

Sustainable zinc flake solutions for reduced CO₂ footprint

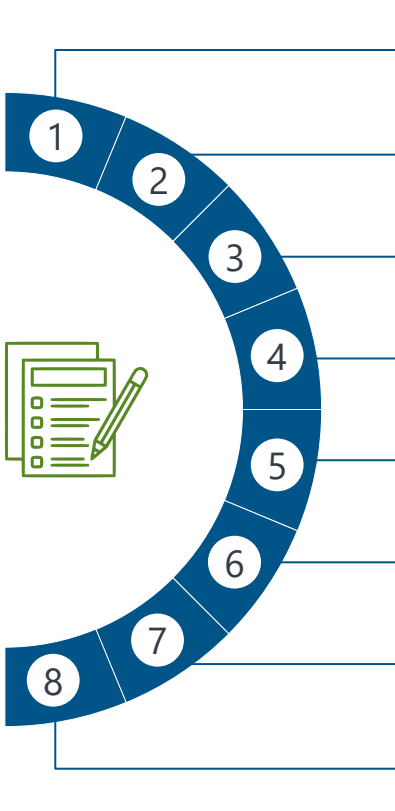
Pasquale Cozzolino | Tiers Manager Europe









Atotech GMF Seminar Poland 2023

September 19 – 21, 2023
Janów Podlaski Castle, Poland

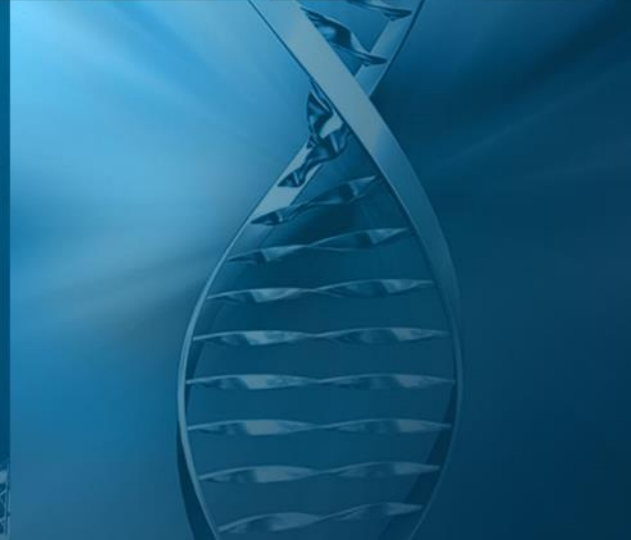


Agenda



1	 Sustainability and saving resources
2	 What's behind PFOA, PFOS and PFAS
3	 General introduction zinc flake coatings
4	 Water-free and water-containing zinc flake systems
5	 Energy demand of common zinc flake systems
6	 Innovative ONE and two coat zinc flake systems
7	 Solutions for top coats
8	 Summary

Sustainability
and reducing
our
environmental
impact



Sustainable development



Everyday talking and reading of **sustainable development**, but what does mean?

It was defined in the World Commission on Environment and Development's 1987 Brundtland as...



"The development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

It seeks to reconcile economic development with the protection of social and environmental balance..."



Source: <https://eur-lex.europa.eu/>

Saving resources

Sustainable development

The 17 goals (SDGs)



United Nations

Department of Economic and Social Affairs
Sustainable Development

Goals

12
Ensure sustainable consumption and production patterns

Source: <https://sdgs.un.org/goals/goal12>



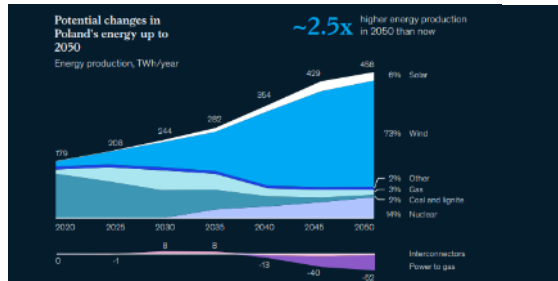
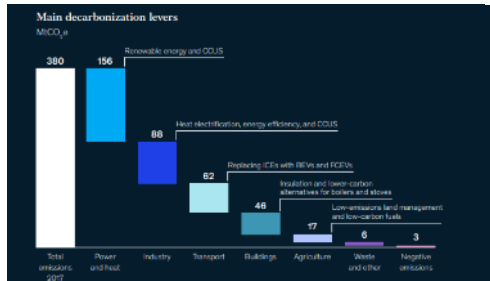
Resource conservation involves an absolute saving of resources and here in particular of primary raw materials. Careful use of natural resources increases resource efficiency and reduces the impact on the environment. In addition to economic approaches for measuring resource flows, ifeu is also investigating concrete measures at the production and consumption level.



