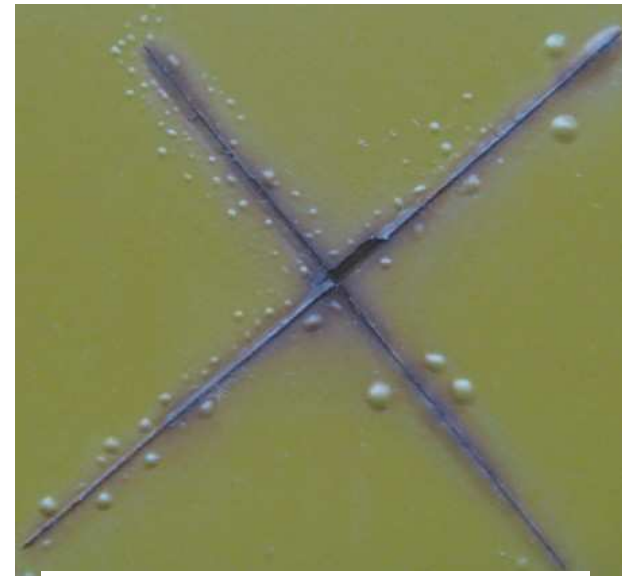
RHEOLATE ® 299_ WB PU Coatings/ 单组分水性聚氨酯涂料

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SPECIALTIES

Corrosion Comparison in
3% NaCl solution for 7 days at RT



RHEOLATE 299



RHEOLATE FX 1010

RHEOLATE ® 299_ 提供更佳的耐腐蚀性能

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一站式整体解决方案的伙伴

RHEOLATE® 299_ WB 2KPU

Coatings/ 水性聚氨酯涂料

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SPECIALTIES

Formula 2: Waterborne Protective Polyurethane Coatings (TiO2)

Raw material	Weight in (%)	Function	Supplier
Part A:			
Water	10.61	Solvent	
DAPRO DF 1181	0.20	Defoamer	Elementis
DAPRO DF 2162	0.50	Defoamer	Elementis
NUOSPERSE FX365	0.20	Wetting agent	Elementis
NUOSPERSE FX600	1.00	Dispersant	Elementis
Ti-PureR-902	25.00	Pigment	Dupont
NALZIN FA 179	0.20	Flash rust inhibitor	Elementis
Disperse at 2500rpm for about 15 minutes ,then grinding to achieve fineness to <15um			
Bayhydrol A 2470	61.20	Resin	Bayer
Levaslip W-469	0.50	Leveling	Elementis
DAPRO DF 1760	0.30	Defoamer	Elementis
RHEOLATE 299	0.29	PUR thickener	Elementis
Total	100.00		
Part B;			
BayhydUR XP 2655(70% in PGDA)	28.00	Hardener	Bayer
Total	128.00		

