Additive solutions for high solids systems

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Budapest, November 2022

Technology possibilities
High solid and solvent-free

Reduction of VOC

- **Change coatings technology**
- **Eliminate VOC**
- **Re-formulate solvent blend**

Powder coatings

Challenges

- Uneven or large parts
- Invest in equipment
- Leveling

EB/UV cure

Challenges

- Uneven or large parts
- Invest in equipment
- Adhesion

Water-based

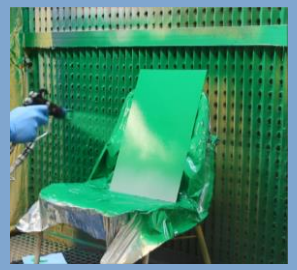
Challenges

- Early water resistance
- Forced drying: popping
- Drying time
- Humidity dependant water evaporation
- Foam
- Substrate wetting

High solids

Spray application

Airless/ Airmix
high pressure, small nozzle size



BYK

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
	Grinding 20 min at 17 m/s		
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

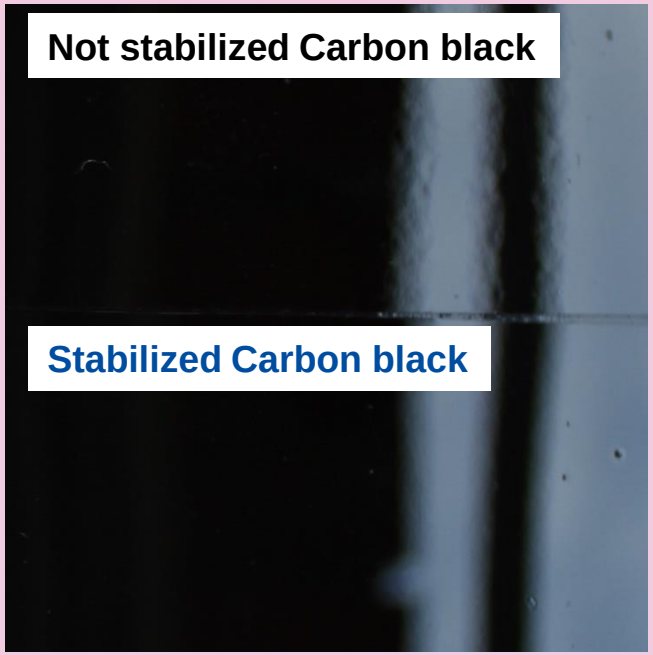
Pos.	Component	Function	Weight [g]
18	Aliphatic polyisocyanate (90% solid)	Hardener	32.5
19	Butylacetate	Solvent	12.8
			45.3

Total solids: ~73%

Developing new high solids systems
Wetting and dispersing additives - test method pre trials

Spray

High shear force during application



Draw Down

Medium shear force during application

Pour down (down tilt ~60°)

Nearly no shear force during application

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 %

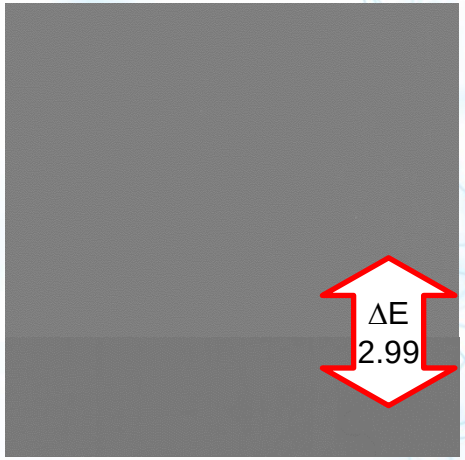
Additive solutions
Wetting and dispersing additives – example percentage calculation

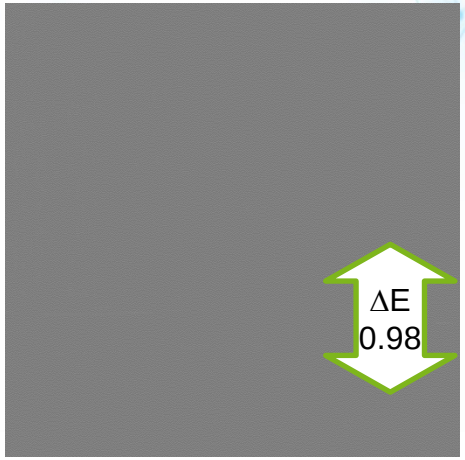
Pigment	Pigment amount [%]	W&D solids on pigment [%]	Additive amount solids on part A [%]
Phthalocyanine blue	0.1	45.0	0.04
Inorganic pigment yellow	1.7	10.0	0.17
Titanium dioxide	17.1	2.5	0.43
Carbon black	0.6	80.0	0.48
Precipitated barium sulphate	7.6	1.0	0.08
Total	**27.1**		**1.20**