Source: ifeu - Institut für Energie- und Umweltforschung Heidelberg gGmbH:

Carbon-neutral Poland 2050

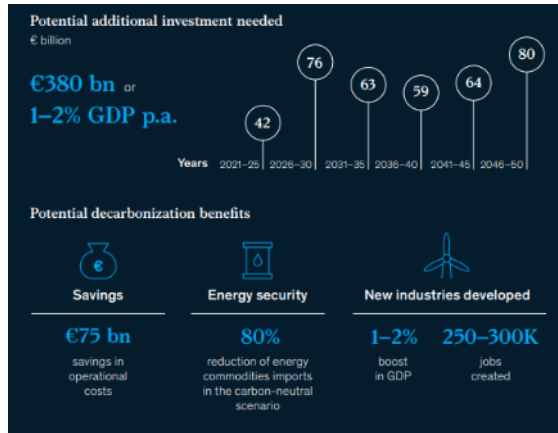
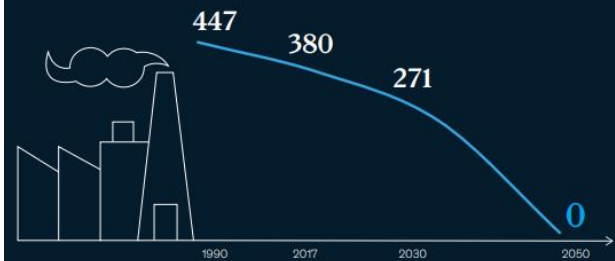
Turning a challenge into an opportunity



Key findings

Poland's emissions levels and potential targets

MtCO₂e



Source: <https://www.mckinsey.com/~media/mckinsey/industries/electric%20power%20and%20natural%20gas/our%20insights/carbon%20neutral%20poland%202050%20turning%20a%20challenge%20into%20an%20opportunity/carbon-neutral-poland-2050.pdf>

Sustainability is becoming mainstream in our business



Our industry is already **one of the most regulated** with focus on hazardous chemistry



There is expected to be **increased scrutiny on the social and environmental impact** of the industry given the dependence on heavily mined metals



The **assessment and reclassification** of many compounds as harmful or toxic **continues to grow**

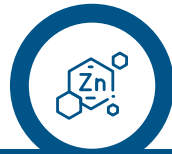


OEMs have stepped up their focus on driving the sustainability agenda particularly on carbon emissions with their **NET ZERO** emission targets



Waste management (hazardous and non/hazardous) and **water pollution** and scarcity are increasingly important

Environmental protection in surface treatment technology



Approaches for sustainable and resource saving high-performance corrosion protection with **ZINC FLAKE COATINGS**



Reduced emissions



Efficient raw material utilization and recycling



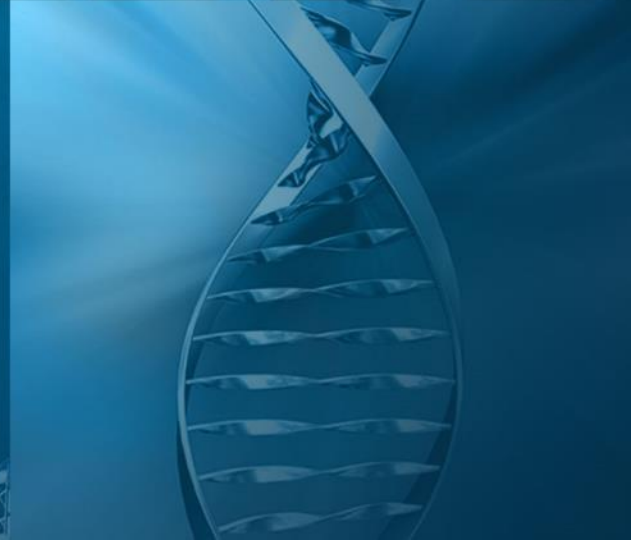
Waste reduction



Energy savings



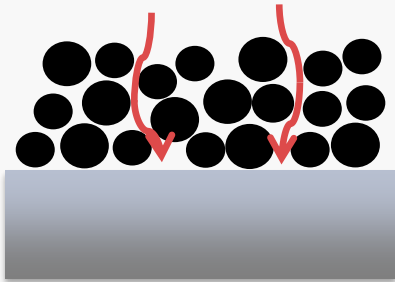
General
introduction
zinc flake
coatings



