Corrosion Protection

Daniel Fischer

Agenda

1. **Corrosion Protection with zinc-flakes**

2. Zinc-flakes in Shop-primer

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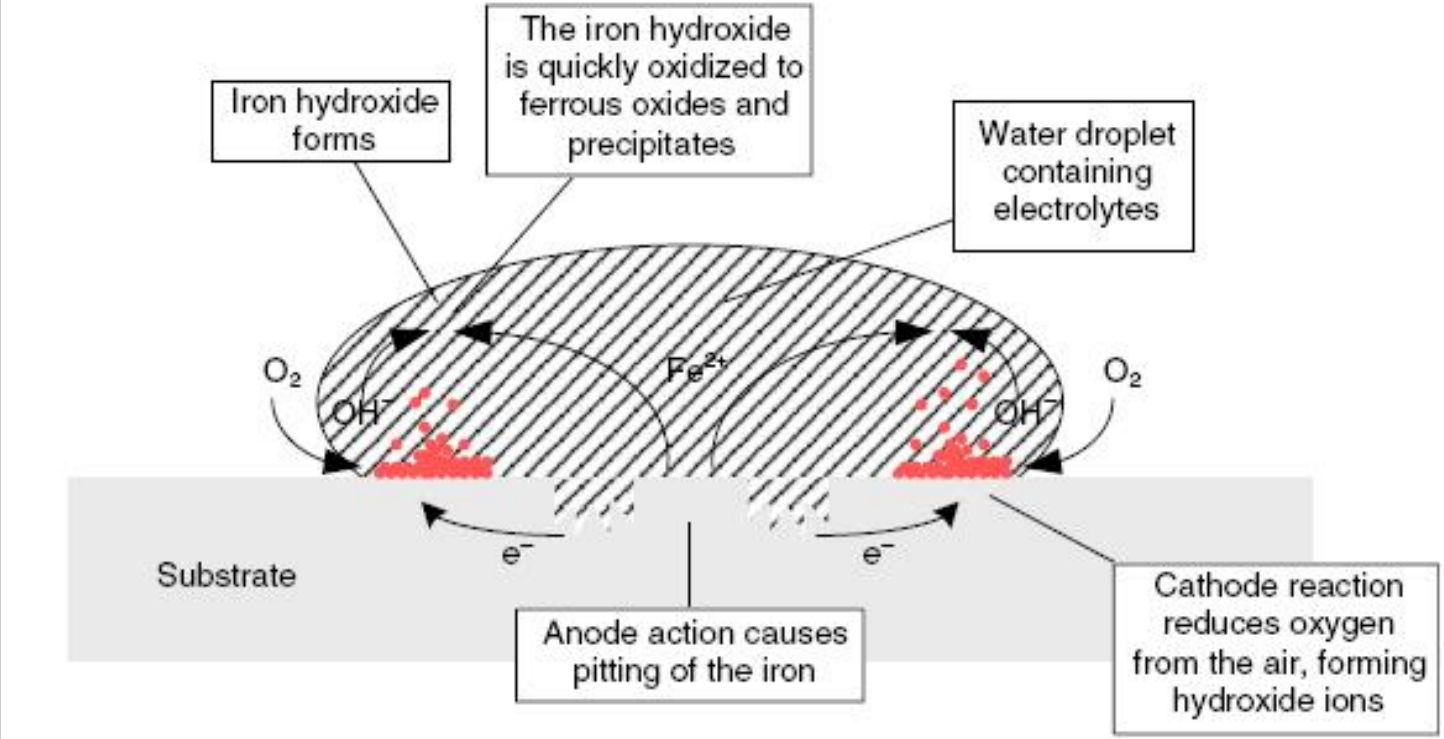
Effect Pigments

Mechanism of wet Corrosion



$$6Fe(s) + 4^1/_2O_2(aq) + 3H_2O(l) \rightarrow 3Fe_2O_3 \cdot H_2O(s)$$

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Mechanism of corrosion protection with zinc pigments