➢ 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 ΔE	Before storage Gloss 20°	Before storage Haze	After storage ΔE	After storage Gloss 20°	After storage 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

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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				

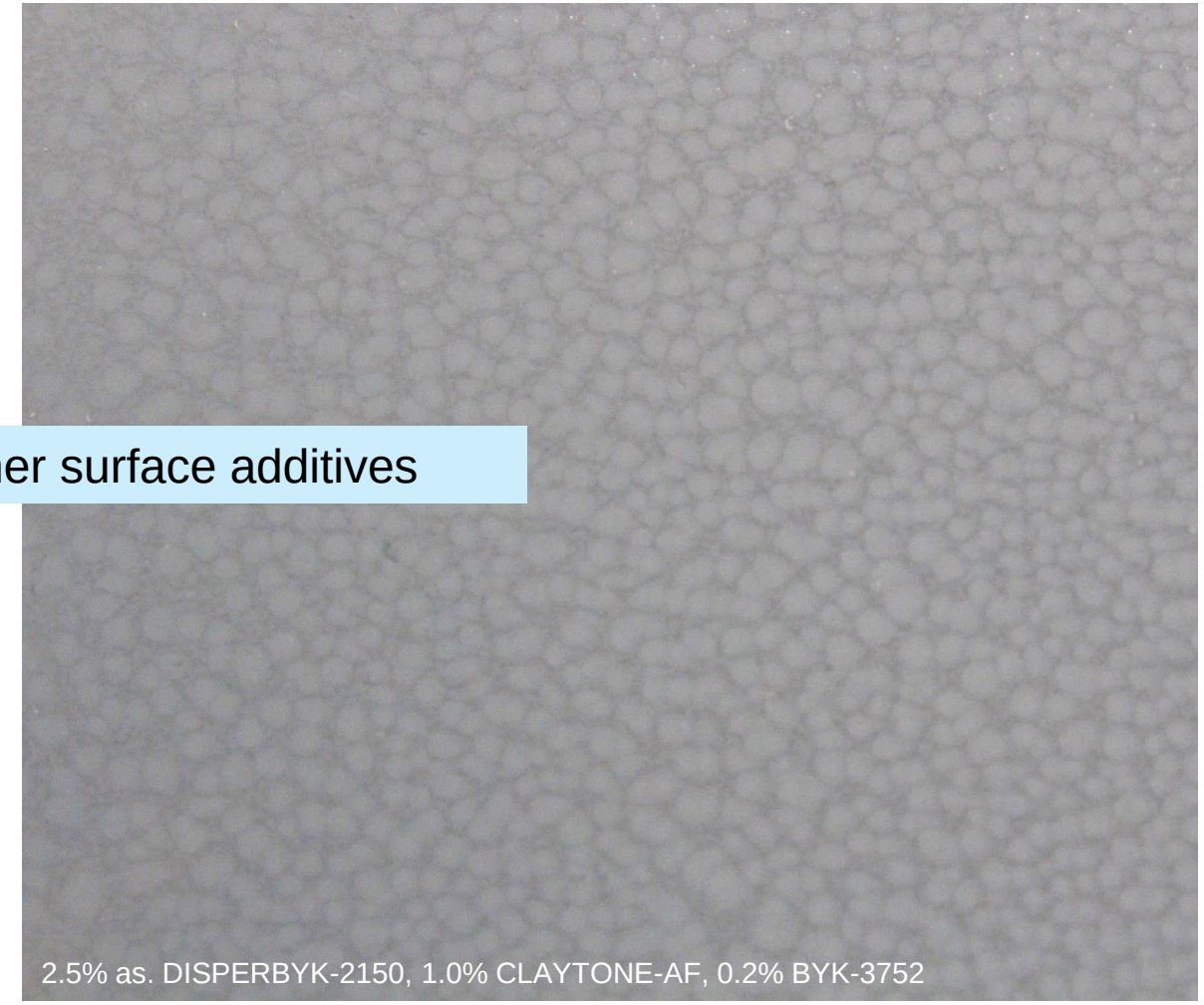
➢ Next step → Spray application / Airless application

