



NACE JUBAIL CUI Workshop 10th December 2015

AvantGuard[®]
Redefining
anti-corrosion

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AvantGuard® Redefining anti-corrosion

- Hempel introduces AvantGuard®, a brand new innovative anti-corrosion technology, based on activated zinc and locked into our new range of high performance protective coatings.
- This innovation significantly reduces the effects of corrosion and offers superior protection. This increased durability has been proven in extensive tests against standard zinc rich epoxies without this new technology.



Table of contents

- Benefits of this new technology
- Where can this be you used?
- Why AvantGuard®
- What is AvantGuard®
- References



BENEFITS FROM USING AVANTGUARD®

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Benefits

Choose slides 8-13
for specifier
customers

Features	Benefits
Reduced rust creep and enhanced corrosion protection	Excellent protection - can contribute to reduced maintenance
Extremely good mechanical properties	High resistance to cracking in corners, welding seams, etc. Excellent resistance to abrasion
Self healing properties	Cracks are being stopped, even before they can be developed



Redefining protection: Reduced rust creep and enhanced corrosion protection



AvantGuard® technology



Zinc epoxy without AvantGuard® technology

Can contribute to reduced maintenance

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Redefining protection: Reduced rust creep and enhanced corrosion protection – also on full systems



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Zinc epoxy without AvantGuard® technology

Can contribute to reduced maintenance

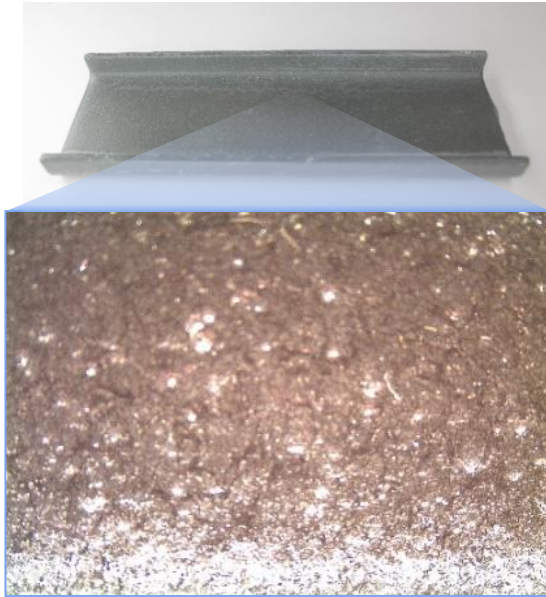
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Redefining durability: Extremely good mechanical properties

High resistance to cracking in corners



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Zinc epoxy without AvantGuard® technology

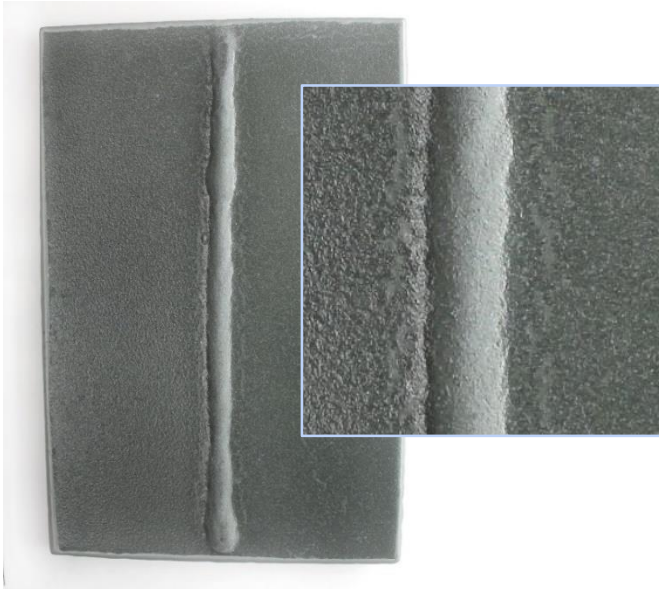
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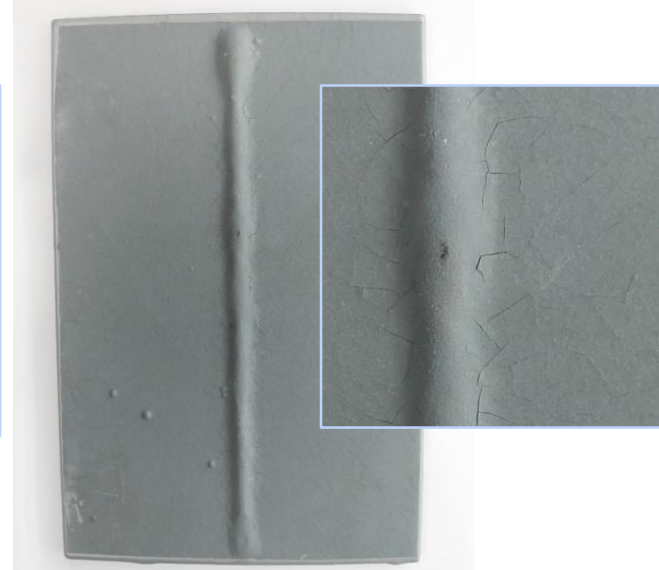


