Sustainable innovation in coil coating

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Prepainted aluminium (3A Composites)
ARCHITECT: MacGabhann Architects
Prepainted Steel (Tata Steel)
SPORTS CENTRE – ODESSA - UKRAINE

ARCHITECT: Juri Serjogin
Prepainted Aluminium (Novelis)
AVILES WAREHOUSE - SPAIN

ARCHITECT: Sergio Baragano
Prepainted Steel (ArcelorMittal)
FERRARI WORLD – ABU DHABI

ARCHITECT:  Benoy
Prepainted Aluminium (Euramax)
ARCHITECT: Chetwood Architects
Prepainted Steel (Tata Steel)
ARCHITECT: Axel Letellier
Prepainted Aluminium (Alcoa architectural products)
WATERVILLA MIDDELBURG - NETHERLANDS

ARCHITECT: Herman Hertzberger
Prepainted Steel (TataSteel)
SHANGHAI EXPO CHINA PAVILION

ARCHITECT: South China University of Technology
Institute of Architectural Design
Prepainted Aluminium (Hunter Douglas)
BRIGHTON - UK

ARCHITECT: RH Partnership
Prepainted Steel (Tata Steel)
Content

I. ECCA and coil coating

II. The markets for coil coating

III. Sustainable innovation
What is Coil coating?

‘A method in which an organic coating material is applied on rolled metal strip in a continuous process. This process includes cleaning if necessary and chemical pre-treatment of the metal surface and either one side or two side, single or multiple application of (liquid) paints or coating powders which are subsequently cured or laminated with plastic films.’
Coil Coating process

The process consists of the following operations:

- **Cleaning** (alkaline degreasing)
- **Surface treatment** (role: improve adhesion between metal and paint, and corrosion resistance)
- **Primer application** (role: bind the topcoat to the substrate, and corrosion resistance)
- **First curing oven**
- **Topcoat application** (role: aesthetic and protective)
- **Second curing oven**
- **Protective film** (if any)
- **On-line inspections**
Coil Coating is the best technology available for applying paint to metal...

- Only uses thin paint films (using less paint!)
- Easier to paint a flat surface than a fabricated one
- Close control over the coating operation results in a high quality, reproducible and reliable finish
- Allows forming
Coil Coating process is environmental friendly...

- Very well and strictly controlled way to dry and cure the paint (in seconds) dramatically cut emissions of harmful VOCs
- Usage of chemicals, water and energy are minimised
- Waste generation and disposal are minimised
- CMR substances (pre-treatments and paints) are substituted
- Continuous process improvements
Prepainted metal has major advantages ...

- Longevity, corrosion protection and long-term aesthetics
- High constant quality product
- Maintenance or replacement is reduced or even eliminated
- 100 % recyclable at end-of-life
European Coil Coating Association

ECCA is the voice of the Coil Coating industry in Europe, representing 130 companies active in coil coating and the major suppliers to the industry.

ECCA is dedicated to the promotion of the use of coil and/or sheet coated metal as the environmentally sound, the cost effective and the high quality method of finishing.

- Founded in 1967
- Headquarters located in Brussels
- Association of corporate companies (≠ federation of national associations)
- 1 320 million m² and 194 kt paint (*)
- 83% Steel / 17% Aluminium(*)

(*) 2012 ECCA statistics
MISSION Objectives

- Increasing the **awareness** of prepainted metal through targeted marketing programmes
- **Promoting** the benefits of prepainted metal through the provision of innovative solutions and with particular emphasis on environmental, cost, quality and design benefits
- **Stimulating** market, application, product and process development
- Setting quality performance **standards** and developing **test methods**
- Creating an **industry network** and forum for the development and exchange of ideas
- **Representation** of the Industry in its contacts with Public Officials, Public Authorities, other Trade Associations and Professional Bodies.
**ECCA Membership**

- **38 European Coil Coaters** (Alcoa, ArcelorMittal, Hydro Aluminium, Novelis, Rautaruukki, Salzgitter, TataSteel, ThyssenKrupp, US Steel …)

- **3 European Stockists**

- **15 European Paint Suppliers** (Akzo Nobel, Beckers, BASF, PPG, Valspar…)

- **44 Other European Ordinary Members** (Arkema, Bayer, Chemetall, Henkel, Solvay…)