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

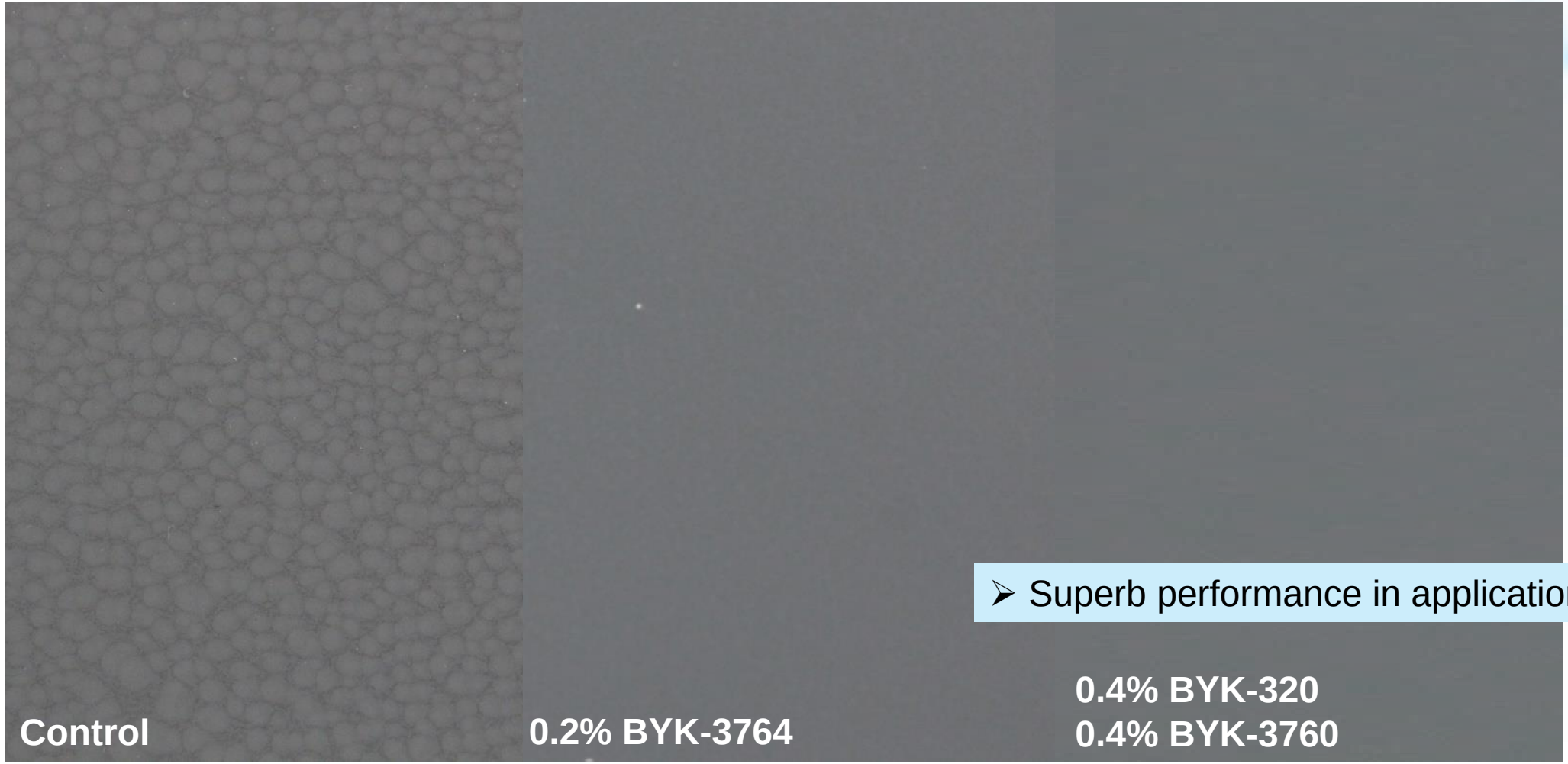
Additive (% delivery form on part A)	Leveling	Bénard cells
Control	4	5
0.8% BYK-310	2-3	2
0.3% BYK-313	1-2	3
0.4% BYK-320	1	2
0.2% BYK-322	2-3	2
0.2% BYK-333	2	2
0.5% BYK-361N	2	4
0.2% BYK-3752	2	4
0.2% BYK-3760	1-2	1-2
0.8% BYK-3761	2	4
0.2% BYK-3764	2	2
0.4% BYK-320 + 0.2% BYK-3760	1	1-2
0.4% BYK-320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



