

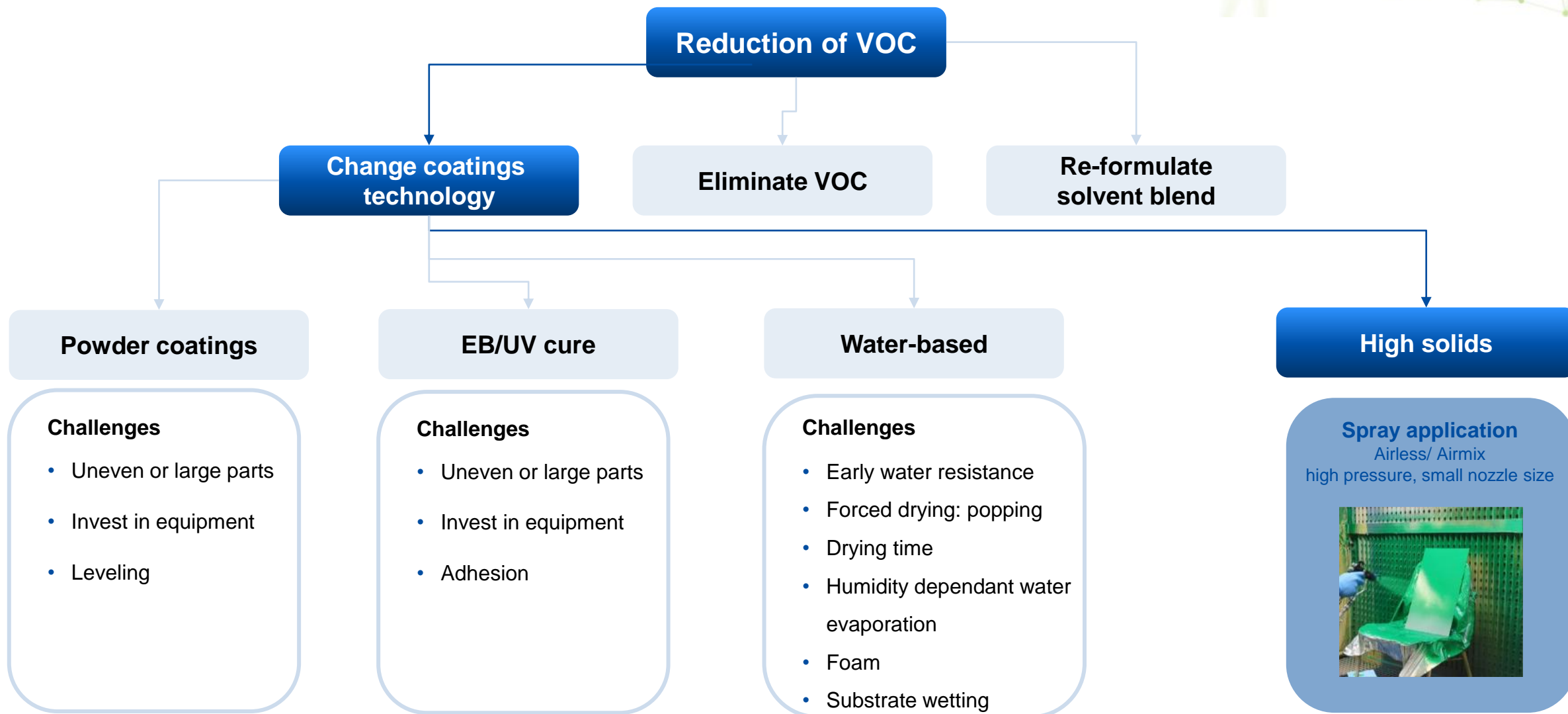
A red tractor is shown from a low angle, moving through a golden field. The sky is filled with large, white, fluffy clouds. The tractor's hood, headlights, and mirrors are visible in the foreground.

Additive solutions for high solids systems

Philipp Teriete, Specialist Special Coatings
Budapest, November 2022

Technology possibilities

High solid and solvent-free



Developing new high solids systems

Requirements for additives

- Development of an up-to-date formulation
- Check for latest additive recommendations
 - Wetting and dispersing additives:
 - Viscosity reduction
 - Pigment stabilization
 - Defoamers:
 - Special focus on airless application systems
 - Rheology:
 - Improve sagging and settlement behavior in HS systems
 - Surface additives:
 - Which are the best surface additives for HS systems?