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一站式整体解决方案的伙伴

RHEOLATE ® 299_ WB 2KPU Coatings/ 双组分水性聚氨酯涂料

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SPECIALTIES

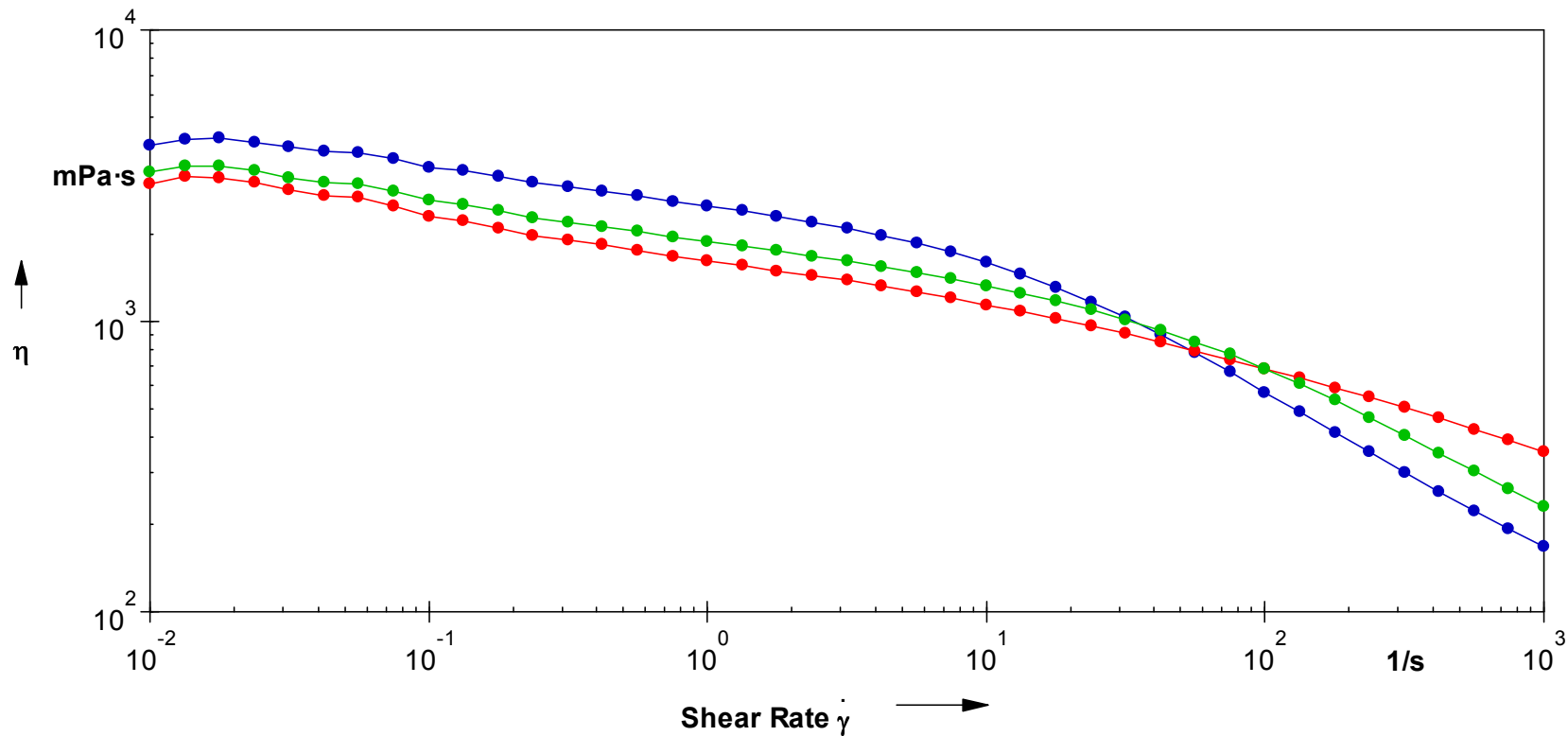
Test result	RHEOLATE 299	RHEOLATE FX1010	RHEOLATE FX1070
Loading (wt/%)	0.29	0.45	0.65
Initial, 25° C			
Stormer viscosity,	87.0	85.7	85.1
Overnight , 25° C			
Brookfield viscosity, cPs			
Spindle, #	5	4	4
10 rpm	2500	1760	1620
20 rpm	2260	1640	1510
50 rpm	1764	1408	1292
100 rpm	1358	1200	1126
Stormer viscosity, KU	88.7	87.9	87.4
ICI, Viscosity P	0.642	0.825	1.482
Gloss Level (60°)	88.0	89.7	88.5
Flow Properties (1-Poor, 10-Excellent)	excellent	excellent	excellent
Ageing results	excellent	excellent	excellent