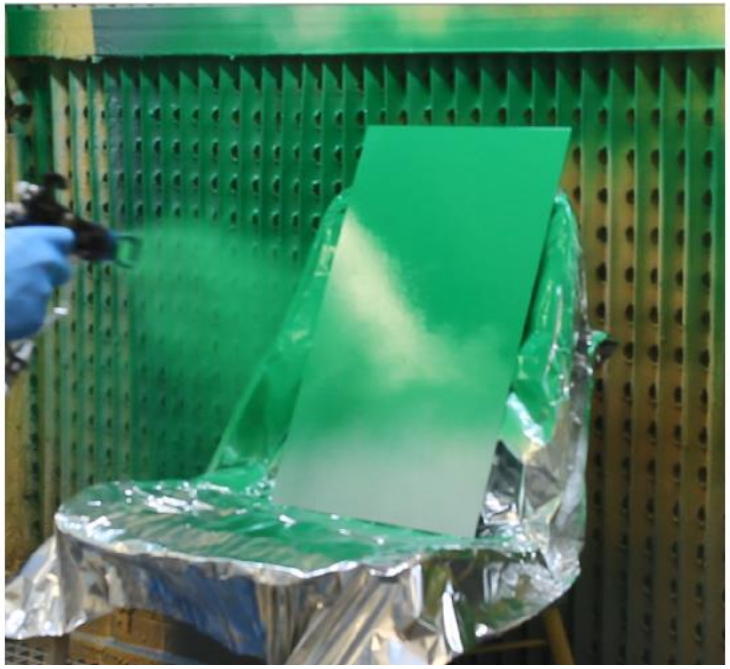
- Superb performance in application

Differences in spray application
Spray Jet

Conventional
Spray Application

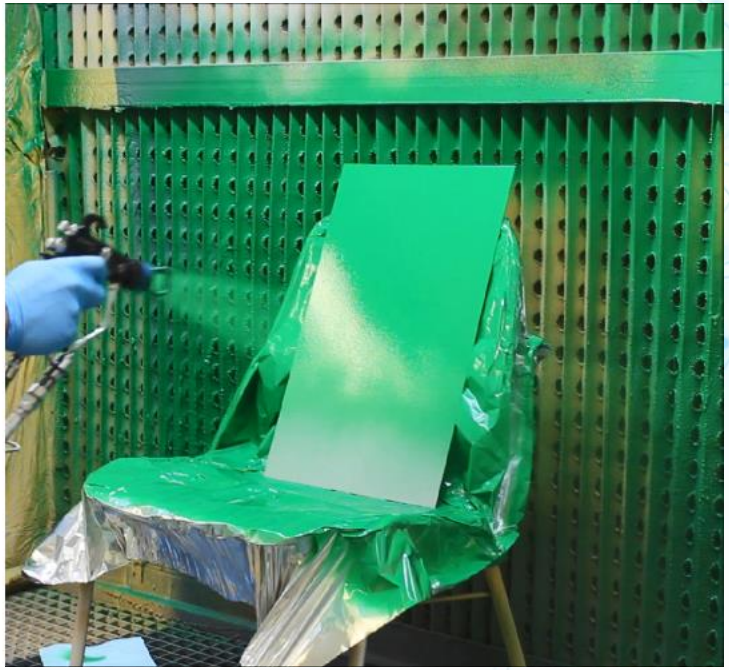
- Regular and homogeneous spray jet
- Very fine droplet size
- Typical pressure; 2 bar = 29 psi

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

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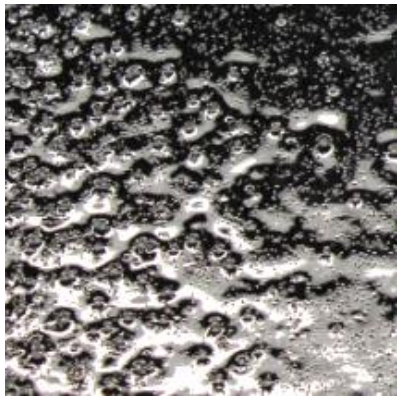
Differences in spray application
Foam entrapment