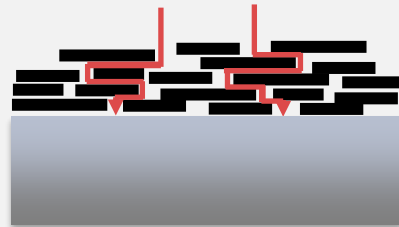
Comparison zinc dust and zinc flake coatings



Zinc dust coating



Zinc flake coating



- Zinc flake layer thickness is significantly lower
- Zinc flake coatings provide a very high barrier protection
- The increased number of contact points between the zinc particles for zinc flakes increases the cathodic corrosion protection



» High-performance corrosion protection

» Longer service life of workpieces

» Active contribution to environmental protection, resource conservation and sustainability

Zinc flake coatings



Zinc flake systems usually consist of at least two layers, rather three and more (related to dip-spin application)



Mostly they consist of twice applied zinc flake containing base layer for cathodic corrosion protection



A top coat increases corrosion protection by means of barrier protection, chemical resistance and also often contains integrated lubricants for defined friction properties, often PFAS containing PTFE

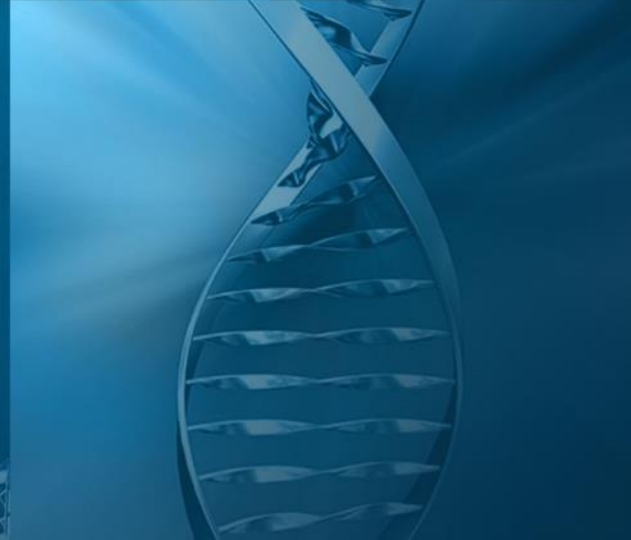


The zinc flake systems are available in various colors, with silver/grey predominating, followed by black, but layers of other colors are also available



There are differences in composition. A distinction is made between water-free and water-containing zinc flake systems

What's behind PFOA, PFOS and PFAS



PFAS – In your daily life



Many products in your daily life are currently containing PFAS, especially PTFE



Nonstick cookware



Packaging material,
e.g. Kerrygold,
recall USA, 2023

Source:
<https://www.greenmatters.com/food/kerrygold-butter-recall>



Dental floss



Membranes of
functional jackets,
shoes, etc.



Sealing tapes

PFAS – Current status



PFAS: umbrella term for per- and polyfluorinated alkyl compounds

Examples: PTFE (Teflon®), PVDF, PFOS, PFOA, fluorosurfactants, etc.



Why are these used in surface coatings?

E.g. to achieve specific lubricating properties



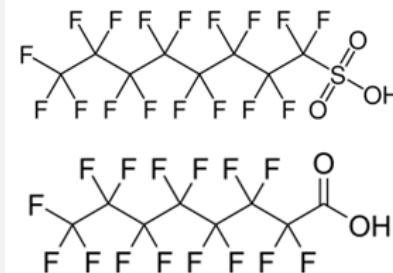
Why are PFAS substances problematic?

Due to their outstanding stability, PFAS are considered “forever chemicals”, i.e. they accumulate in nature, are not biodegradable, and can release highly toxic compounds in fires, for example



What is the legal situation?

- The EU is working on a PFAS restriction with likely very few exceptions; the European Chemicals Agency, ECHA, published a proposal as of Feb. 7. Planned entry into force: 2025; expected latest full implementation: 2027
- PTFE, which is frequently used in the surface coating industry, is not proposed for an exemption in the first proposal



PFAS – Current status



What does this mean for chemical suppliers and thus also for coaters and parts suppliers?

In zinc flake coatings, regardless of the chemical supplier, PTFE is often used and also partly required by coating standards



How about the Atotech CP product line?