Must haves

- Up-to-date additives in use
- Low cyclic siloxane content
- No SVHC
- Preferably 100% additives
- Good viscosity
- BTX free
- Tin free (catalyst and additives)
- ...

Developing new high solids systems

High solids 2-pack PU solvent-borne

Pos.	Component	Function	Weight [g]
1	Hydroxy Acrylic Resin (75% solid)	Binder	43.3
2	DISPERBYK-2150	W&D additive	4.8
3	Butylacetate : Methoxypropylacetat 2:1	Solvent	1.1
4	CLAYTONE AF	Rheology additive	1.0
5	Phthalocyanine blue	Pigment	0.1
6	Inorganic pigment yellow	Pigment	1.7
7	Titanium dioxide	Pigment	17.1
8	Carbon black	Pigment	0.6
9	Precipitated barium sulphate	Filler	7.6
	<i>Grinding 20 min at 17 m/s</i>		
10	Hydroxy Acrylic Resin (75% solid)	Binder	8.4
11	Saturated Polyester Resin (100% solid)	Binder	10.0
12	Butylacetate : Methoxypropylacetat 2:1	Solvent	0.4
13	Butyl glycol acetate	Solvent	2.0
14	BYK-320	Surface additive	0.4
15	BYK-3760	Surface additive	0.4
16	BYK-LP D 24636	Defoamer	1.0
17	Mixed carboxylate catalyst	Catalyst	0.1
			100.0

Pos.	Component	Function	Weight [g]
18	Aliphatic polyisocyanate (90% solid)	Hardener	32.5
19	Butylacetate	Solvent	12.8
			45.3

Total solids: ~73%



Developing new high solids systems

Wetting and dispersing additives - test method pre trials

Spray

High shear force during application

Not stabilized Carbon black

Stabilized Carbon black

Draw Down

Medium shear force during application

Not stabilized Carbon black

Stabilized Carbon black

Pour down (down tilt ~60°)

Nearly no shear force during application

Not stabilized Carbon black

Stabilized Carbon black

Additive solutions

Wetting and dispersing additives – example percentage calculation

Pigments

Recommended wetting and dispersing additive dosage [% solids on pigment or filler]

Extender / Filler

0.2 - 2 %

Titanium dioxide

0.8 - 3 %

Colored inorganic pigments

4 -10 %

Organic pigments

15 - 35 %

Carbon black

25 - 80 %

Additive solutions

Wetting and dispersing additives – example percentage calculation

Pigment	Pigment amount [%]	W&D solids on pigment [%]	Additive amount solids on part A [%]
Phthalocyanine blue	0.1	45.0	0.04
Inorganic pigment yellow	1.7	10.0	0.17
Titanium dioxide	17.1	2.5	0.43
Carbon black	0.6	80.0	0.48
Precipitated barium sulphate	7.6	1.0	0.08
Total	27.1		1.20

➤ Dosage for first trials 1.2% solid W&D, part A

Additive solutions

Wetting and dispersing additives – results first trials

Additive (1.2% solids on part A)	Before storage			After storage		
	ΔE	Gloss 20°	Haze	ΔE	Gloss 20°	Haze
Control	2.99	53	357	2.34	82	35
ANTI-TERRA U 100	4.29	48	390	4.00	73	175
BYK-9076	3.46	89	4	3.52	81	8
BYK-9077	2.44	89	3	2.71	82	4
DISPERBYK-142	0.10	90	3	0.77	73	7
DISPERBYK-145	1.73	88	4	1.96	78	4
DISPERBYK-161	3.27	90	5	3.79	86	7
DISPERBYK-163	6.21	88	15	5.35	72	31
DISPERBYK-2013	5.08	89	19	3.12	85	4
DISPERBYK-2014	3.66	65	266	3.17	78	37
DISPERBYK-2055	1.23	89	2	0.77	82	2
DISPERBYK-2150	0.81	90	2	0.98	86	2
DISPERBYK-2155	1.65	90	4	1.18	84	2
DISPERBYK-2200	2.39	89	5	1.96	84	29
DISPERBYK-2205	2.22	89	2	2.09	82	5