Redefining durability: Extremely good mechanical properties

High resistance to cracking in weldings



AvantGuard® technology



Zinc epoxy without AvantGuard®
technology

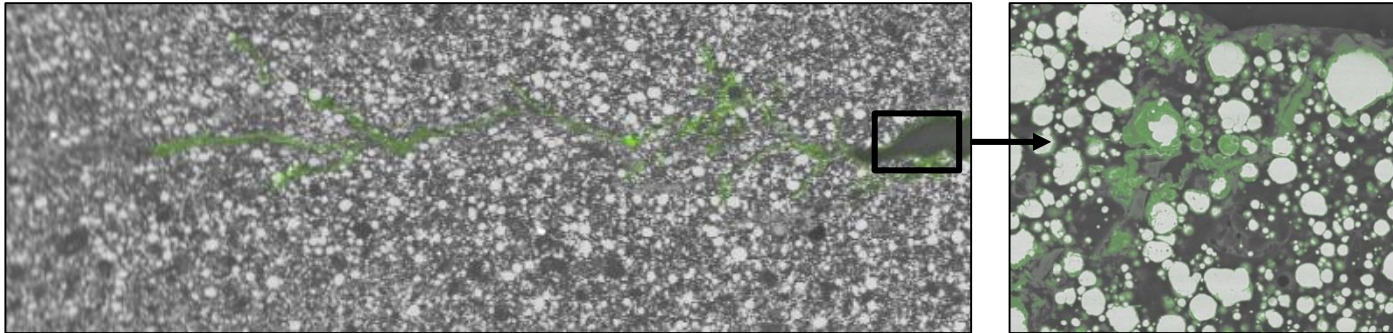
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Redefining durability: Improved self healing properties

Cracks are being stopped, even before they can be developed



Micro-crack covered by zinc corrosion sub-products



Benefits

Choose slides 1
17 for contractor
customers

Features	Benefits
No special application technique or equipment needed	No change in production line setup
Very tolerant to different climatic conditions and with high DFTs	Less rework due to application during high humidity, high temperature or accidental excessive film thickness
Drying properties among best in class	Fast throughput, less need for waiting on drying