- CRC products, i.e. products for galv. Zn, ZnFe, ZnNi, as well as related pre- and post-treatments do not contain PFAS, incl. sealers
- Zinc flake products:
 - Anorg. base coats may contain PFAS, depending on the product
 - Org. top coats, e.g. Techseal[®], may contain PFAS, depending on the product
 - Anorg. top coats: all Zintek[®] Top products do not contain PFAS



We have been supplying well lubricating top coats that meet automotive standards for a long time. And that without containing PFAS!





We are working on sustainable equivalents for the products currently still containing PFAS:

Products for galv. Zn, ZnFe, ZnNi, as well as related pre- and post-treatments do already not contain PFAS, incl. sealers

Organic top coats are challenging; further development work necessary

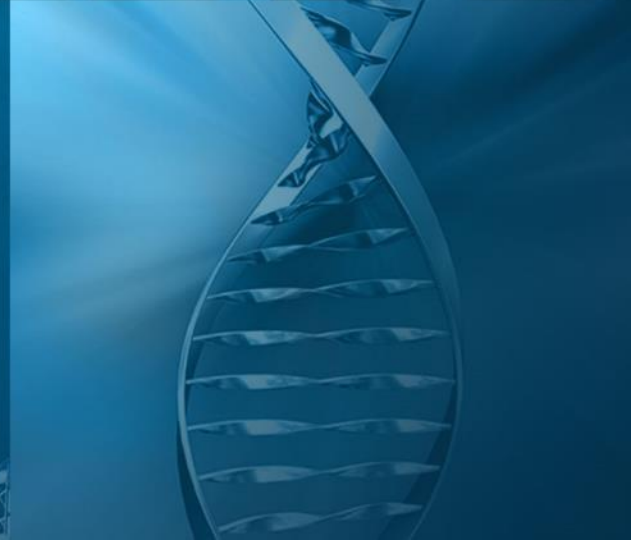
Alternative standard base coats available as early as 2023



We have the expertise in PFAS-free coating solutions for many years and will work with you to create a sustainable future



Water-free and
water-
containing zinc
flake systems



Comparison zinc flake systems



Typically people differentiate in

Solvent-based zinc flake coatings
(Atotech)

WATER-FREE system

Water based/born zinc flake coatings

WATER-CONTAINING system



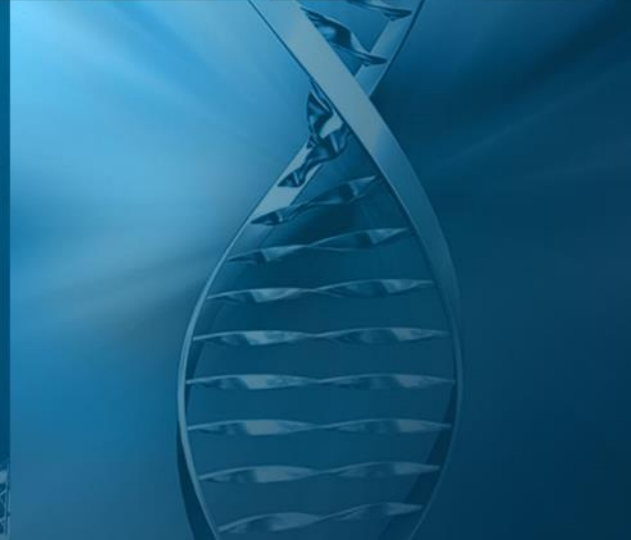
Both systems provide excellent corrosion protection



All available zinc flake coatings contain **solvents (VOC*)**
Water-free systems such as **Zintek®** need lower curing temperature = **lower energy costs**

*volatile organic compound

Energy demand of common zinc flake systems



Significant factor energy

Energy costs



The factor of energy costs is becoming more and more important for the coating industry with rising energy prices



If you look at the price development for natural gas (NCG) from June 2021 to June 2022, it has increased from around €14/MWh to almost €23/MWh



The lower the required baking temperature, the less energy is consumed, making the zinc flake system more economical and environmentally friendly in the overall balance



Source: Internet; [Energiamarkt-Kommentar: Kurse nach Einbruch wieder im Aufwind – ISPEX](#)

How about energy consumption?



Calculation base:

- Coating line with 5,000 kg output per hour
- 16 hours per day and 220 working days/a
- Bolts size M8x35
- 2x silver zinc flake base coat



Curing temperatures:

- | | |
|------------------------|---------------|
| • Solvent-based: | 230 °C |
| • Water-based: | 320 °C |
| • Water-based low VOC: | 320 °C |



We choose 15 min PMT curing time for the following examples to have a better comparison between the results

How about energy consumption?