1) electro-chemical process

direct contact zinc – iron
iron electrochemically more precious than zinc

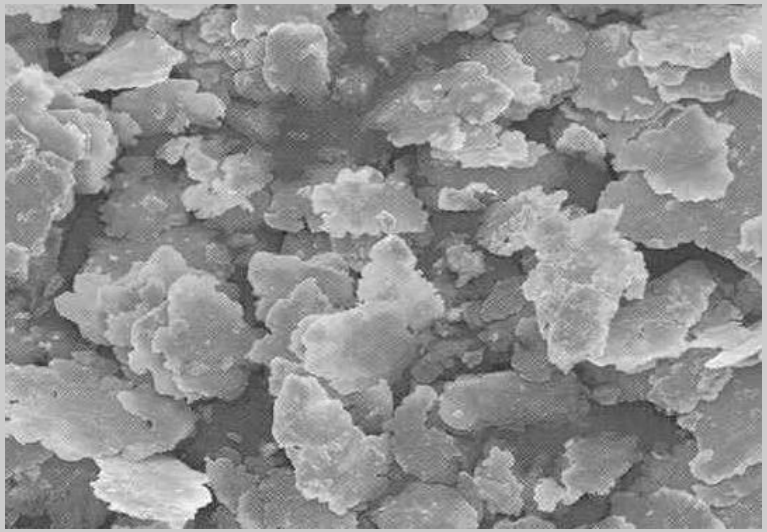
=> zinc sacrifices itself to protect iron
=> zinc starts to oxidize

2) cementation (i.e. sealing zinc layer will be formed)

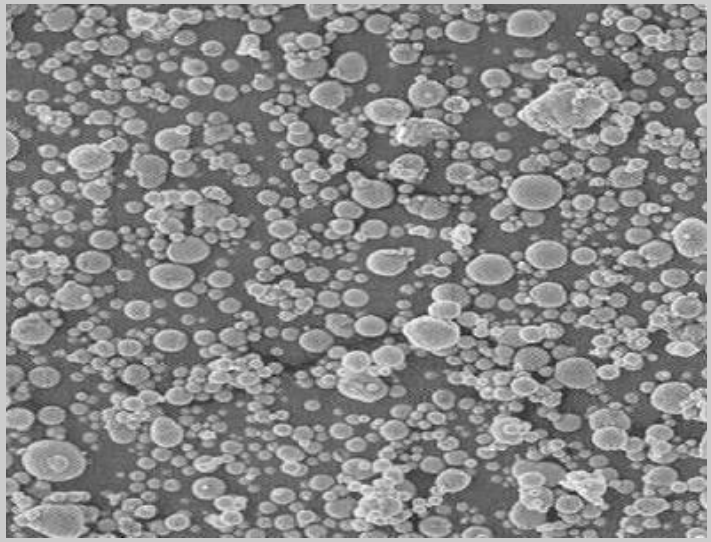
zinc pigments oxidize

=> volume increase
=> pores are sealed (i.e. barrier protection)

Microscope



zinc-flake x450



zinc-dust x700

Comparison of technical data zinc flake vs zinc dust

	Zinc flake	Zinc dust
Particle shape	lamellar (flake)	spherical (dust)
Apparent density	approx. 1,1 kg/l	approx. 2,2 kg/l
Oil absorption value	approx. 22 g/100g	approx. 6,5 g/100g
Average particle size	approx. 15 µm	approx. 3 µm
Specific surface area	large	small
Binder absorption	high	low
electrical conductivity	high	low

Zincflake - Portfolio

Grade:	Solid-content	Particle size D50
STANDART® Zinc flake TV	**100 %**	**50 µm**
STANDART® Zinc flake GTT	**100 %**	**13 µm**
STANDART® Zinc flake G	**100 %**	**9 µm**
STANDART® Zinc flake AT	**100 %**	**20 µm**
STAPA ® TE Zinc AT	**90 %**	**17 µm**
STAPA ® TE Zinc GTT	**90 %**	**13 µm**
STAPA ® Zinc 4	**90 %**	**14 µm**
STAPA ® Zinc 8	**90 %**	**11 µm**
STAPA ® 4 ZnAl7	**91,5 %**	**14 µm**
STAPA ® 4 ZnSn 30	**91,5 %**	**14 µm**
STAPA ® 4 ZnSn 15	**91,5 %**	**14 µm**