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一站式整体解决方案的伙伴

RHEOLATE ® 299_ WB 2KPU Coatings/ 双组分水性聚氨酯涂料

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SPECIALTIES



R-299 1

● η Viscosity

FX1070 1

● η Viscosity

FX1010 1

● η Viscosity

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SPECIALTIES

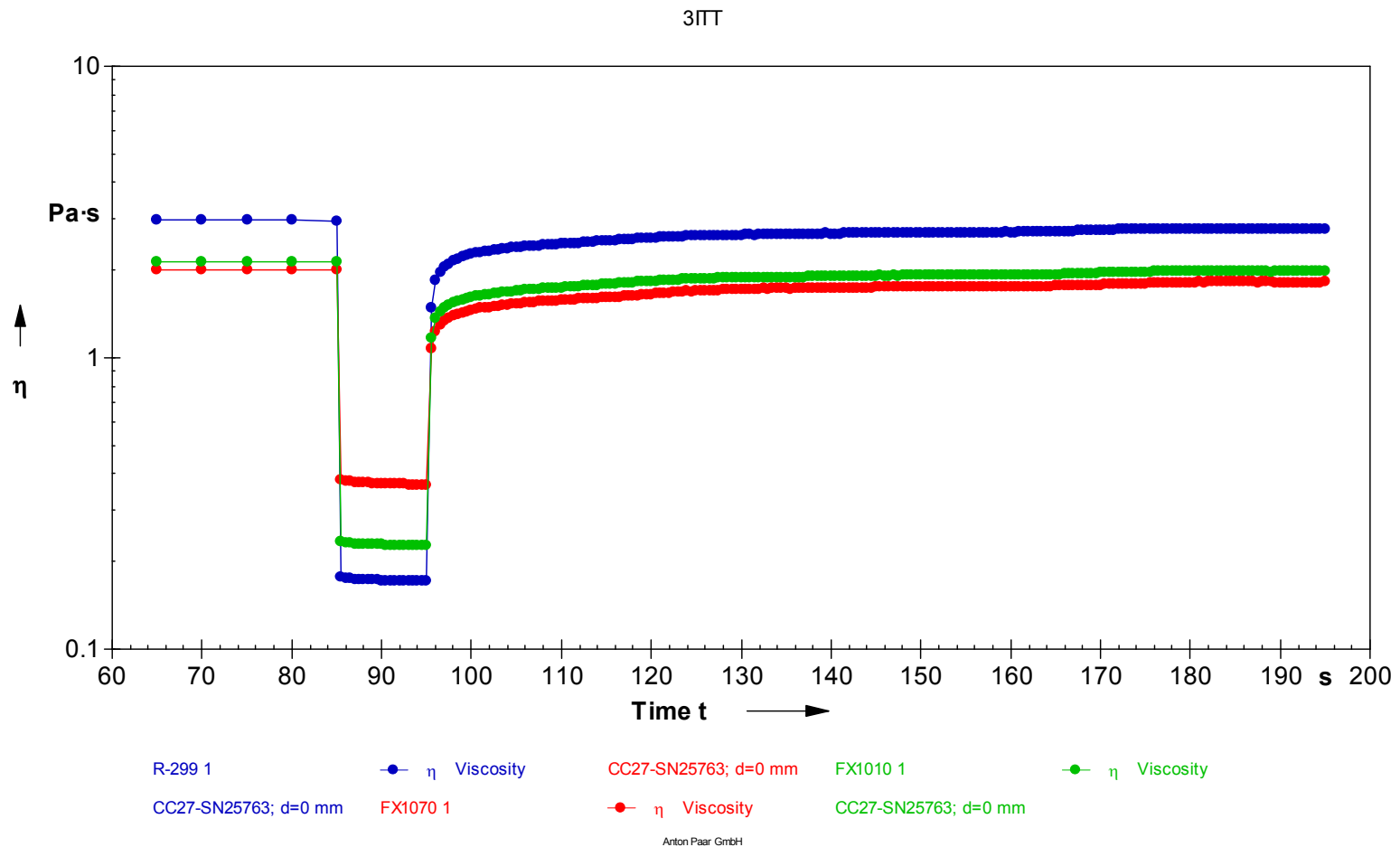
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RHEOLATE ® 299_ WB 2KPU Coatings/ 双组分水性聚氨酯涂料

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RHEOLATE® 299_WB 2KPU Coatings/ 双组分水性聚氨酯涂料

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SPECIALTIES



FX 1010



FX 1070



R-299

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一站式整体解决方案的伙伴

Waterborne acrylic emulsion system/ 水性 丙烯酸涂料

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SPECIALTIES

Raw Materials	weight %	Function	Supplier
DI water	22	Water	Local
PM	1.5	Co-solvent	Local
NALZIN FA 179	0.15	Anti-corrosion inhibitor	ELEMENTIS
DAPRO DF 1161	0.3	Deformer	ELEMENTIS
NUOSPERSE FX 365	0.2	Wetting agent	ELEMENTIS
NUOSPERSE FX 600	0.6	Dispersing agent	ELEMENTIS
Premix the above ingredients and disperse for 10mins			
R-902	20	Titanium white Pigment	Dupont
Carbon black	0.4	Carbon black	Local
20% DMAE	0.3	Neutralizer	ELEMENTIS
Texanol	3	Coalescing agent	Eastman
Add these materials under agitation, again disperse for 10min, finally grind until achieve desired fineness			
GM 1105	50.3	Acrylic latex	Beijing Gaomeng
20% DMAE	0.3	Neutralizer	ELEMENTIS
DAPRO U-99	0.15	Leveling agent	ELEMENTIS
SLIP-AYD FS 444	0.1	Leveling agent	ELEMENTIS
Propanediol	0.4	Freeze proof agent	Local
Rheological additive	0.3	Rheological additive	ELEMENTIS
Add the remaining ingredients under agitation, then disperse until homogeneous			
Total	100		