➤ DISPERBYK-2150 shows a good and stable ΔE and stable gloss values
 → Trials with higher dosage of DISPERBYK-2150



Grinding time: 20min

Additive solutions

Wetting and dispersing additives – ladder study

Additive (% solids on part A)	Before storage			After storage		
	ΔE	Gloss 20°	Haze	ΔE	Gloss 20°	Haze
Control	2.99	53	357	2.34	82	35
1.2% DISPERBYK-2150	0.81	90	2	0.98	86	2
2.0% DISPERBYK-2150	0.75	90	2	0.72	86	2
2.5% DISPERBYK-2150	0.45	89	2	0.46	88	2



An overdose can lead to poor stabilization / compatibility!



- 2.5% active substance DISPERBYK-2150 shows the best result before and after storage
- Slight settlement after storage
→ Further trials with other rheology additives to improve sagging and settlement

Additive solutions

Rheology additives in the millbase – pour out



w/o rheology

CLAYTONE-40

CLAYTONE-AF

RHEOBYK-7410 CA

w/o surface additive



0.2% BYK-3752



➤ Next step → Spray application / Airless application

Additive solutions

Rheology additives in the millbase – spray application



HVLP application



2.5% as. DISPERBYK-2150, 1.0% CLAYTONE-AF, 0.2% BYK-3752

Airless application



2.5% as. DISPERBYK-2150, 1.0% CLAYTONE-AF, 0.2% BYK-3752

➤ Further trials with other surface additives

Additive solutions

Surface additives – screening trials

Additive (% delivery form on part A)	Leveling	Bénard cells
Control	4	5
0.8% BYK-310	2-3	2
0.3% BYK-313	1-2	3
0.4% BYK-320	1	2
0.2% BYK-322	2-3	2
0.2% BYK-333	2	2
0.5% BYK-361N	2	4
0.2% BYK-3752	2	4
0.2% BYK-3760	1-2	1-2
0.8% BYK-3761	2	4
0.2% BYK-3764	2	2
0.4% BYK-320 + 0.2% BYK-3760	1	1-2
0.4% BYK-320 + 0.4% BYK-3760	1	1

