From Advanced to Game-Changing Pretreatment Technologies for the Automotive Industry

Dr. Andreas Treitl
Agenda

- Customers requirements
- New and traditional conversion coatings
  - Zinc-phosphate „Gardo®Flex“
  - Thin-film „Oxsilan®“
  - New substrates
- 2 in 1 – „Universal Dip Coat“
- Conclusions
Customer requirements

**Lightweight construction**
- No limitation in aluminium throughput
- New zinc alloys
- Increased magnesium throughput
- Sandwich material
- Reduce hazardous materials
- New SHE Regulations
- Less waste water
- SHE + Environment
- Less sludge
- Borate-free systems
- REACH
- No Nickel

**Quality**
- Variable substrate mix
- Pretreated surfaces
- Reduce etching rate on AL
- High strength steel
- New customer specs
- Paint adhesion
- Corrosion protection
- Higher quality standards
- Less / no sanding operations
- Robust process
- Less energy consumption
- Less maintenance
- Reduce tank temperature
- Primerless process
- Less water consumption

**Costs**
- Reduce process costs
- New installation, less tanks
- Easy to handle process
- Less process steps
- Less energy consumption
Evolution in multi-metal pretreatment
Overview

- Traditional Zinc-Phosphate
- Gordo®Flex Zinc-phosphate
- Oxsilan® Thin-film
- Universal Dip Coat
Evolution in multi-metal pretreatment
Microscopic view on the surface

Traditional Zinc-Phosphate

- Further layer
  - E-Coat
- Substrate
  - Thickness 1 – 2 µm

Gardo®Flex

- Further Layer
  - E-Coat
- Substrate
  - Thickness 0.8 – 1.5 µm

Oxsilan®

- Further Layer
  - E-Coat
- Substrate
  - Thickness 0.1 – 0.25 µm

Universal Dip Coat

- Further Layer
- Substrate
  - Thickness 10 – 15 µm
Process overview (schematical)

**Zinc-phosphate + E-Coat**
- Cleaner
- Rinse
- Activation
- Zinc-phosphate
- Rinse
- Passivation (optional)
- E-Coat
- Rinse

**Thin-film „Oxsilan®“ + E-Coat**
- Cleaner
- Rinse
- Thin film
- Rinse
- E-Coat
- Rinse

**2 in 1- UDC**
- Cleaner
- Rinse
- UDC
- Rinse
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**Gardo®Flex**

The flexible modular concept

- **Clean**
  - demulsifying cleaner
  - emulsifying cleaner
  - controlled etching
  - borate-free

- **Rinse**

- **Activate**
  - powder or liquid product
  - titanium- or zincphosphate based
  - extended shelf life of tanks
  - low weight

- **Zinc-phosphate**
  - high aluminium throughput
  - low temperature
  - reduced treatment time
  - less sludge

- **Rinse**

- **Passivate (optional)**
  - Zr-based standard
  - fluoride-free
  - silane based
  - no passivation
**Gardo®Flex**
High throughput of aluminum

+ **Fine crystalline and thin phosphate layer on Aluminum**
  - Covers substrate and body-in-white defects
  - Smooth and homogeneous surface conditions for best E-Coat performance

+ **Controlled etching rate**
  - Reduced formation of sludge
  - Less consumption of fluoride additives

+ **Reduced level of free Fluoride**
  - Traditional Zn-Ph $\rightarrow$ 170 – 210 mg/l
  - Gardo®Flex $\rightarrow$ 60 – 120 mg/l

+ **Reduced coating weight**
  - Reduced consumption of Zn-Ph replenisher products
### Field experiences

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* with Aluminum; temperature to be further decreased

Cost savings i.e. GM Ellesmere Port: 160,000 £ / year
Gardo®Flex
Reduced phosphating time

Field experience on difficult to treat CRS substrate

Traditional Zinc Phosphate

Gardo®Flex

Improvement in minimum phosphating time and crystal structure
Gardo®Flex
Summary of benefits

+ No line modification required ➔ Less invest
+ Extended bath life ➔ Less waste water
+ Reduced minimum phosphating time ➔ Higher process robustness
+ Low temperature process ➔ Energy savings
+ Aluminium: less sludge ➔ Less maintenance and disposal
+ No limitation in aluminium throughput ➔ More flexibility
+ No poisoning of the phosphate tank ➔ No flash rust on CRS
+ Phosphate layer on all substrates ➔ Covers body-in-white and substrate defects

+ References:
Evolution in multi-metal pretreatment
Overview

- Traditional Zinc-Phosphate
- Gardo®Flex Zinc-phosphate
- Oxsilan® Thin-film
- Universal Dip Coat
Oxsilan®
Evolution Steps

OS 9830
• New silane system for multi-metal
• Good performance on EG, HDG and Al
• Small operation window for CRS

Improved throwing power

OS 9831
• Introduction of accelerator
• Multi-metal standard for Automotive OEM
• Better on aluminum than zinc-phosphate