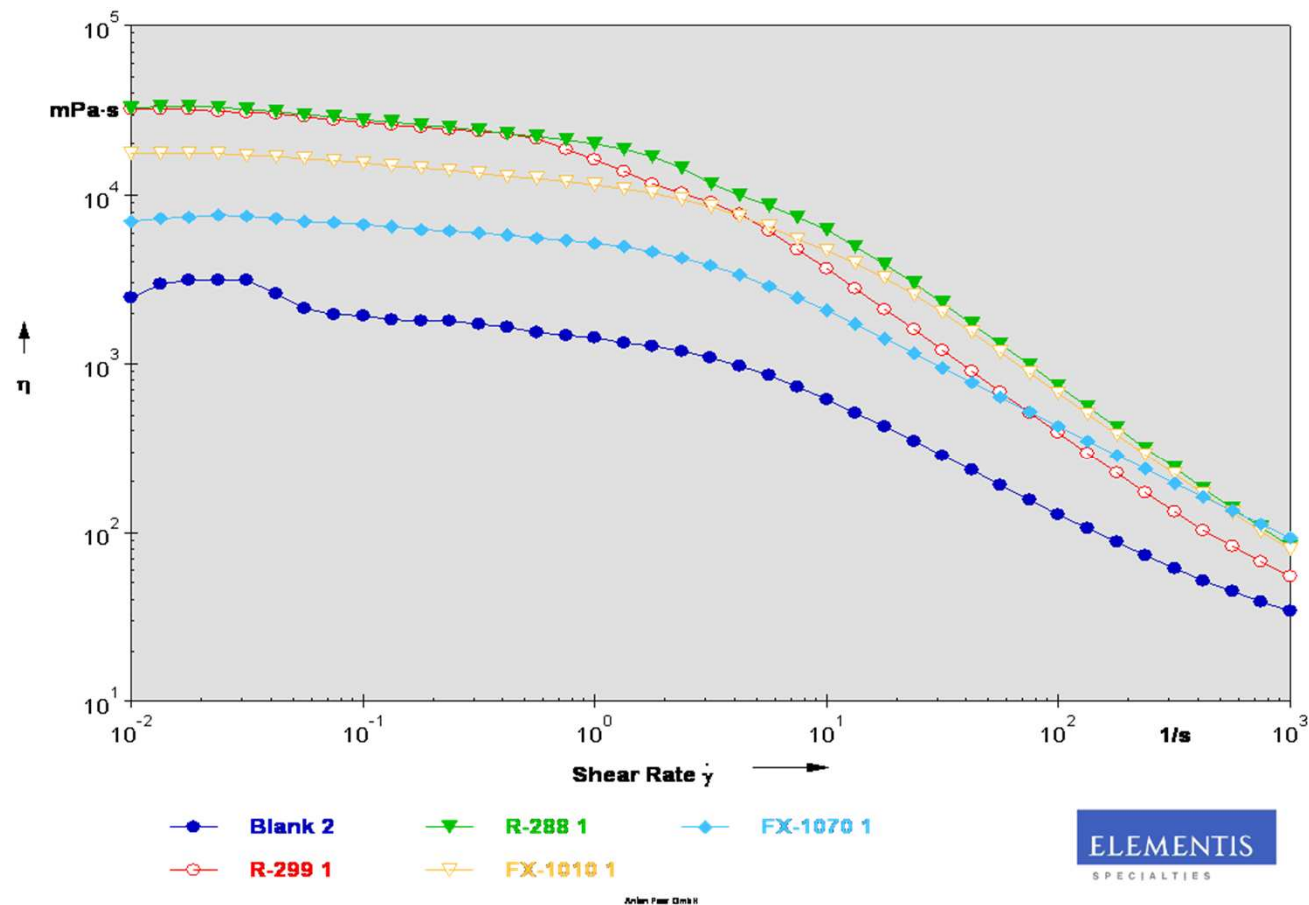
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One-stop Total Solution Provider
一站式整体解决方案的伙伴

Waterborne acrylic emulsion system

/ 水性丙烯酸涂料

ELEMENTIS
SPECIALTIES



ELEMENTIS
SPECIALTIES

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Waterborne acrylic emulsion system