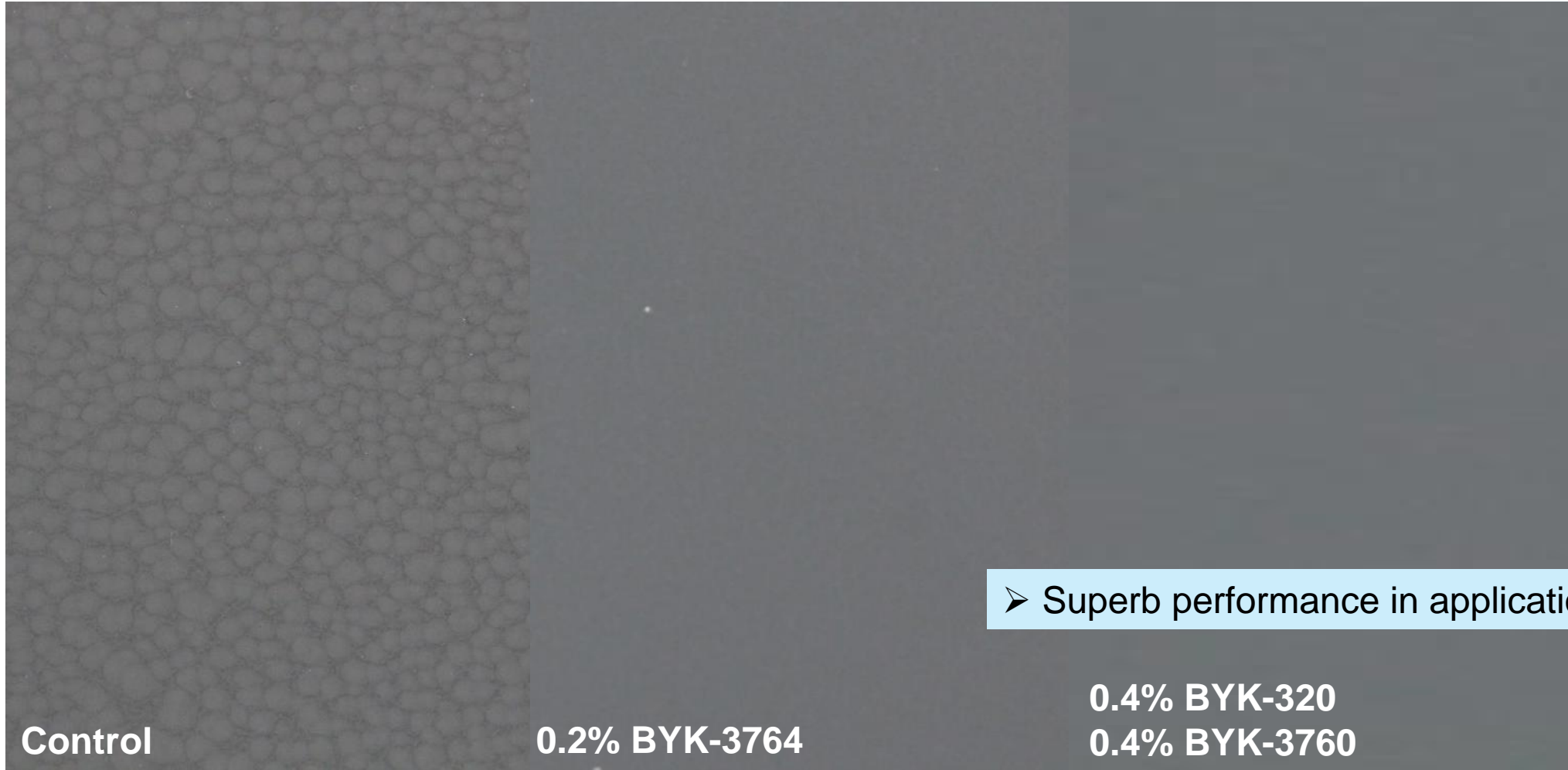
- BYK-320 shows an excellent leveling
- BYK-3760 eliminates the Bénard cells

Evaluation:

5: bad leveling / strong Bénard cells formation
1: superb leveling / no Bénard cells visible