Demand of energy solvent-based zinc flake paint

- Two times coating (2x base coat)
- Including thermic air treatment

ca. Σ 1,400 kW*



Demand of energy water-based zinc flake paint

- Two times coating (2x base coat)
- Including thermic air treatment

ca. Σ 1,570 kW*



Demand of energy water-based low VOC zinc flake paint

- Two times coating (2x base coat)
- **Without** thermic air treatment

ca. Σ 1,500 kW*



Energy demand and costs are significantly higher for water-based zinc flake paints

*calculation base

Innovative ONE
and two coats
zinc flake
systems



Possibilities for a sustainable use of zinc flake coatings



Optimized corrosion requirements

- Adjusted requirements for the respective place of use
- Corrosion requirements for the interior and exterior areas are different



Layer thickness reduction

- Currently from ca. 8 – 12 μm to ca. 6 – 10 μm



Reduction of curing temperatures

- Innovative modern top coats require lower curing temperatures
- 2-K systems are available for spray applications



Reduction of the layers

- Currently 3 layers and more are common (depending on requirements and color)
- Reduction to 1 – 2 layers possible



Reduced emissions
Efficient raw material utilization
Waste reduction
Energy saving

Zintek® ONE HP

ONE layer zinc flake base coat



Inorganic base coat



Excellent, cathodic corrosion protection



Reliable corrosion protection up to 720 hours in NSST ISO 9227 with only one coat (6 – 8 μm)