Conventional
Spray Application

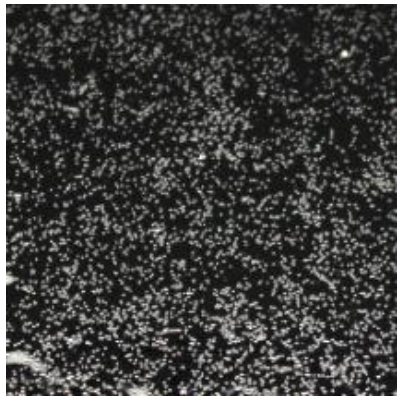
- Medium foam stabilization
- Mainly macro foam (>100µm in diameter)
- Low amounts of micro foam



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

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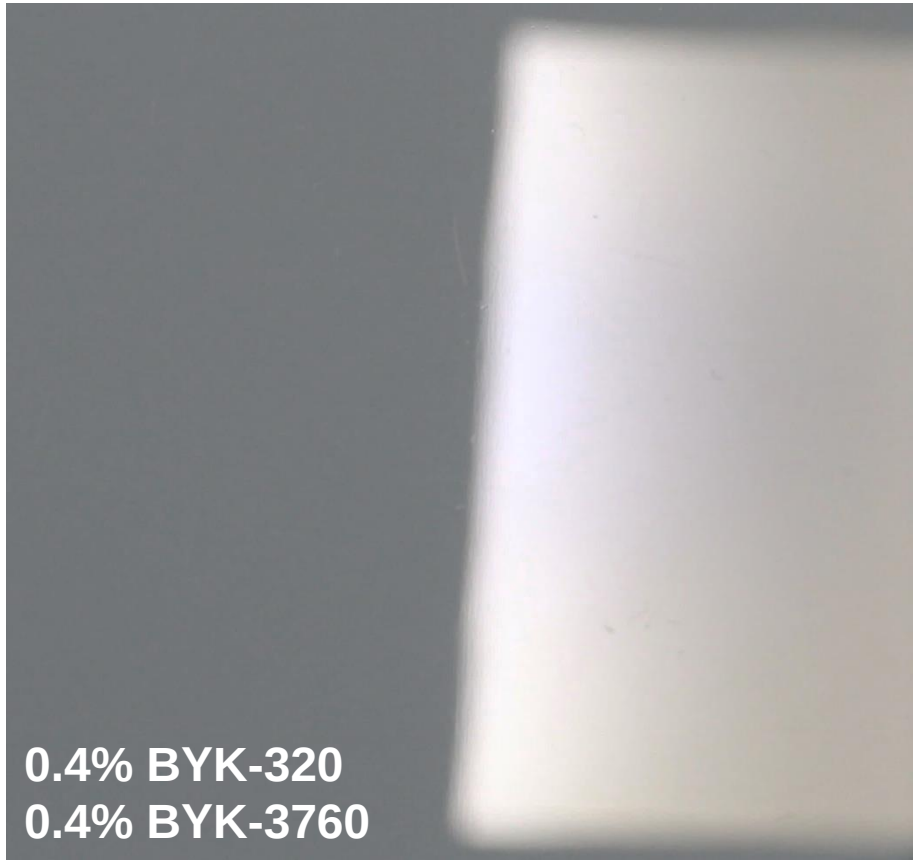
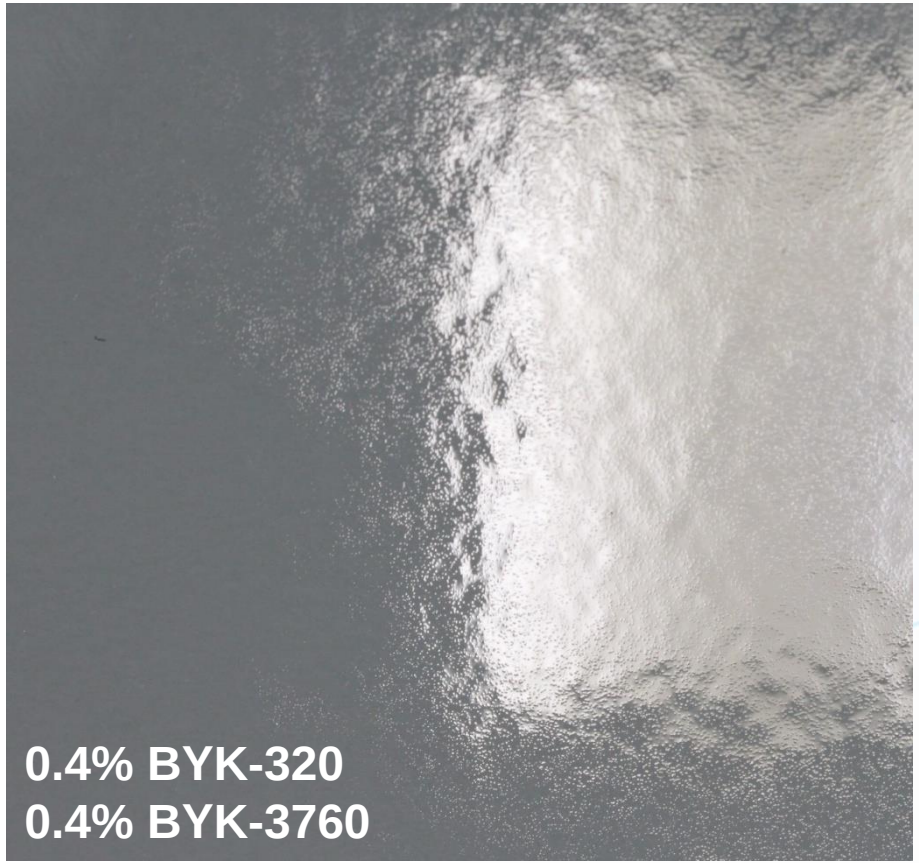
Additive solutions
Surface additives – different application type