Additive solutions

Surface additives – Bénard cells in HVLP application



Differences in spray application

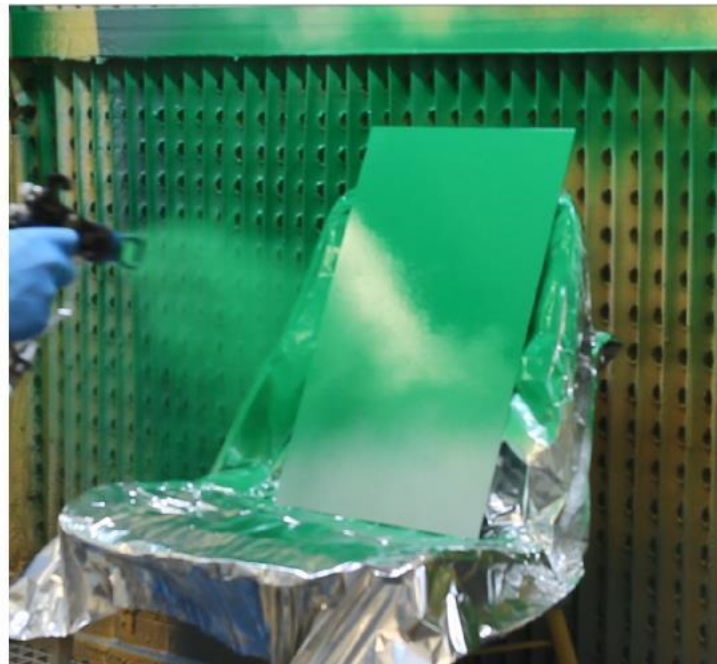
Spray Jet

Conventional Spray Application



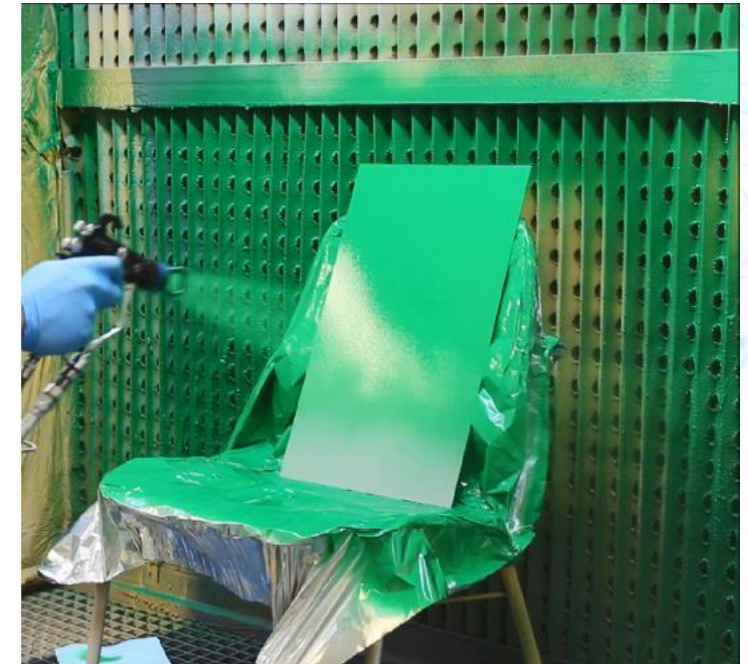
- Regular and homogeneous spray jet
- Very fine droplet size
- Typical pressure; 2 bar = 29 psi

Airless Spray Application



- No regulation of spray jet
- Larger droplet size
- Typical pressure:
180-190 bar = 2600 -2755 psi

Air Assisted Airless Spray Application



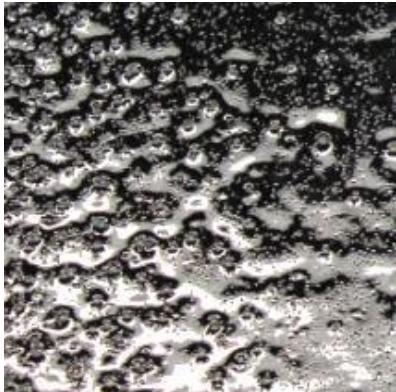
- Homogeneous spray jet
- Medium droplet size
- Typical pressure: 120 bar = 1740 psi+
2-3 bar = 29 – 44 psi air support

Differences in spray application

Foam entrapment

Conventional Spray Application

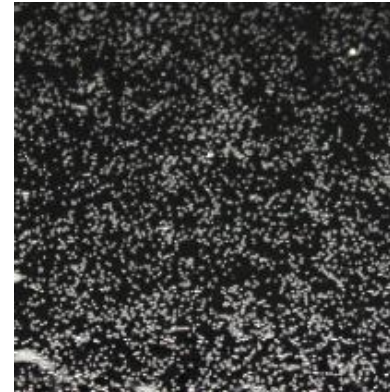
- Medium foam stabilization
- Mainly macro foam (>100µm in diameter)
- Low amounts of micro foam



 Defoaming easier

Airless Spray Application

- A lot of foam
- Predominately micro foam (Size 10µm-70µm in diameter)
- No or minor macro foam formation