Very good adhesion and wear resistance



Attractive alternative to both multilayer zinc flake coatings and plated systems



No hydrogen embrittlement



Free of hazardous heavy metals such as Cr(VI), cadmium, cobalt, lead or nickel

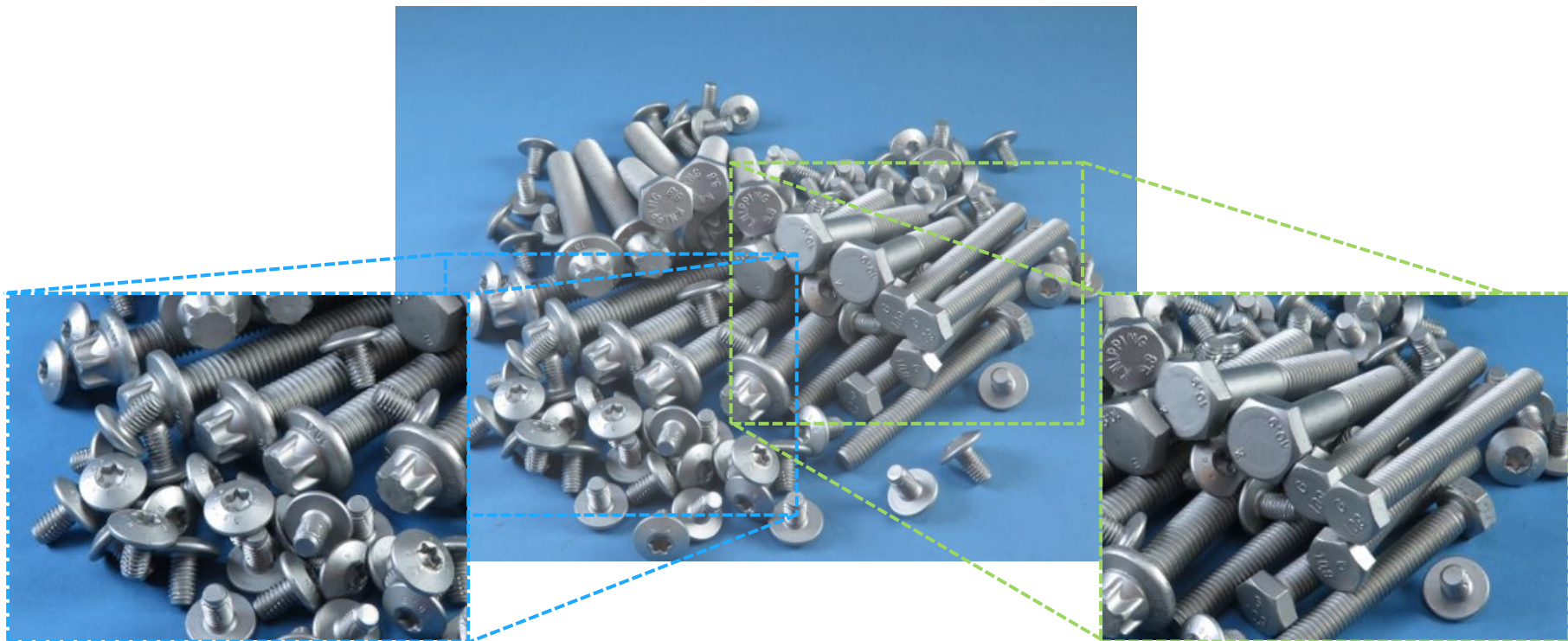


Compatible with commonly used topcoats



Zintek® ONE HP

Appearance



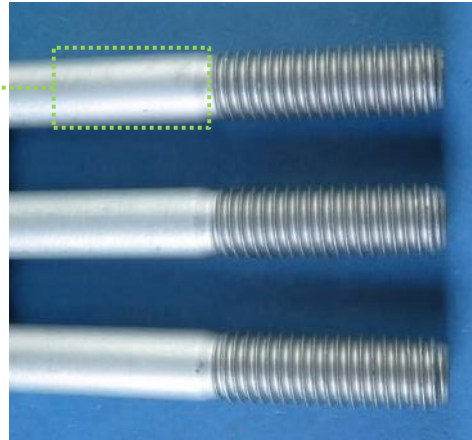
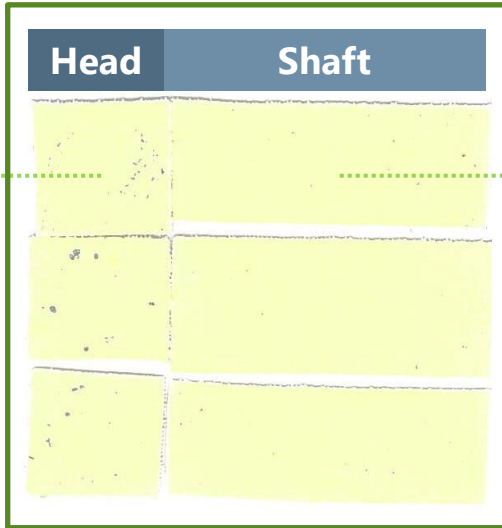
Zintek® ONE HP

Adhesion – Tape test



Tape standard: Tesa® 4651

- Adhesion force to steel: 3.3 N/cm





Shot-blasted parts after mechanical impact treatment

Before impact test



After impact test



Excellent adhesion and wear resistance

☆☆☆☆☆



1x Zintek® ONE HP

0 h



480 h

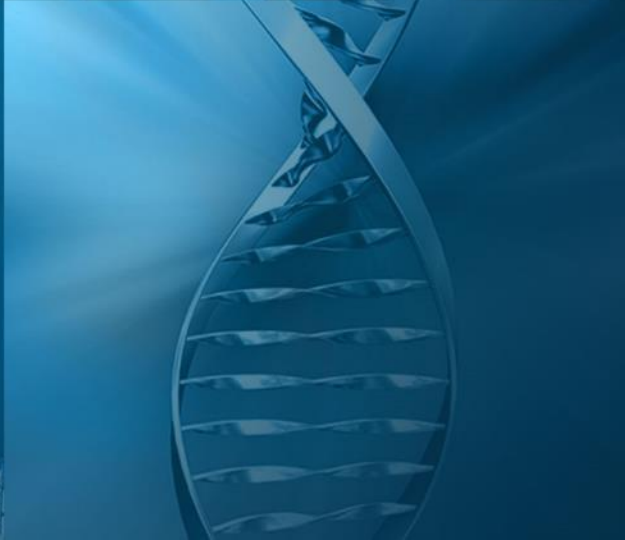


720 h



ONE layer Zintek® ONE HP with a layer thickness of ca. 7 μm
up to **720 h** without base material corrosion in **NSST** acc. ISO 9227

Zintek® Top XT
– Water-based
top coat



Zintek® Top XT

Water-based high-performance top coat



Water-based transparent inorganic topcoat



Low drying temperature



Integrated lubrication for defined friction values



Easy to apply



Can be used in combination with zinc flake coatings and also on electroplated zinc and zinc alloy coatings



Despite its low coating thickness of $< 2 \mu\text{m}$, the corrosion protection in salt spray tests and cyclic corrosion protection tests increases significantly



Zintek[®] Top XT

Water-based high-performance top coat



1x Zintek[®] ONE HP + 1x Zintek[®] Top XT

0 h



480 h



1,000 h



> 1,500 h



> 1,500 h without base material corrosion with 1+1 layer set-up
NSST acc. ISO 9227