HVLP application

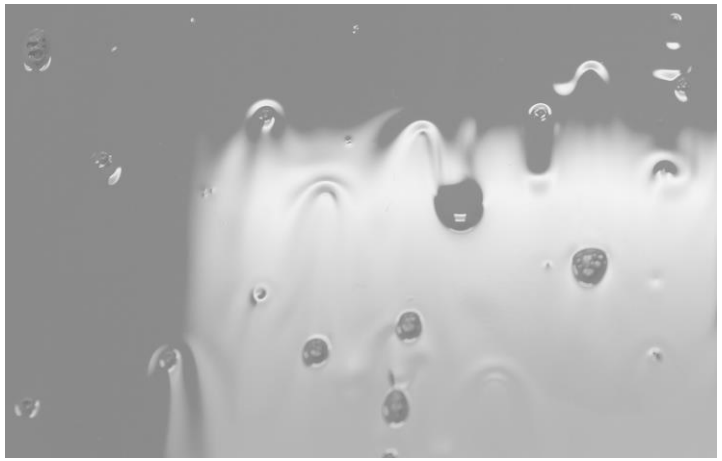
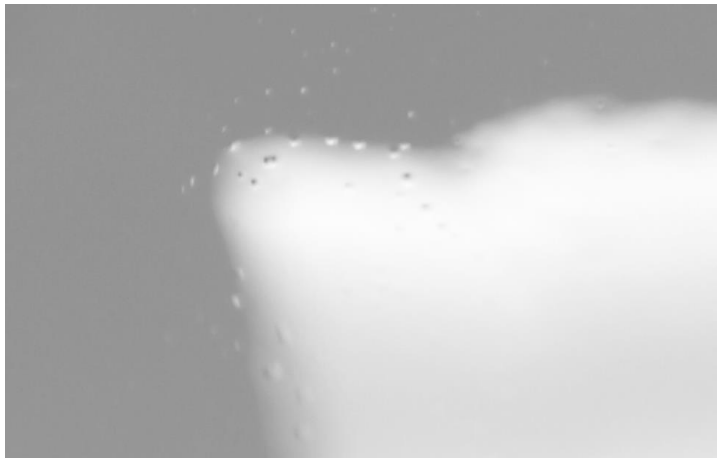
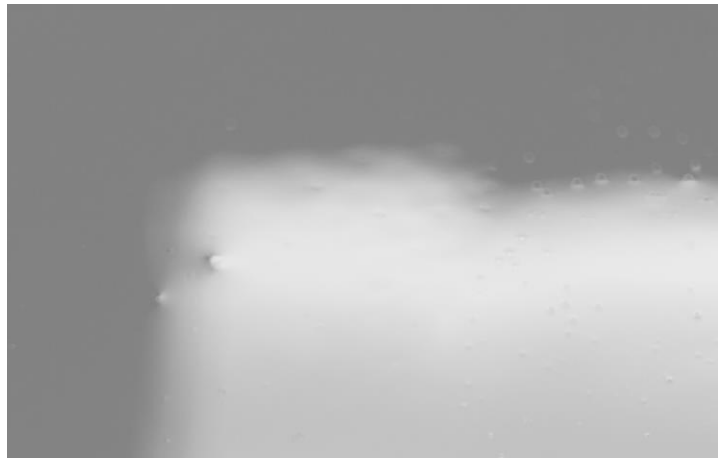
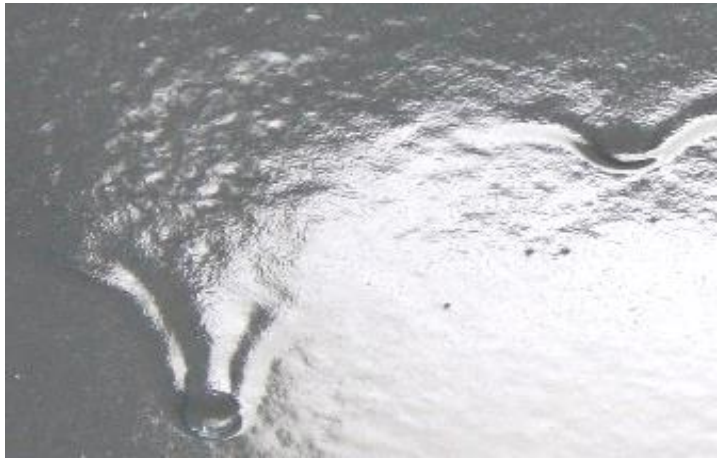
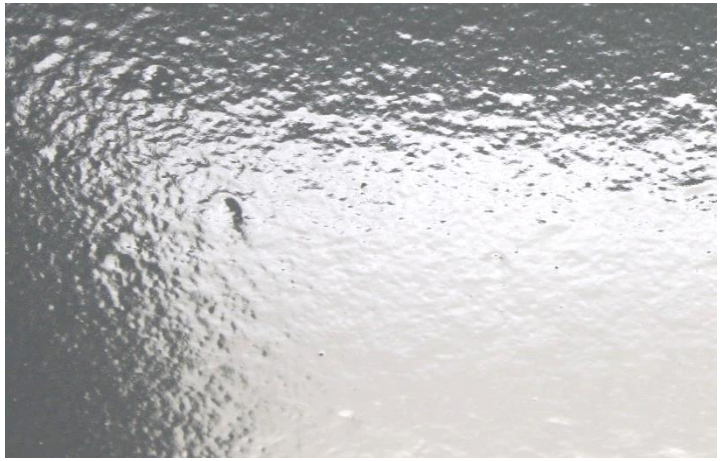
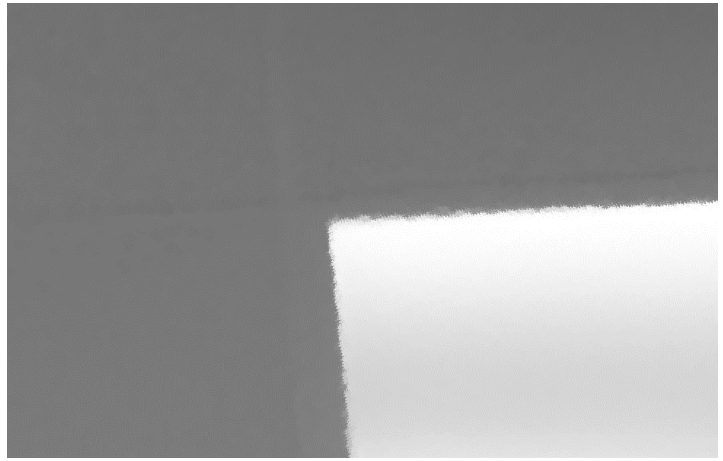


Airless application



➢ 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

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
	Grinding 20 min at 17 m/s		
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

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Any questions?

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