Redefining productivity: No special application technique or equipment needed

No change in production line setup

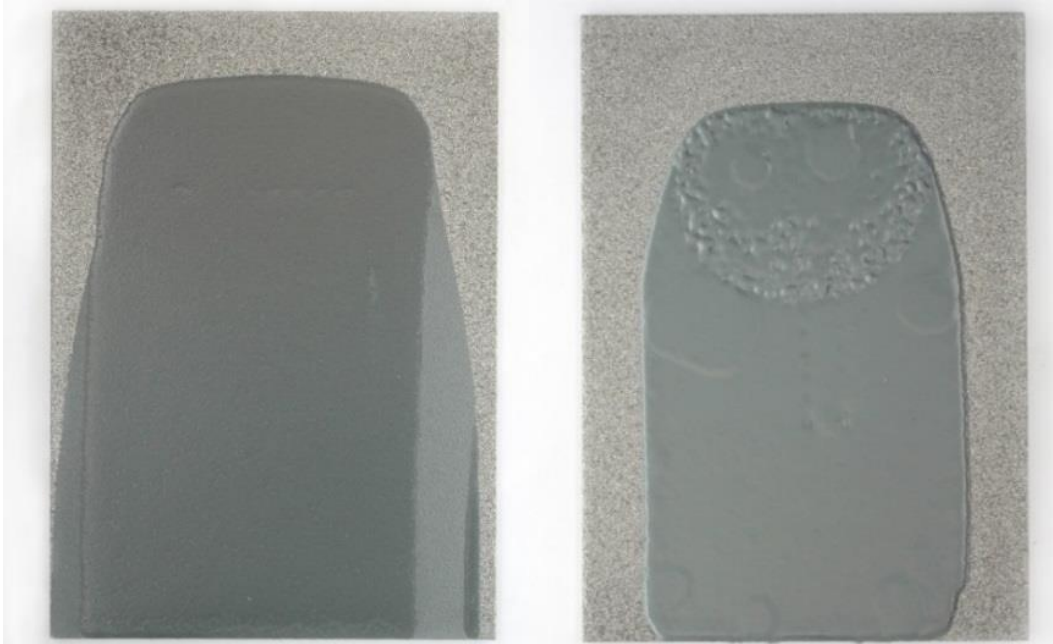


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Redefining productivity: Very tolerant to different climatic conditions and with high DFTs



AvantGuard® technology

Zinc epoxy without AvantGuard® technology

Less rework due to application during high humidity, high temperature or accidental excessive film thickness

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Redefining productivity: Drying properties among best in class

Fast throughput, less need for waiting on drying

Also excellent:

- stability
- spray ability
- film formation
- sag resistance



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HEMPEL'S AVANTGUARD HAS BEEN TESTED WE KNOW IT WORKS!

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We know it works because we have tested it - internally and externally!

■ High Zinc Content

- NORSOK M 501 revision 6 (ISO 20340) – certified by COT (Netherlands)

■ Medium Zinc Content

- ISO 12944 C5 M/I, 2007 – certified by COT (Netherlands)

■ Other tests

- Water permeability test
- Thermal Cycling Resistance test
- NACE cracking test
- Hempel welding test





WHERE CAN YOU USE AVANTGUARD®

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AvantGuard® product range

Product	VS %	VOC	Zinc content	Test certificates
HEMPADUR AvantGuard® 770	66	328 G/L	Comply with their ISO 12944 Part 5, 2007, and Level 2, type II in SSPC Paint 20, 2002. Utilizes ASTM D520, type II zinc dust.	NORSOK M-501 Ed. 6 (ISO 20340)
HEMPADUR AvantGuard® 750	65	316 G/L	Comply with the requirements in ISO 12944 Part 5, 2007, and Level 2, type II in SSPC Paint 20, 2002. Utilizes ASTM D520, type II zinc dust.	ISO 12944 C5M/I, 2007
HEMPADUR AvantGuard® 550	65	319G/L	Comply with the requirements for Level 3, type II in SSPC Paint 20, 2002. Utilizes ASTM D520, type II zinc dust.	ISO 12944 C5M/I, 2007



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No difference in areas of application

- Activated zinc primers can be used in the same applications as any zinc epoxy without this technology- there is no difference in areas of application
- Application equipment is the same as with zinc epoxies without this technology - no special equipment needed



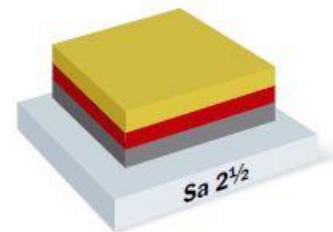


Activated zinc primers are versatile and conform well with numerous different paint systems

- Typical paint system:
 - 1st coat: Activated zinc epoxy: 40 – 100 mic (1,6 – 4 mils)
 - 2nd coat: Epoxy midcoat 100 – 200 mic (4 – 8 mils)
 - 3rd coat: Polyurethane topcoat 50 – 80 mic (2 - 3,2 mils)

Other typical system combinations could be:

- Different combinations of Activated zinc primer and a PU topcoat in a two-coat system