- **3 European Extraordinary Members**

- **27 Non-European members**

**Total:** 130

(*) Pretreatment, Resins, Pigments, Equipment

(**) Research Institutes, other associations
ECCA major activities

- Communication, Promotion, Education
- Statistics
- Standards and Tests methods development
- Environmental Benchmarking
- Legislation monitoring
- Technical projects
- Conferences (spring conference opened to customers)
- New project: Quality Label
ECCA major activities

- Communication, Promotion, Education
- Statistics
- Standards and Tests methods development
- Environmental Benchmarking
- Legislation monitoring
- Technical projects
- Conferences (spring conference opened to customers)
- New project: Quality Label
• Collection of high quality buildings made of prepainted metal
• Primarily dedicated to Architects
• Currently more than 40 buildings are detailed and illustrated by pictures and drawings
The ECCA collection - magazine

Target audience: architects and major European architecture schools
Creative Roofing
www.creativeroofing.eu

- For roofing applications
- Includes:
  - a roof simulator where the visitor can choose its roof type, colour and aspect
  - the 7 benefits to end-users in terms of environmental care, cost effectiveness, thermal insulation, performances...
  - an architect testimony
  - case studies
• Free e-learning platform

• Comprehensive information on Coil Coating process, markets (statistics), product technology,

• When completing the 9 modules the visitor is awarded with an ECCA Academy Degree
ECCA major activities

- Communication, Promotion, Education
- Statistics
- Standards and Tests methods development
- Environmental Benchmarking
- Legislation monitoring

Technical projects

- Conferences (spring conference opened to customers)
- New project: Quality Label
Colour assessment of prepainted metal

ECCA recommendations (*)

- Why is colour management important?
- Colour: basic principles
- Colour characterisation
- Colour management
- Colour difference tolerances
- Colour matching and specification

(*) available on ECCA website
To ensure tonal consistency, all material should come from the same production batch.
Colour management

Colour category definition

- Colour classification by category is obtained from the colour parameters $L^*$, $a^*$, $b^*$, $C^*$

  - **Category 1:** light colours
  - **Category 2:** medium colours
  - **Category 3:** dark colours
  - **Category 4:** sharp/saturated colours
  - **Category 5:** metallized colours

<table>
<thead>
<tr>
<th>$L^*$</th>
<th>$C^*$</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt; 80$</td>
<td>$\leq 10$</td>
<td>Category 1</td>
</tr>
<tr>
<td>$10 &lt; C^* \leq 20$</td>
<td>Category 2</td>
<td></td>
</tr>
<tr>
<td>$20 &lt; C^* \leq 30$</td>
<td>Category 3</td>
<td></td>
</tr>
<tr>
<td>$C^* &gt; 30$</td>
<td>Category 4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$60 &lt; L^* \leq 80$</th>
<th>$C^*$</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 10$</td>
<td>Category 2</td>
<td></td>
</tr>
<tr>
<td>$C^* \leq 25$ and $-11 &lt; a^* &lt; 11$ and $-5 &lt; b^* &lt; 25$</td>
<td>Category 2</td>
<td></td>
</tr>
<tr>
<td>$C^* &gt; 30$ and $-16 &lt; a^* &lt; 16$ and $-5 &lt; b^* &lt; 25$</td>
<td>Category 3</td>
<td></td>
</tr>
<tr>
<td>$C^* &gt; 30$</td>
<td>Category 4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$L^* \leq 60$</th>
<th>$C^*$</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 30$</td>
<td>Category 3</td>
<td></td>
</tr>
<tr>
<td>$C^* &gt; 30$</td>
<td>Category 4</td>
<td></td>
</tr>
</tbody>
</table>

$C^* = \sqrt{a^{*2} + b^{*2}}$

**NOTE!** Colours that do not fall into any category are classified by the paint supplier.
Colour tolerance recommendations

General tolerances to be applied using 45/0°, 0°/45 and D/8° geometries with spectro equipment

<table>
<thead>
<tr>
<th>Colour tolerance recommendations</th>
<th>Geometry used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45/0° or 0°/45</td>
</tr>
<tr>
<td></td>
<td>CIELab</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1: light colours</td>
<td>ΔE* ≤ 1,0</td>
</tr>
<tr>
<td>Category 2: medium colours</td>
<td>ΔE* ≤ 1,3</td>
</tr>
<tr>
<td>Category 3: dark colours</td>
<td>ΔE* ≤ 1,5*</td>
</tr>
<tr>
<td>Category 4: sharp/saturated colours</td>
<td>ΔE* ≤ 1,5*</td>
</tr>
<tr>
<td>Category 5: metallized colours</td>
<td>visual control required</td>
</tr>
</tbody>
</table>