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ELEMENTIS
SPECIALTIES

Anti-settling performance after storage at 50°C
for one week



Blank

R-299

R-288

FX1010

FX1070

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一站式整体解决方案的伙伴

Waterborne 2K Epoxy Primer /

水性环氧涂料

ELEMENTIS
SPECIALTIES

Test results	BLANK	R-299	FX 1010	R-299	FX-1010	Function	Supplier
Anquamine 701	35	35	35	35	35	WB epoxy curing agent	AIR Products
PM	3	3	3	3	3	Co-solvent	Local
DI water	10	10	10	10	10		
NUOSPERSE FX 365	0.5	0.5	0.5	0.5	0.5	Wetting agent	ELEMENTIS
NUOSPERSE FX 2006	1.5	1.5	1.5	1.5	1.5	Dispersant	ELEMENTIS
DAPRO DF 7015	0.3	0.3	0.3	0.3	0.3	Defoamer	ELEMENTIS
Premix the above ingredients, and disperse at 1000rpm for 5 min							
Ti-Pure R902	10	10	10	10	10	White pigment	DUPONT
CMS 444	8	8	8	8	8	Filler	Local
MS 200	10	10	10	10	10	Filler	Local
APW-2	10	10	10	10	10	Anti-corrosive pigment	Local
Add in the above ingredients under continuous agitation, and then disperse at 2500rpm for 20 min							
DI water	10.5	9.7	10.1	8.9	9.7		
Rheolate 299		0.8		1.6		Rheological additive	ELEMENTIS
Rheolate FX 1010			0.4		0.8	Rheological additive	ELEMENTIS
DAPRO DF 1181	0.2	0.2	0.2	0.2	0.2	Defoamer	ELEMENTIS
Levelol W-469	0.5	0.5	0.5	0.5	0.5	Leveling agent	ELEMENTIS
NALZIN FA 179	0.5	0.5	0.5	0.5	0.5	Corrosion inhibitor	ELEMENTIS
Add the above ingredients and the disperse at 1000rpm for 10 min							
Total	100	100	100	100	100		

Raw Materials	weight %	Function	Supplier
EPIKOTE 828	15	Epoxy resin	Shell
Total	15		

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Part A: Part B=100:15

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水性环氧涂料

ELEMENTIS
SPECIALTIES

Test results	Blank	R-299(0.8%)	FX1010(0.4%)	R-299(1.6%)	FX 1010(0.8%)
Initial Test at 25° C					
Brookfield viscosity, cPs					
Spindle, #	4	4	4	5	5
10 rpm	1200	1840	1700	2480	2080
20 rpm	1190	1780	1660	2440	2020
50 rpm	1160	1712	1592	2352	1944
100 rpm	1140	1668	1540	2300	1900
Overnight Test at 25° C					
Brookfield viscosity, cPs					
Spindle, #	4	5	5	5	5
10 rpm	1560	2260	2200	3000	2600
20 rpm	1540	2160	2080	2940	2540
50 rpm	1480	2090	2008	2824	2440
100 rpm	1458	2012	1936	2684	2360
Sag control (Microns)	175	250	200	275	225
Aged Test at 25° C					
Brookfield viscosity, cPs					
Spindle, #	5	5	5	5	5
10 rpm	1000	1760	1720	2480	3320
20 rpm	990	1740	1700	2440	3240
50 rpm	980	1696	1656	2296	2864
100 rpm	976	1636	1560	2112	2500
Sag control (Microns)	175	200	200	275	250

Waterborne 2K Epoxy Primer / 水性环氧涂料

ELEMENTIS
SPECIALTIES



RHEOLATE -299(0.8%wt)



RHEOLATE FX1010 (0.8%wt)

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2000/1/10

Summary-WB Industrial Coatings

ELEMENTIS
SPECIALTIES

- NUOSPERE FX 365 (非离子型润湿剂)
- NUOSPERSE FX 600 (高分子型分散剂)
- DAPRO DF 7015/1181(抑泡剂, 适合于色漆)
- DAPRO DF 1760(破泡剂, 适合于清漆)
- DAPRO U-99 (非硅类流平剂)
- Levelol W-469(改性有机硅型流平剂)
- BENTONE LT (水性有机改性锂蒙托石)
- BENTONE DE (易分散型锂蒙托石, 铝粉定向与防沉)
- RHEOLATE 299 (环保型聚氨酯流变助剂)
- RHEOLATE FX 1010 (环保型聚氨酯流变助剂)
- NALZIN FA 179(防闪锈剂)



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Thank You !!

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