WHY AVANTGUARD®

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Nature wants it back



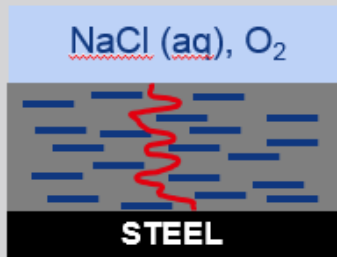


Nature wants it back



Three ways to provide anti-corrosion protection using coatings

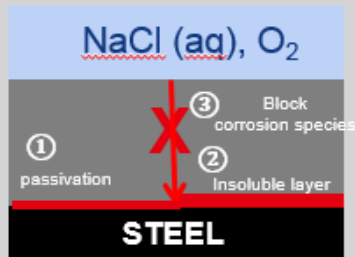
Barrier effect



Physical barrier that reduces (or blocks) the diffusion of species that can cause corrosion

- High DFT
- Low water permeability
 - ❖ Highly cross-linked binder matrix
 - ❖ Optimal packing (often laminar fillers are used)

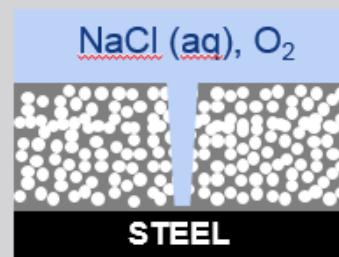
Inhibition effect



Chemical reaction that minimises or prevents corrosion

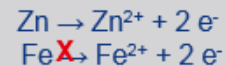
- Ensuring a stable pH in the steel interface (pH between 7-12) (steel passivation)
- Formation of an insoluble layer at the interface with steel
- Blocking movement of corrosive species (addition of environmental scavengers)

Galvanic effect



Altering the electro-chemical reaction forcing the oxidation of a different substance

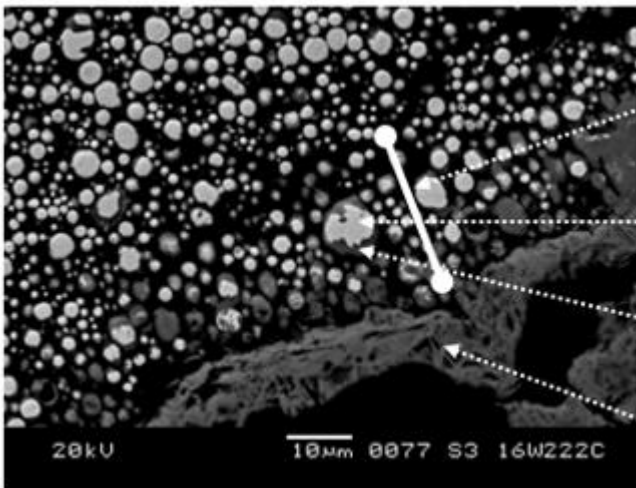
- Addition of a substance more active than steel (typically Zn), that acts as anode, blocking the oxidation of iron





Not full utilisation of zinc content

Only the zinc in the closest 20-30 microns is active to provide a galvanic protection