*ΔE* ≤ 2,0 can be accepted for specific colours

Note! The supplier has the final responsibility of defining the colour category of his products. This applies particularly for special, demanding colours and cases where the colour is close to a limit between two categories, or where a colour shade falls out of any category.
Colour tolerance recommendations

- Metallized colours: Interaction light-material
  - \( \Delta E^* \) measurement can be disturbed by interaction between the incoming light and the surface of the metallic flake. Visual control remains important.
  - Specular reflection on metallic fillers: mirror effect, variable effect on the reading depending on the orientation of the angle
ECCA major activities

- Communication, Promotion, Education
- Statistics
- Standards and Tests methods development
- Environmental Benchmarking
- Legislation monitoring
- Technical projects
- Conferences (spring conference opened to customers)

- New project: Quality Label
WHY a quality and sustainability label?

- Increasing amount of materials on the market not fulfilling the requirements of the national and European quality and sustainability standards

- Increasing competition on price at the cost of quality and sustainability

- All actors on the market are not constrained by REACH

- No visible way to prescribe quality and sustainability

- Competitive and well-known quality marks on the market, e.g. Qualicoat
Philosophy behind ECCA Premium®
Goals and objectives

- Make “Quality & Sustainability” top criteria for product selection by decision makers along the construction chain

- Fight against low quality materials: promote sustainability and quality upgrade of products and ensure a level playing field and fair competition

- Avoid deterioration of coil coating image by promoting sustainable and high quality product & processes
ECCA Premium® proposal

Scope

A quality and sustainability label, which ensures that the processes of manufacturing are done in accordance to a well-defined standard

Application for the label by written statement

Granting the label based on independent inspections and test procedures

- Technical and sustainability criteria
- Product and manufacturer specific requirements
<table>
<thead>
<tr>
<th>Product quality</th>
<th>Manufacturing quality</th>
</tr>
</thead>
</table>
| - Product with minimum requested performance level according to EN10169 (steel) and EN1396 (AI)  
  • Substrate type (aluminium only)  
  • Metallic coating thickness (steel only)  
  • Organic coating thickness & tolerances  
  • Colour consistency and gloss tolerances  
  • Adhesion and bendability  
  • Corrosion, UV, and fire resistance | - Manufacturer adopts duly accredited quality (ISO9001), environmental (14001 or EMAS) management systems  
- Manufacturer is able to ensure regular quality control for the following:  
  • Substrate type (aluminium only)  
  • Metallic coating thickness (steel only)  
  • Organic coating thickness & tolerances  
  • Colour consistency and gloss tolerances  
  • Adhesion and bendability |

<table>
<thead>
<tr>
<th>Product sustainability</th>
<th>Manufacturing Sustainability</th>
</tr>
</thead>
</table>
| - Product does not intentionally contain any Substances of Very High Concern that are included in the Annex XIV of REACH | - Manufacturer adopts a duly accredited safety management system (OHSAS18001 or similar)  
- Manufacturer is committed to follow the European legislation and limits set for resources consumption (energy and water), VOC emissions and production of wastes |
I. ECCA and coil coating

II. The markets for coil coating

III. Sustainable innovation
European Prepainted Metal market in 2012 (ECCA statistics)

2012 Shipments (m²)

Sales of prepainted metal in Europe in 2012
Total: 1 292 mio m² (5 317 Kt): 84% steel / 16% aluminium
Paints systems in 2012

2012 Sales (193 kT)
- Primers
- Top Coats
- Backing Coats

Top Coats (113 kT)
- POLYESTER: 72%
- POLYURETHANE SYSTEMS: 12%
- PLASTISOL: 11%
- PVDF: 3%
- PVDF: 2%
- OTHERS: 12%
Substrates vs. coatings since 1992
### OC STEEL - Imports into EU-27

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>kt</td>
<td>23</td>
<td>288</td>
<td>336</td>
<td>1192</td>
<td>1101</td>
<td>677</td>
<td>898</td>
<td><strong>1231</strong></td>
<td>848</td>
<td><strong>736</strong></td>
</tr>
</tbody>
</table>