Improved E-Coat distribution
Reduced flange corrosion

OS 9832
• More robust silane system and process parameters
• Keep good performance on EG, HDG and Al

Improved corrosion resistance on CRS

Corrosion Test Results of fully painted panels

Outdoor exposure 1 year

Filiform Test 1008 hrs
Oxsilan®
Corrosion test results

1008 h Filiform

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Driving test (static)

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PVW 1210

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Evolution in multi-metal pretreatment
New substrates

- High strength steel
- ZnMg coated steel
- Magnesium
High Strength Steel
ZnPh → Gardo®Flex → Oxsilan®

Benefits of Gardo®Flex

♣ Similar results in VDA cycle test (10 cycles) than traditional ZnPh
♣ In adhesion test, best results with Gardo®Flex at low temperature (35°C).

Benefits of Oxsilan®

♣ Better results in VDA cycle test and adhesion tests than ZnPh
♣ Robust system, low influence of other process parameters like cleaner conditions etc.
VDA cycle test results (10 cycles) on high strength steel

- Trad ZnPh 53°C
- Trad ZnPh 35°C
- Gardoflex 53°C
- Gardoflex 35°C
- Oxsilan 9831
- Oxsilan 9832

HSS Type 1
HSS Type 2
High Strength Steel

ZnPh ➔ Gardo®Flex ➔ Oxsilan®

Adhesion test results on high strength steel
(cross hatch after 240 h CH)

![Bar chart showing adhesion test results on high strength steel](chart.png)
Zinc-Magnesium coated steel
Traditional Zinc phosphate

- ZnMg panels from different suppliers with and without prior coil pretreatment show good phosphating results
- No negative impact of high Mg concentrations in the phosphate tank (up to 200 mg/l)
- VDA 10 cycl. <1mm
Traditional Zinc phosphate and Oxsilan® 9832 show comparable corrosion and paint adhesion results on Zinc-Magnesium coated steel.
Magnesium Treatment
State-of-the-art Technologies from Chemetall

- Alkaline cleaners → GC S 5165, GC S 5569
- Deoxidizer, chemical trimming → GC S5 491
- Oxsilan Technology → OS MG-0611, OS 9802
- Conversion coatings → GB X 4707, GB X 4729
- Anodizing → GB X 4658

Function
- Electrical conductive layers
- Chemical trimming of rolled and extruded semi-finished products
- Flammability protection
- Coating of multi-metals structures (Al and Mg)
- Selective conductive coatings in combination with anodizing & MAO/PEO
- High performance coating for dynamic loaded structures
- Sealing of anodizing and MAO/PEO layers
- Paint, PTFE and adhesive bonding pretreatments
- Bare corrosion protection
- Galvanic corrosion protection
Evolution in multi-metal pretreatment
Overview

Traditional Zinc-Phosphate

Gardo®Flex
Zinc-phosphate

Oxsilan®
Thin-film

Universal Dip Coat
Universal Dip Coat Project
Application Requirements

**Traditional Process**

- Drop-in replacement for Pretreatment and E-Coat
- Application without current / voltage
- Wet coating resistant against rinsing

**UDC Process**
Universal Dip Coat Project
Status of Application Conditions

- Cleaning and rinsing conditions similar to state-of-the-art
- Universal Dip Coat
  - No additional heating required
    - Bath temperature between 20 and 40 °C preferred range
  - Treatment time between 2 and 5 min preferred
- Deposited coating stable against water
  - Removal of excess solution by thorough rinsing feasible
- Standard curing conditions
  - ~ 200 °C
  - ~ 20 min
Universal Dip Coat Project
Chemistry Requirements

- Water-borne formulation
- Environmentally compatible
  - no heavy metal
  - low VOC
- Suitable to deposit coatings on surfaces of Iron, Zinc and Aluminum and others
- Suitable also for multi-metal constructions

Cured film (SEM)
EG substrate, 20 µm

Homogeneous coating on microdoor (EG)
Universal Dip Coat Project
Status of Chemistry

**Base Components**
- Activator
- Binder
- Accelerator

**Additive and Fillers**
- Pigments
- Cross linking agent
- Additives

**Bath Solution**
- pH 4-6
- Room temperature
- Solid content 15-20 %
- VOC < 2 %
Universal Dip Coat Project
Performance

Adhesion after bending on different substrates with different pigments

E-Coat on CRS substrates after humidity test

Top-coated CRS substrates with UDC after humidity test
Universal Dip Coat Project
Performance

Zn Mg substrates (two different qualities)
after NSS – Test (1008 hrs)
Universal Dip Coat Project
Appearance

UDC

E-Coat
Conclusion
Evolution in Multimetal-Pretreatment

Traditional Zinc-phosphate

Established standard

Low temp
Aluminium

Modern Zinc-phosphate
Gardo®Flex

Thin-film
Oxsilan®

Low temp
Aluminium
Environment

2-in-1
Universal Dip Coat

Low temp
Aluminium
Environment
2 in 1
Thank you very much for your attention!