Claus Weinell, NACE 2007

About 20-30 µm of Zinc primer is consumed

Zinc

$ZnCl_2$, $ZnOHCl$

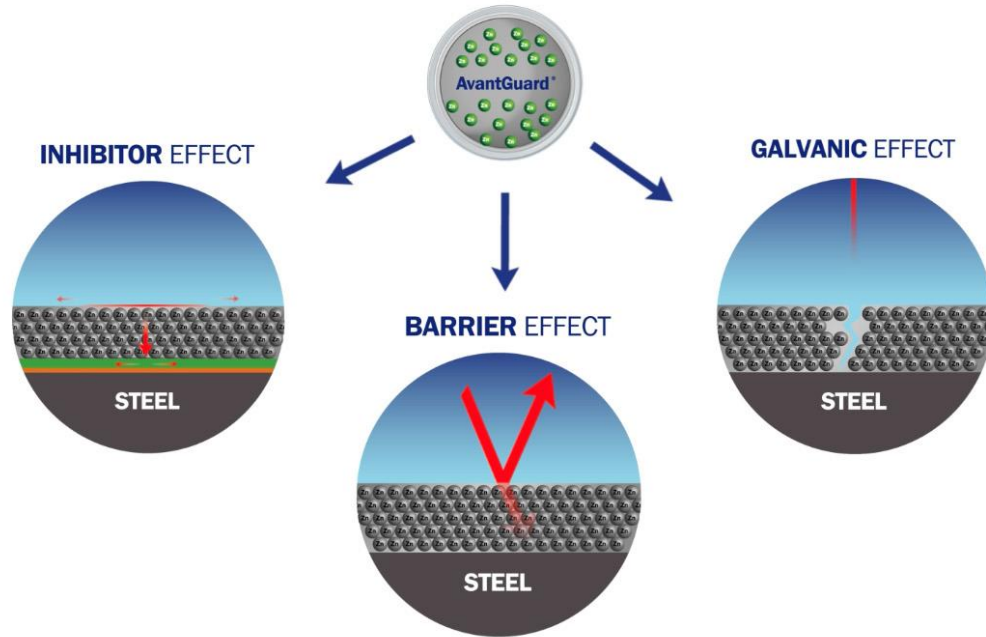
Zn and Fe containing corrosion products

Galvanic effect of normal zinc epoxies is limited.

In most zinc epoxy coatings with a zinc content < 85% only a small amount of the added zinc will provide a Galvanic protection.



AvantGuard® is activated zinc and provides three types of protection

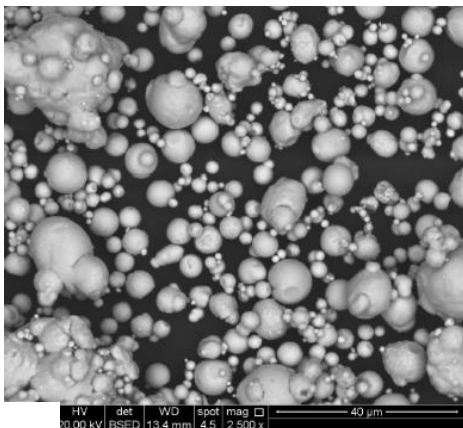


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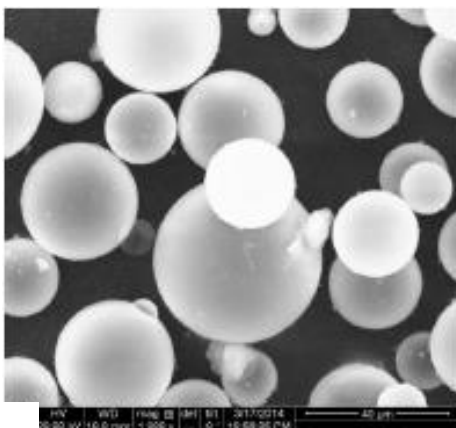
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AvantGuard® ingredients