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Zinc flake properties for cathodic protection

-Better Zinc to Zinc and Zinc to Iron contact

-Better current flow

-Better corrosion protection

-Flakes degrade more rapidly

Addition of lamellar (e,g, Talc) and spherical fillers (e.g. Blanc fixe) and a small portion of an active anti-corrosion pigment (e.g. Heucophos ZCP) compensates a more rapid degradation of zinc flake primers.

Advantages of Zinc Flake Pigments

- Ideal for thin paint films
- Lower pigmentation level (max. 30% of zink dust)
- Low tendency to sediment
- Higher binder content (improved coating flexibility)
- Lower porosity and permeability
- Smooth surface
- Improved intercoat adhesion performance

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Concept of shop primers

Shop primers are fast drying materials applied as a thin film onto a metal surface to give protection in the period before and after fabrication.

As final step of production, steel substrates are exposed to automatic blasting and after that they will be storage for a certain period of time. To avoid corrosion they are temporarily protected by a thin primer (shop primer)

Shop primers – technical requirements

- Dry film thickness approx. 20 µm
- Atmospheric protection about 6 months
- 3 to 5 minutes drying time
- Thermal decomposition products formed during gas cutting/welding must not cause any harm to workers
- No negative impact on welding
- No adverse effect on gas cutting quality and gas cutting rate

Shop primers – technical requirements

- resistance to handling damage while being processed

- thermal damage during welding operation should be minimal

- high degree of reflectance causes problems during arc welding and should be minimized

- no negative impact on top coating properties

- suitable resistance to short immersion periods in fresh and seawater

Tested formulations

2 K Epoxy Zinc flake shop primer

Component A:

Epikote 1001-X-75	9,6
Heucophos ZCP plus	3,7
- pre disperse –	
Araldite GY 783	7,3
- add and stir homogeneously –	
Solventnaphtha	5,0
MIBK	9,5
n-Butanol	4,5
Disperbyk 142	1,1
Byk 410	0,2
Blanc fixe micro	13,7
Micro Talkum AT extra	16,9
Stapa zinc 4	28,5
- add one after the other	
- under stirring –	

Component B: Aradur 450 BD (hardener)

Mix ratio : 100p.b.W comp.A : 6,0 p.b.W.comp.B

This paint is ready to use

2 K Epoxy Zinc dust shop primer

Component A:

Toluene	7,0
n.Butanol	3,0
Epicote 1001X75	7,0
Anti-terra U	0,5
BYK-052	0,3
Byk-323	0,05
Zinc dust	76,0
Xylene	4,15
Byk-410	2,0

Component B:

Toluene	17,5
n-Butanol	60,3
Anti-terra 203	0,5
Aradur 115 (hardener)	21,7

Mix ratio:
100 p.b.W.Comp.A
9,1 p.b.W Comp.B

1K Silica shop primer

Commercially available system

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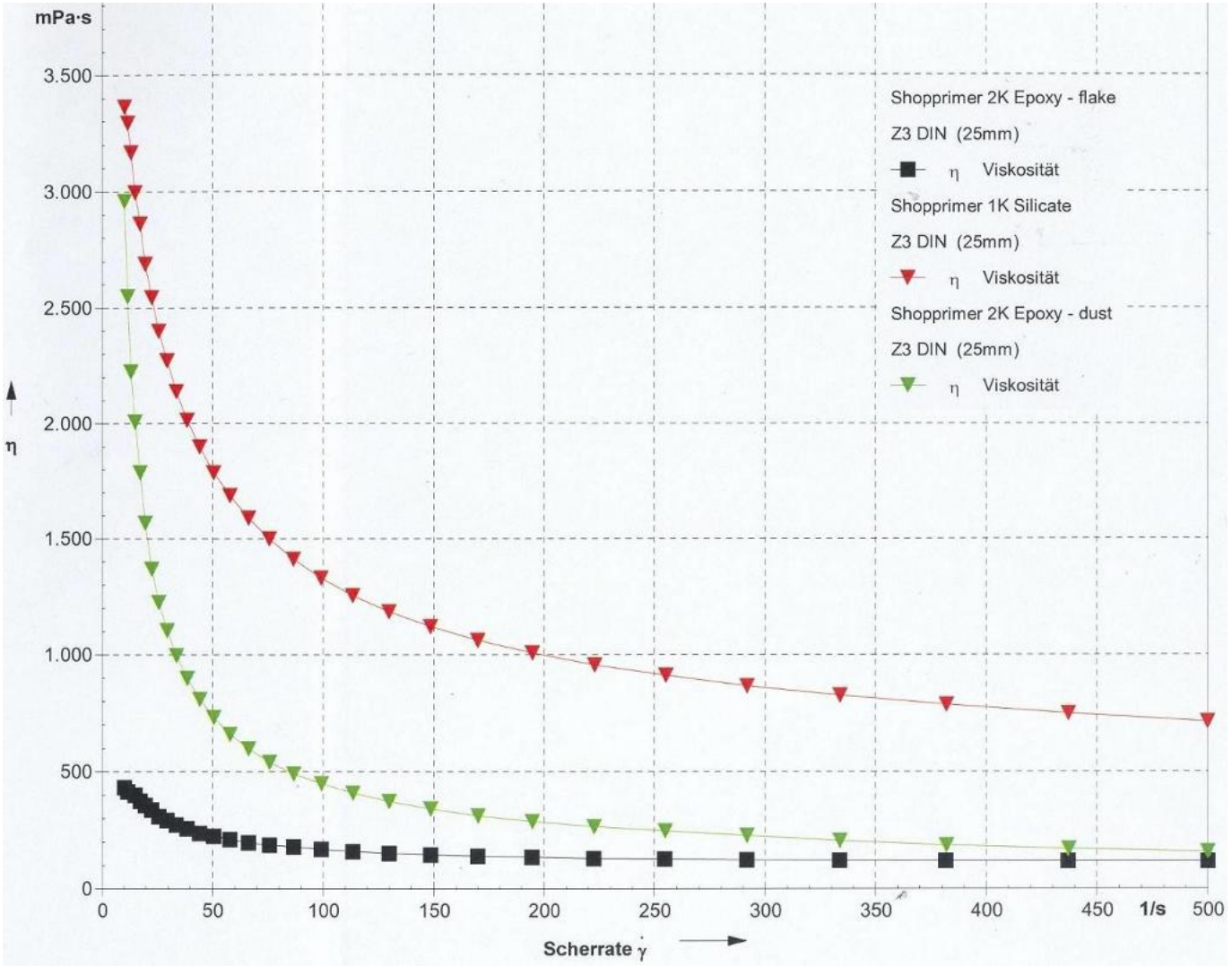
Technical parameters of the formulations

	2K Epoxy zinc flake	2K Epoxy zinc dust	1K Silicate zinc dust
Density spray ready:	1,650 g/cm³	2,420 g/cm³	2,417 g/cm³
Solid content (spray ready):	76,60%	77,60%	86,10%
VOC (spray ready):	390 g/l	540 g/l	416 g/l
Yield (20µm DFT):	17,3 m²/kg	8,2 m²/kg	13,9 m²/kg

Comparison of rheological properties (flow curve)



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10 days salt spray test results (DIN EN 23270)