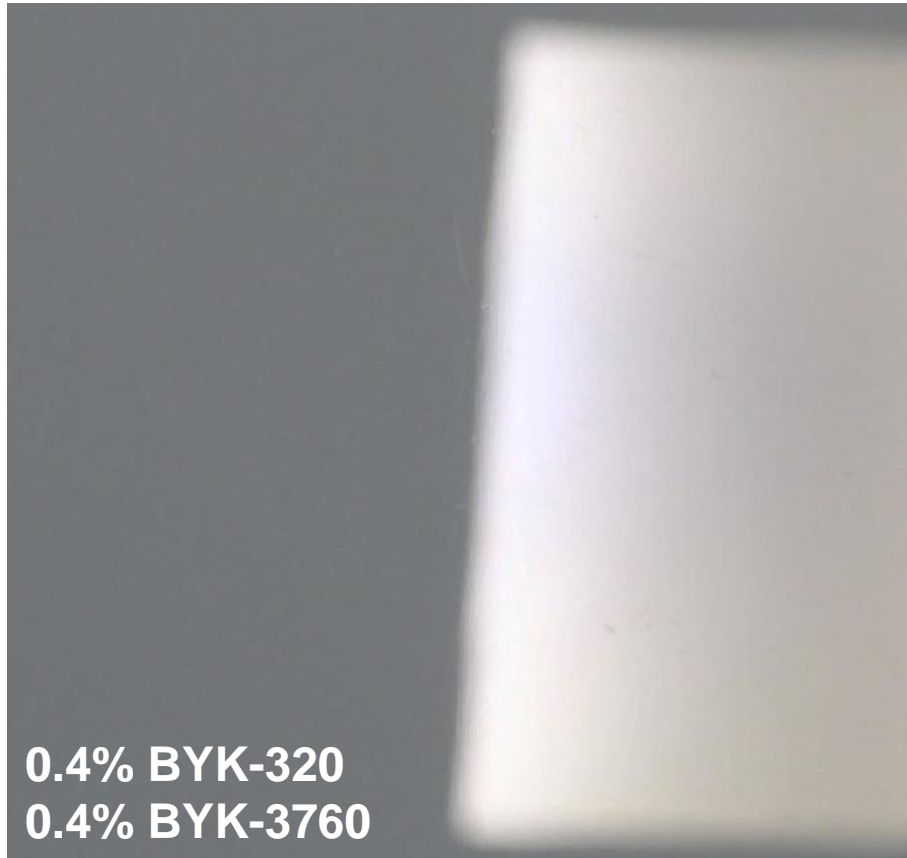


 Defoaming more difficult

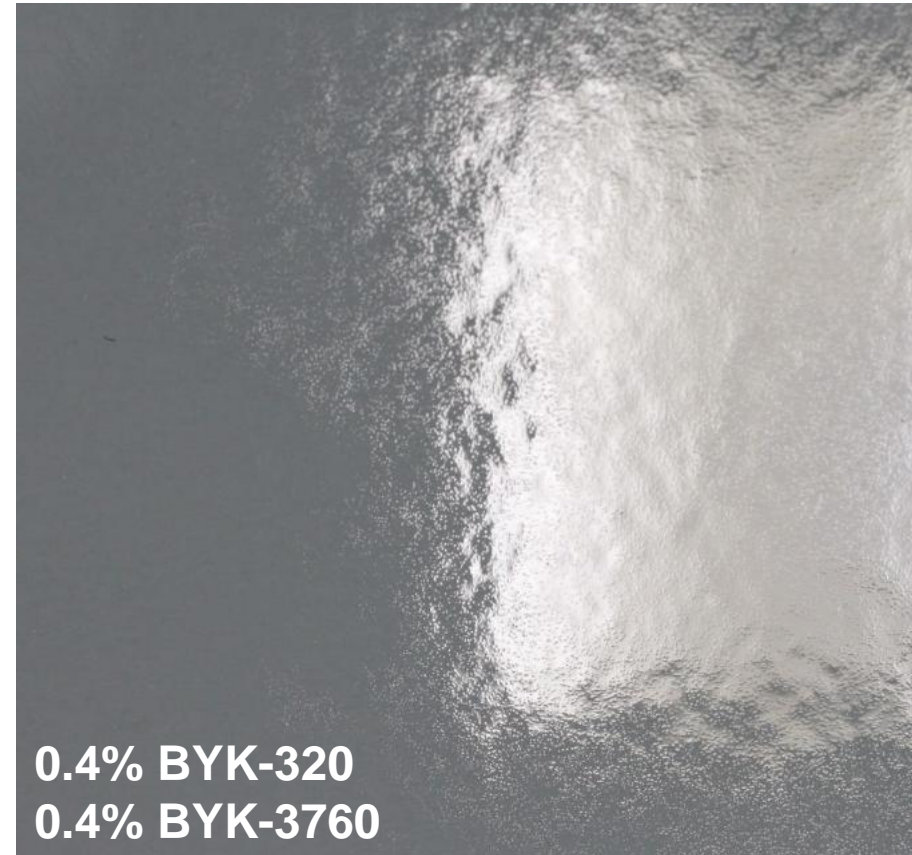
Additive solutions

Surface additives – different application type

HVLP application



Airless application



➤ Defoaming especially in airless application needs to be optimized!