Zinc



Hollow Glass Spheres



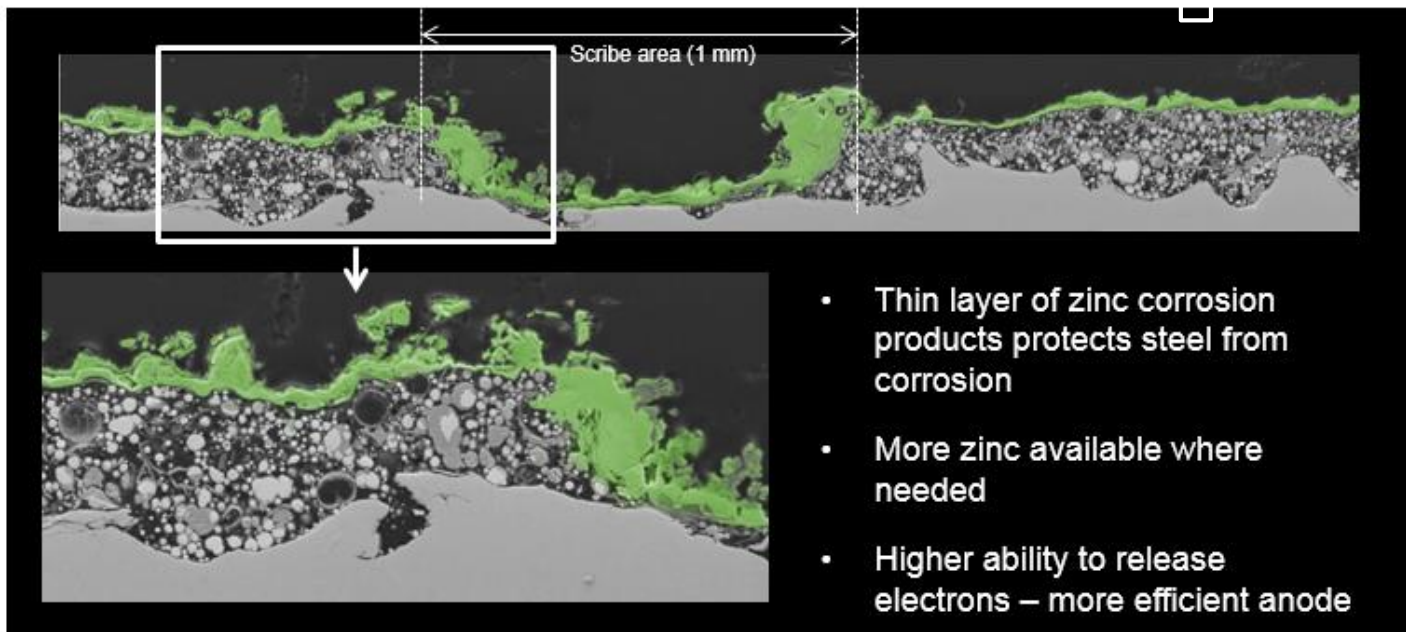
Activator

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Redefining protection: Improved galvanic effect



Insoluble zinc salts have been coloured green

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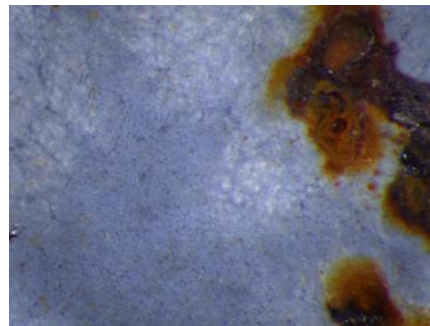
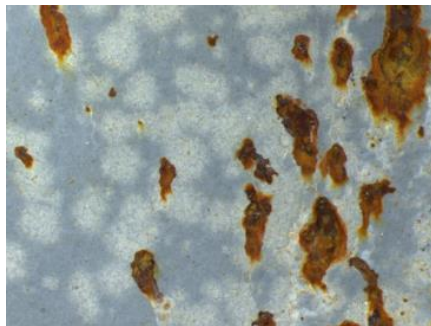
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Redefining protection: Improved barrier properties



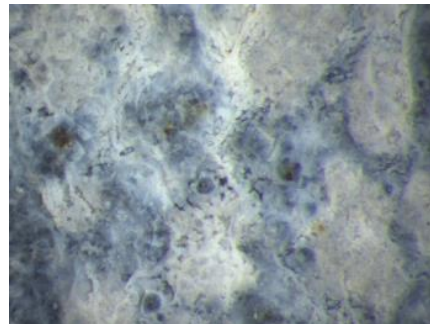
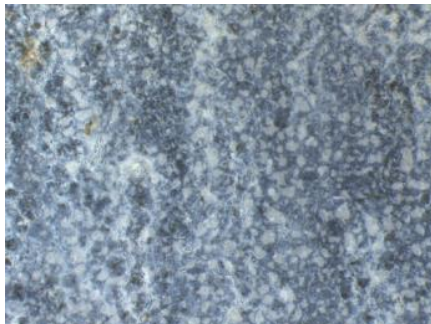
Zinc epoxy without AvantGuard® Technology



Activated zinc
on the surface
creates a barrier
and reduces the
permeability of
water