Comparison of zinc-oxide formation between

Zinc dust **Zinc flake**

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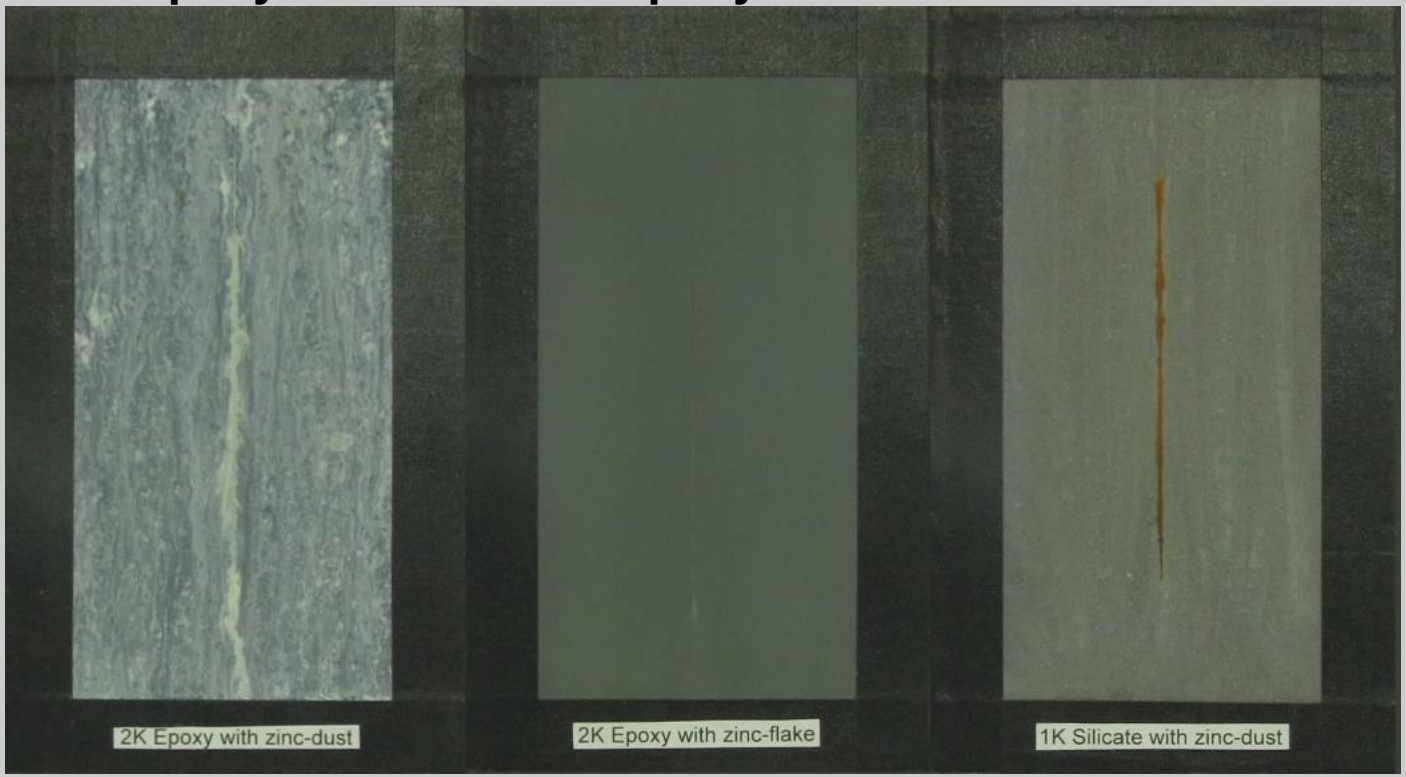
10 days salt spray test results (DIN EN 23270)

1 mm panel thickness; depth of roughness: approx. 30 µm
(Substrates sand blasted)