Zintek® Top XT

Water-based high-performance top coat



1x Zintek® ONE HP + 1x Zintek® Top XT

Start



5 cycles



10 cycles

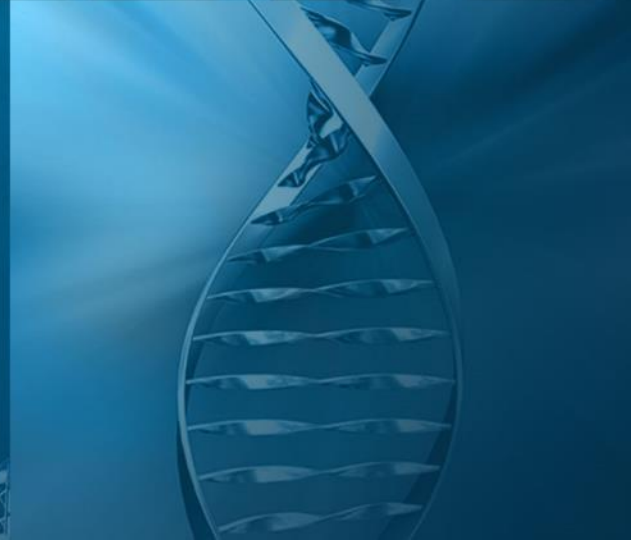


15 cycles



Up to 15 cycles without base material corrosion with **1+1** layer set-up
CCT results acc. VW PV 1209

Solutions for top coats





XLink: Newly developed additives for spray application of organic top coats and zinc flake coatings

- Reduction of the baking or drying temperature
- Reduction of energy consumption
- Reduction of CO₂ consumption
- Reduction of coating costs



Function

- Chemical curing of the corresponding product, triggering a reaction between the polymer chains
- Accelerated curing process, lowers the curing temperature, e.g. from 210 °C to 150 °C
- Accelerated curing process for special applications or properties, here for some high-temperature resistant binder types



XLink 800 with Techdip® Black SL HC

Test results



On bare steel
(no plating, no base coat)



Techdip® Black SL HC with
XLink 800



~40 µm, dried at 80 °C



NSST ISO 9227

After 480 h

No corrosion

No optical change

NSST after 480 h
no corrosion

On bare
steel !!!



XLink 800 with Techdip® Black SL HC

Test results



Zintek® 200 XT + Techdip® Black SL HC with XLink 800

- Top coat dried for 30 min at 80 °C



NSST ISO 9227

After 720 h

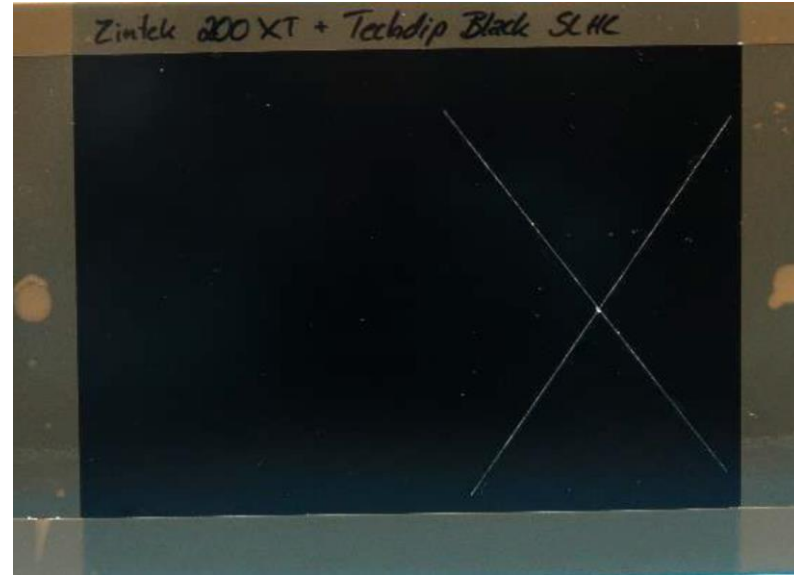
No red rust (even in the scratch)

No white corrosion

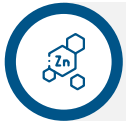
**NSST
after
720 h
no
corrosion**

**Nearly
no
optical
change!!!**

**No red
rust
in the
scratch**



Zintek[®] 400



Zintek[®] 400 is an organic base coat containing zinc and aluminum flakes



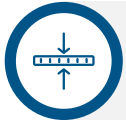
The coating consists of special binder system that is optimized for spray application



When used as a 2K-system in combination with XLink 800 (cross-linker) drying at low temperatures is possible