AvantGuard® Technology

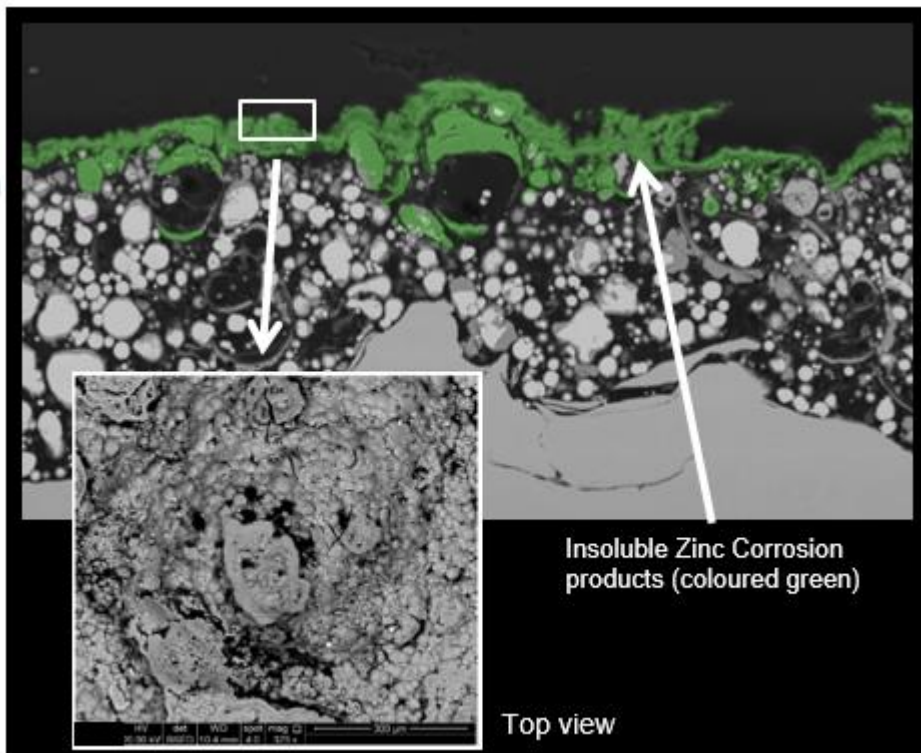


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Redefining protection: Improved barrier properties



Insoluble compounds

- Accumulate on the surface of the panel acting as a **barrier** to water, oxygen and ions
- Accumulate around the spheres reducing the porosity of the film and improving the **barrier effect**

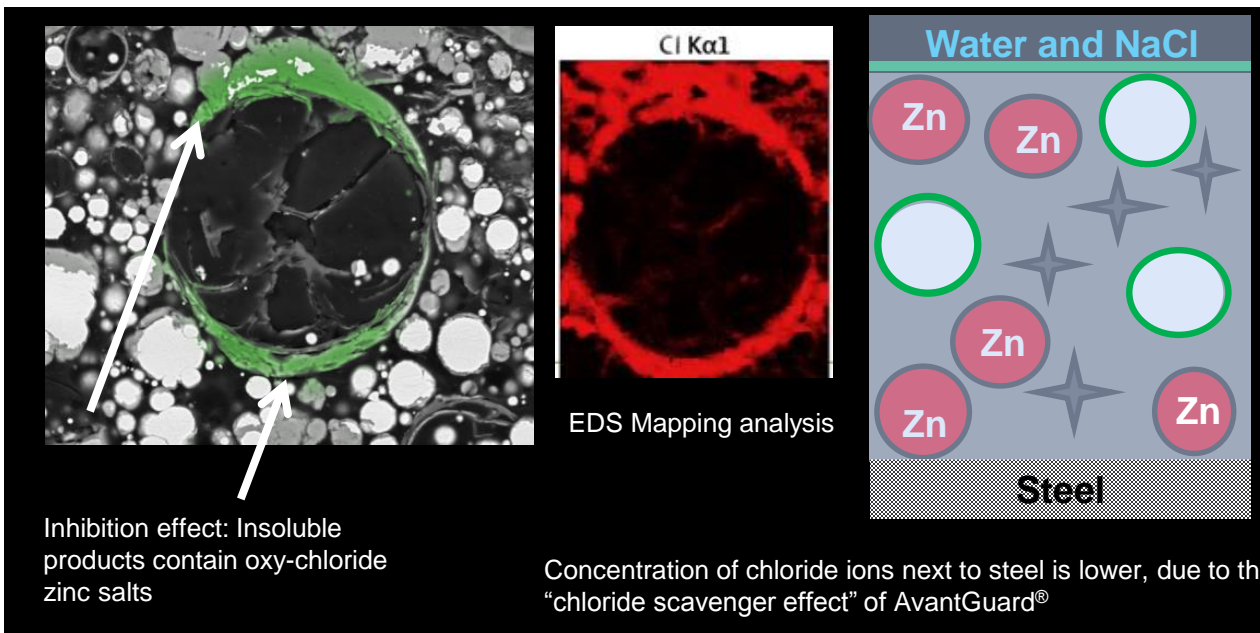
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Redefining protection: Enhanced inhibition effect

Chloride ions are captured by the film, **inhibition effect** enhanced by the hollow glass spheres