2K Epoxy dust **2K Epoxy flake** **1K Silicate dust**



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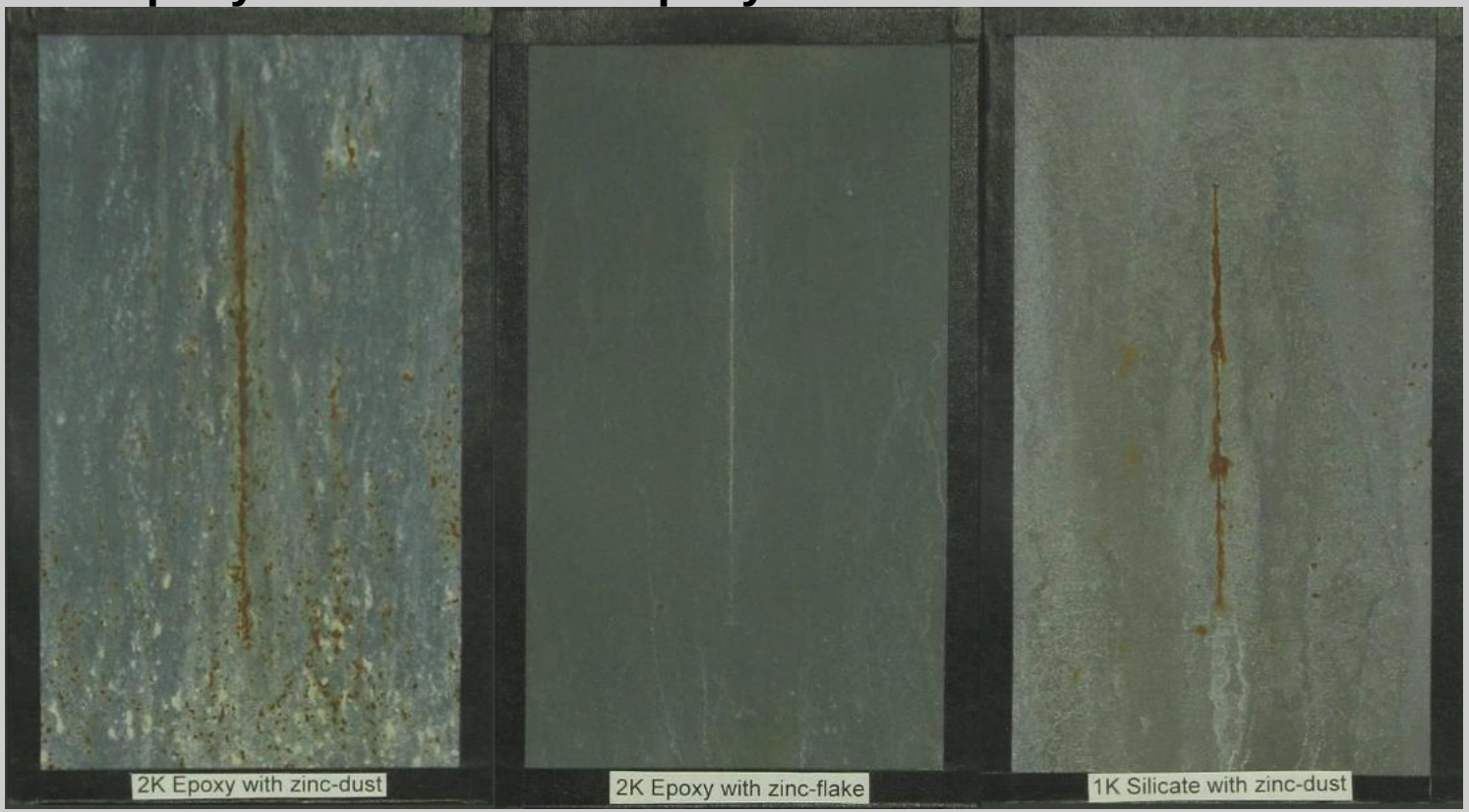
10 days salt spray test results (DIN EN 23270)

5 mm panel thickness; depth of roughness: approx. 80 µm
(Substrates sand blasted)