Ductile coating



Optimum coating thickness $\geq 25 \mu\text{m}$



Very good corrosion protection



XLink 800 with Zintek[®] 400

Test results



Zintek[®] 400 with XLink 800 (44 μm) drying for 30 min at 80 °C



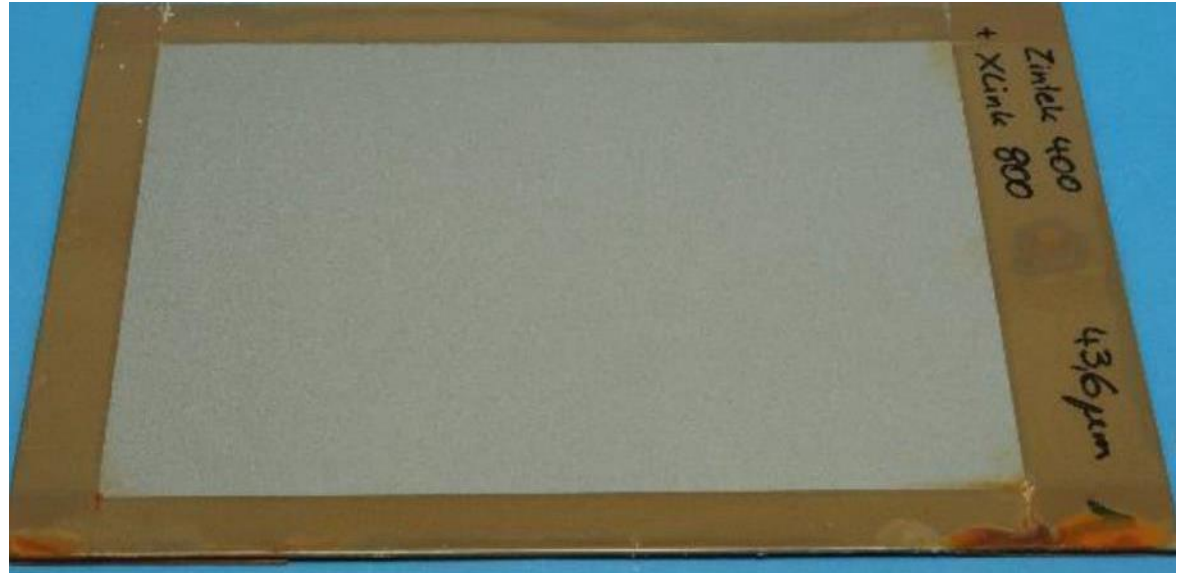
NSST ISO 9227

After 1,008 h

No red rust (even in the scratch)

No white corrosion

**NSST after 1,008 h
no corrosion**



XLink 800 with Zintek[®] 400

Test results



Zintek[®] 400 with XLink 800 (44 μ m) drying for 30 min at 80 °C



NSST ISO 9227

After 2,736 h

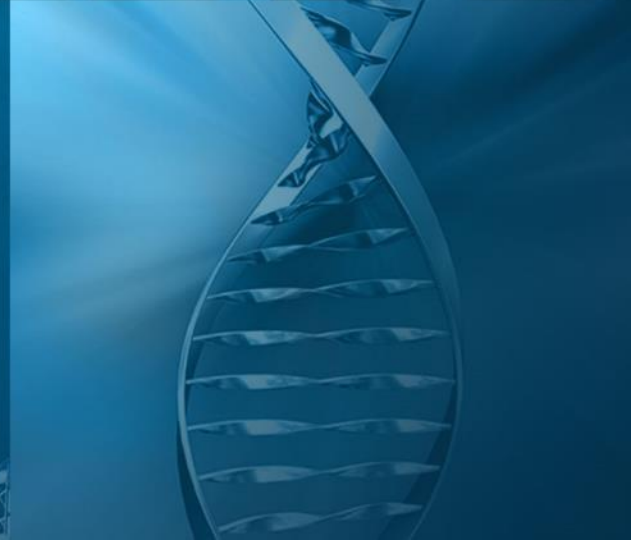
No white corrosion

No red rust

**NSST after 2,736 h
no corrosion**



Summary



Summary

Zinc flakes as a established and consistent solution for corrosion resistance...



But is it sustainable as well?

Chemistry w/o restrictions from chemical legislation

Efficient raw material utilization

Energy saving/ low curing temperature



PFAS-free and hazard heavy metals-free systems

One coat systems or with reduced layers

Zintek® Top family and XLink technology



Zinc flake coatings

Solutions for advanced and sustainable corrosion protection

Thank you!

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