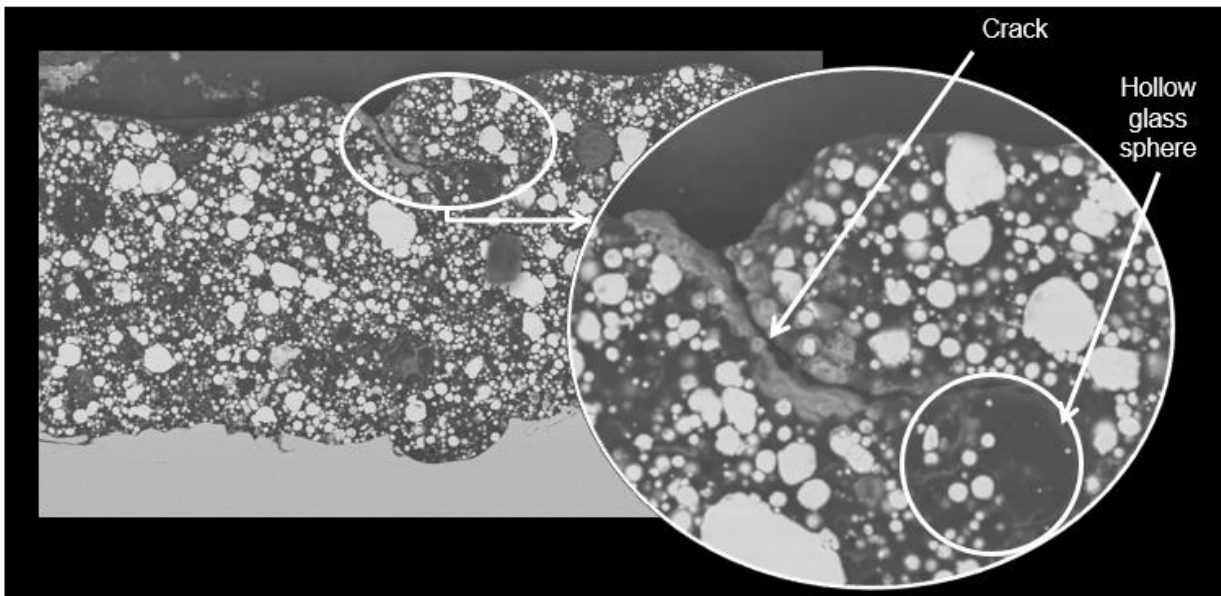
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Redefining durability: Improved mechanical properties

Hollow glass spheres stop the development of cracks and reduce internal stress



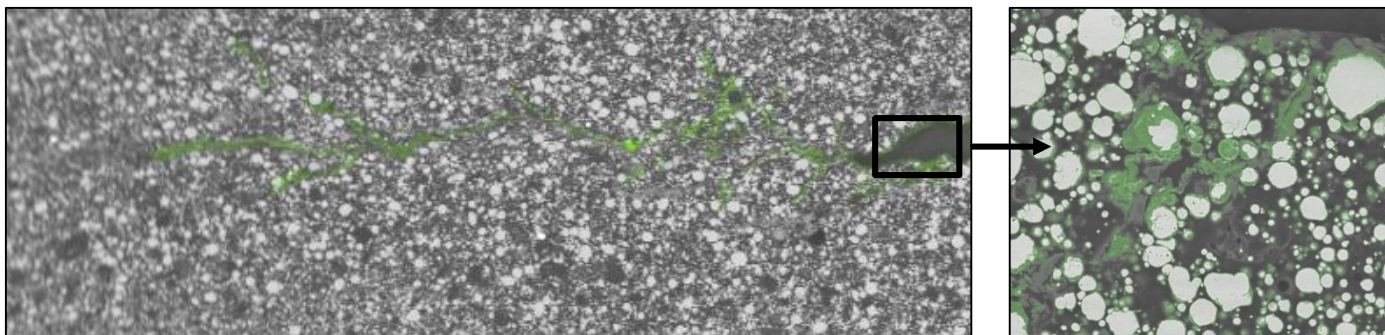
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Redefining durability: Self-healing effect towards the cracks

Zinc corrosion sub-products fill the empty space of the micro-cracks and delay their expansion into big cracks, thus **self-heal**



Micro-crack covered by zinc corrosion sub-products