**Graph Details:**
- **Others:** Other countries not individually listed.
- **Ukraine:** Ukraine
- **USA:** United States
- **Canada:** Canada
- **Japan:** Japan
- **Egypt:** Egypt
- **Vietnam:** Vietnam
- **Switzerland:** Switzerland
- **Russia:** Russia
- **Morocco:** Morocco
- **Australia:** Australia
- **Macedonia:** Macedonia
- **Taiwan:** Taiwan
- **Turkey:** Turkey
- **India:** India
- **Korea:** Korea
- **China:** China

**Graph Description:**
- The graph shows the annual steel imports into the EU-27 from various countries over a span of years.
- The x-axis represents the years from 1995 to 2013, with annualised data for 2013.
- The y-axis represents the quantity of steel imports in thousand tonnes (kt).
- Each country is represented by a different color, indicating the trend and magnitude of their import activity over the years.
- The highlighted data points for 2011, 2012, and 2013 annualised are shown.
OCS Monthly Imports (kt)

6 months Y-o-Y
- China: -93%
- India: +328%
- Taiwan: +66%
- Korea: +13%

Chart showing the monthly imports for China, Korea, India, and Taiwan from January 2012 to June 2013.
EU-27 IMPORTS vs. EXPORTS (kT)

Y-o-Y 2012 / 2011

Imports: - 31 %
Exports: + 22 %
I. ECCA and coil coating

II. The markets for coil coating

III. Sustainable innovation
Sustainable innovation

- REACH conformity & chromate-free systems
- Functional and Textured coatings
- New outperforming substrates for outperforming prepainted steel
- Sustainable Buildings: energy through colour
REACH conformity

- REACH Conformity is mandatory in Europe
- Targets for sustainable Coatings
  - Heavy Metal free: no Chrome, Lead, Nickel
  - Free of critical CMR raw materials: no carcinogenic, mutagenic, reprotoxic substances
## REACH UPDATE

### Coatings for Prepainted Metal

<table>
<thead>
<tr>
<th>Identification as SVHC – proposal to be included in the candidate list</th>
<th>Inclusion in the candidate list (of Annex XIV)</th>
<th>Prioritisation</th>
<th>Latest application date</th>
<th>SUNSET date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chromic Acid, Chromium Trioxide</strong></td>
<td>Aug 2010</td>
<td>15/12/2010</td>
<td>19/12/2011 for Feb 2013</td>
<td>21/03/2016</td>
</tr>
<tr>
<td><strong>Strontium Chromate</strong></td>
<td>Feb 2011</td>
<td>20/06/2011</td>
<td>Prioritisation recommended by ECHA on 17/01/2013</td>
<td>Estimated 2016</td>
</tr>
<tr>
<td><strong>Dichromium tris(chromate)</strong></td>
<td>Aug 2011</td>
<td>19/12/2012</td>
<td>Prioritisation recommended by ECHA on 17/01/2013</td>
<td>Estimated 2016</td>
</tr>
</tbody>
</table>
REACH : Chromates Fade-out in 2017

Corrosion Protection

- Chromate-free systems (pretreatment, primers & topcoats) for prepainted metals (Steel/Aluminium) have been used in construction applications for 20 years...
- Show comparable corrosion protection profile

Colours

- Chromate-free pigment substitutes are available and used
- Some bright colour standards will need to be adjusted to new pigments
Chromate-free Prepainted Steel – Quality confirmed!

Longterm Durability

- Outdoor Weathering Test in corrosive Atmosphere
  - Bohus Malmö (S)
  - Brest (F)

Source: BASF Coatings
Low Corrosion Impact after 5 Years in Brest & Bohus M.