2K Epoxy dust **2K Epoxy flake** **1K Silicate dust**



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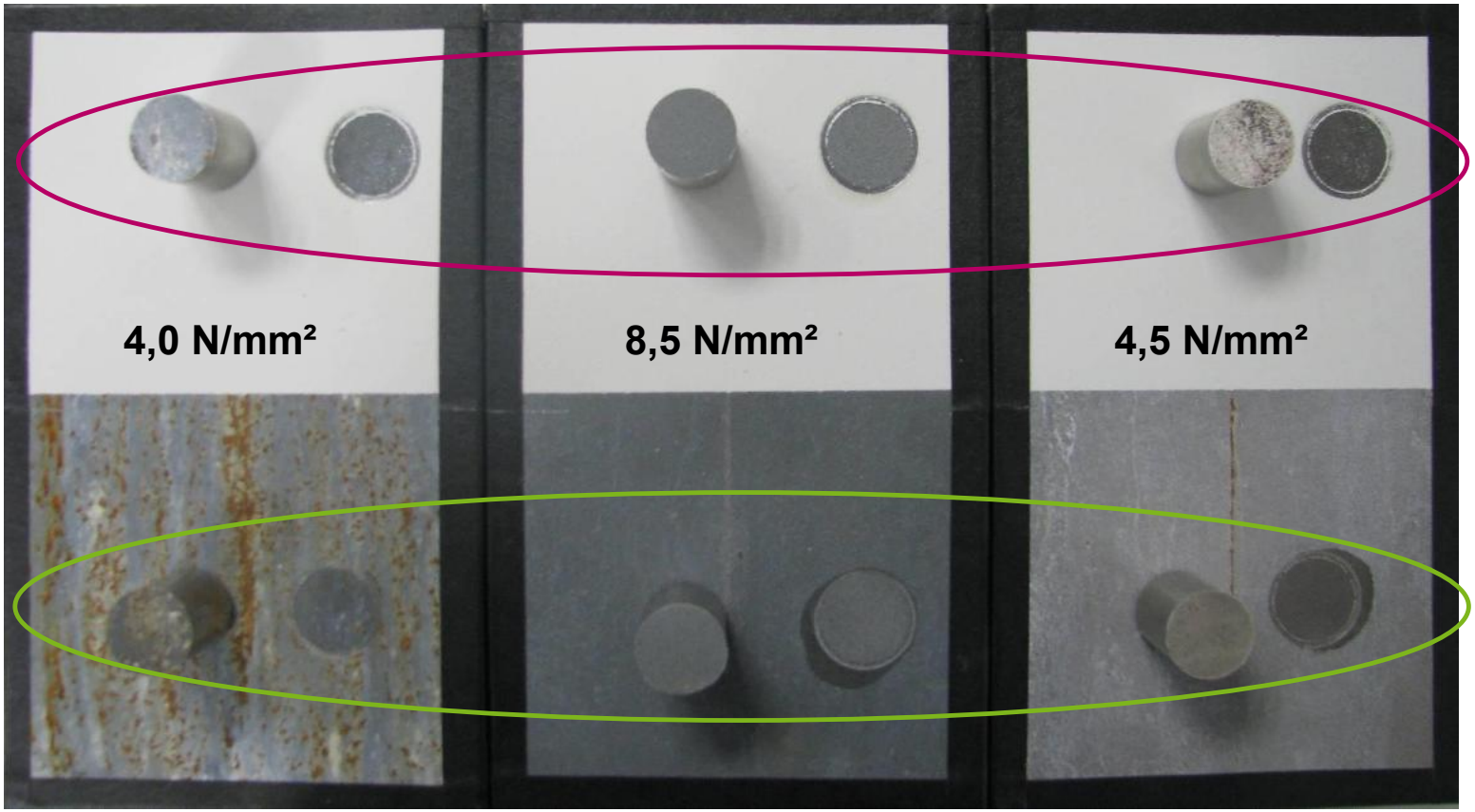
Adhesion- and intercoatadhesiontest on exposed panels (300h SST)

	2K Epoxy dust	2K Epoxy flake	1K Silikate dust
Primer + 2K PU	4,0 N/mm²	8,5 N/mm²	4,5 N/mm²
Primer	4,5 N/mm²	6,0 N/mm²	5,0 N/mm²
	cohesion/adhesion	cohesion	adhesion



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Summary

Shopprimer-formulations with zinc flakes display:

- Lower heavy metal content
- Higher yield compared to zinc dust formulations
- Improved coating flexibility
- Simpler to comply with VOC regulations
- Excellent corrosion protection in thin film layer
- Less whiterust or even no whiterust after 300h SST

Thank you for your kind attention

In Hungary:

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