Additive solutions

Final formulation - airless application

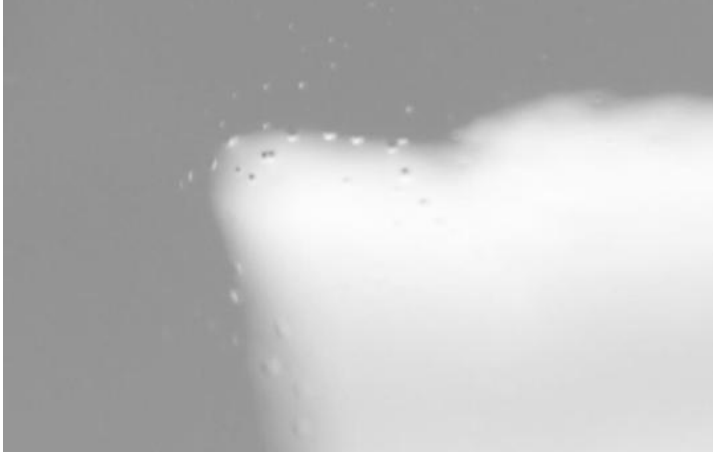
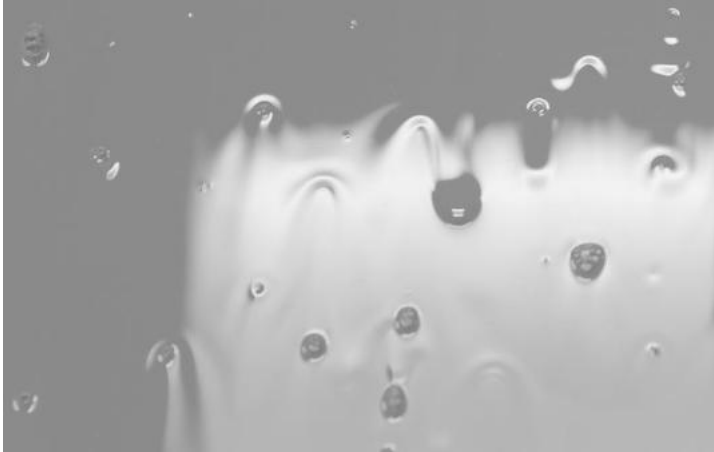


Control

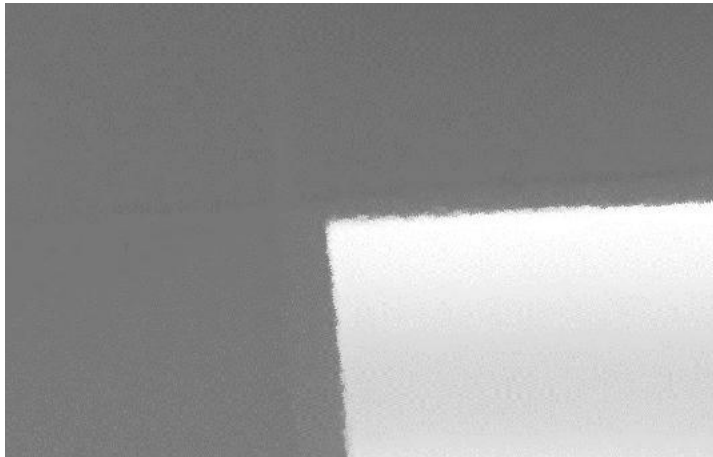
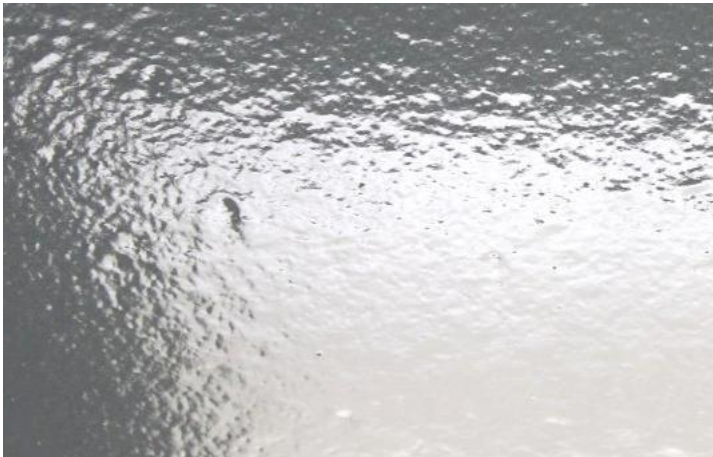
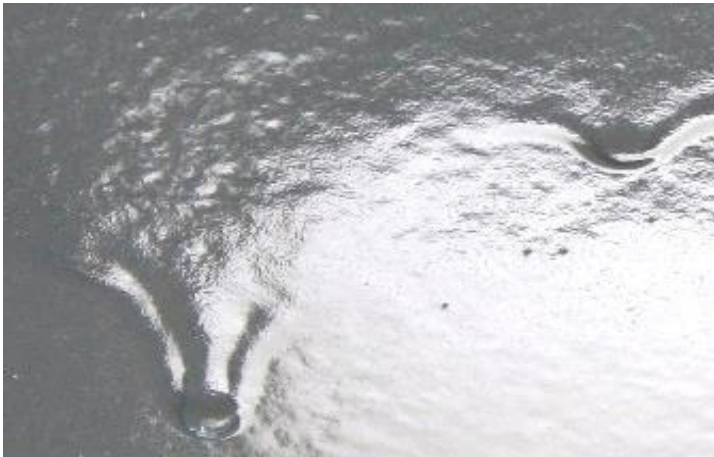
1.0% BYK-1796