Prepainted Steel from different Coil Coaters
- Substrate: HDG (Z)
- Coating Systems
  - 5 µm Chromate-free Universal Primer
  - 20 µm Polyester & Polyurethane Topcoats

Source: BASF Coatings
Variable design

- **APPEARANCE:**
  - Colour
  - Gloss
  - Surface finishing
    - smooth
    - grained, textured, embossed, etc..)
### Appearance Examples

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth</td>
<td><img src="image" alt="Smooth Example" /></td>
</tr>
<tr>
<td>Orange Peel</td>
<td><img src="image" alt="Orange Peel Example" /></td>
</tr>
</tbody>
</table>

**Legend:**
- Red: Topcoat
- Blue: Primer (or base coat)
- Gray: Substrate
### Variable design

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grained</td>
<td><img src="image" alt="Polymeric particles (polyamide)" /></td>
</tr>
<tr>
<td>Structured</td>
<td><img src="image" alt="Structured varnish" /></td>
</tr>
</tbody>
</table>

- **Polymeric particles (polyamide)**
- **Structured varnish**

<table>
<thead>
<tr>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topcoat</td>
</tr>
<tr>
<td>Primer (or base coat)</td>
</tr>
<tr>
<td>Substrate</td>
</tr>
</tbody>
</table>
### Variable design

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embossed</td>
<td><img src="image1.png" alt="Embossed Example" /></td>
</tr>
<tr>
<td>Embossed with textured rolls</td>
<td><img src="image2.png" alt="Example" /></td>
</tr>
<tr>
<td>Wrinkled</td>
<td><img src="image3.png" alt="Wrinkled Example" /></td>
</tr>
</tbody>
</table>

- **Appearance**
  - Embossed
  - Wrinkled

- **Examples**
  - ![Embossed Example](image1.png)
  - ![Wrinkled Example](image3.png)

*Legend:*
- Topcoat
- Primer (or base coat)
- Substrate
Key attributes & performances of prepainted metal

- **KEY PERFORMANCES**
  - Formability
  - Corrosion resistance
  - UV Resistance
  - Abrasion resistance
  - Scratch resistance
Functional coatings

- Specific PERFORMANCES
  - Chemical resistance
  - Reflectivity / Emissivity
    - cool roofs / urban heat island effect
Functional coatings

- Specific PERFORMANCES
  - Anti graffiti
  - Anti-dirt / self cleaning
ZincMagnesium: new outperforming substrate

• Continuous innovation in substrate development to offer the most complete range suitable for industrial applications
ZM: new outperforming substrate

- ZnAlMg coated steels are readily available in Europe and their superior performance is now well known on the market
  - Increased corrosion resistance compared to classical HDG in severe environments (e.g. chloride & highly alkaline)

Salt spray test: 20 µm coating per side
ZM: new outperforming substrate

- ZnAlMg coated steels are readily available in Europe and their superior performance is now well known on the market
  - Similar corrosion protection performance with lower metallic coating thickness

<table>
<thead>
<tr>
<th>Z</th>
<th>ZM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z100</td>
<td>ZM60</td>
</tr>
<tr>
<td>Z180</td>
<td>ZM80</td>
</tr>
<tr>
<td>Z225</td>
<td>ZM100</td>
</tr>
<tr>
<td>Z275</td>
<td>ZM120</td>
</tr>
<tr>
<td>Z350</td>
<td>ZM175</td>
</tr>
<tr>
<td>Z450</td>
<td>ZM275</td>
</tr>
</tbody>
</table>
ZincMagnesium: new outperforming substrate

- ZnAlMg coated steels are readily available in Europe and their superior performance is now well known on the market
  - Improved cut-edge protection
ZincMagnesium: new outperforming substrate

Standardization (EN10346: Continuously hot-dip coated steel flat products...) update with ZM ongoing

- Definition of the alloy: *application of a zinc-magnesium coating by passing the prepared strip through a molten zinc bath with aluminium and magnesium contents in sum of 1,5 to 8 % by mass*
- Steel grades available
- Alloy coating masses available
- Coating finish
- Surface condition
New outperforming substrate for outperforming OCS

- ZM is an excellent substrate for coil coated material with balanced product properties.
- The use of ZM metallic coatings for coil coating has been validated by several national certification bodies e.g. DIBt (Germany), CSTB (France)
Sustainable Buildings: energy through colour

- Cool Colors or Heat Absorbing Surfaces
  - material in the walls and roofs that contribute to saving energy for cooling and ventilation
  - prepainted metal solar collector absorbing solar energy and converting it into useable heat
In a nutshell ...

- Coil coating is the best available technology for applying paint to metal
- The process is environmental friendly
- Prepainted metals have major advantages over competing materials in terms of aesthetics, longevity, corrosion protection, quality and sustainability
- Prepainted metals are 100% recyclable at end-of-life
- Continuous and sustainable innovation