1.0% BYK-LP D 24636

Pour out pre-test



Airless application



Developing new high solids systems

High solids 2-pack PU solvent-borne final formulation

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2	DISPERBYK-2150	W&D additive	4.8
3	Butylacetate : Methoxypropylacetat 2:1	Solvent	1.1
4	CLAYTONE AF	Rheology additive	1.0
5	Phthalocyanine blue	Pigment	0.1
6	Inorganic pigment yellow	Pigment	1.7
7	Titanium dioxide	Pigment	17.1
8	Carbon black	Pigment	0.6
9	Precipitated barium sulphate	Filler	7.6
	<i>Grinding 20 min at 17 m/s</i>		
10	Hydroxy Acrylic Resin (75% solid)	Binder	8.4
11	Saturated Polyester Resin (100% solid)	Binder	10.0
12	Butylacetate : Methoxypropylacetat 2:1	Solvent	0.4
13	Butyl glycol acetate	Solvent	2.0
14	BYK-320	Surface additive	0.4
15	BYK-3760	Surface additive	0.4
16	BYK-LP D 24636	Defoamer	1.0
17	Mixed carboxylate catalyst	Catalyst	0.1
			100.0

Pos.	Component	Function	Weight [g]
18	Aliphatic polyisocyanate (90% solid)	Hardener	32.5
19	Butylacetate	Solvent	12.8
			45.3

Total solids: ~73%



Summary

Additive solutions for high solids systems

Wetting and dispersing additives

- **DISPERBYK-2150**
- DISPERBYK-2205
- DISPERBYK-2013
- Development of a new tailor-made wetting and dispersing additive ongoing

Rheology

- **CLAYTONE-AF**
- CLAYTONE-40
- RHEOBYK-7410 CA and family

Surface

Substrate wetting, COF adjustment, anti-crater

- **BYK-3760**
- BYK-3764

Leveling

- **BYK-320**
- BYK-399

Defoamer

- **BYK-LP D 24636**
- BYK-052N
- BYK-A 505
- BYK-1790
- BYK-A 530

Summary

Additive solutions for coatings systems

Optimized paint formulation



- Sufficient mixing of raw materials
- Optimized pigment dispersions
- Improved application properties
- Perfect appearance
- Long-term storage stability

Dosage & Incorporation



- Dosage level of different additives
 - Start with recommendation
 - Dosage studies for optimal performance
- Point of addition
- Duration and shear force of incorporation

Evaluation



- Dosage studies
- Storage tests
- Synergies and side effects
- Selected test methods
 - Different pre-tests for different problems
 - Actual application method



Philipp Teriete
Philipp.Teriete@altana.com

Any questions?