



ArcelorMittal

## Implementing environmental friendly smart surfaces in steel sheet production

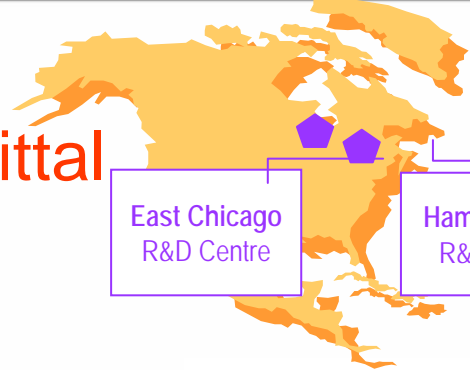
J. De Strycker, F. Hörzenberger

June 08  
Brugge

# Outline

- OCAS in the ArcelorMittal R&D network
- E-Passivation: worldwide Cr(VI) elimination
- ‘Smart water’ concept
- Easyfilm E: the ‘smart water’ in practice
- Synthesis
- Outlook

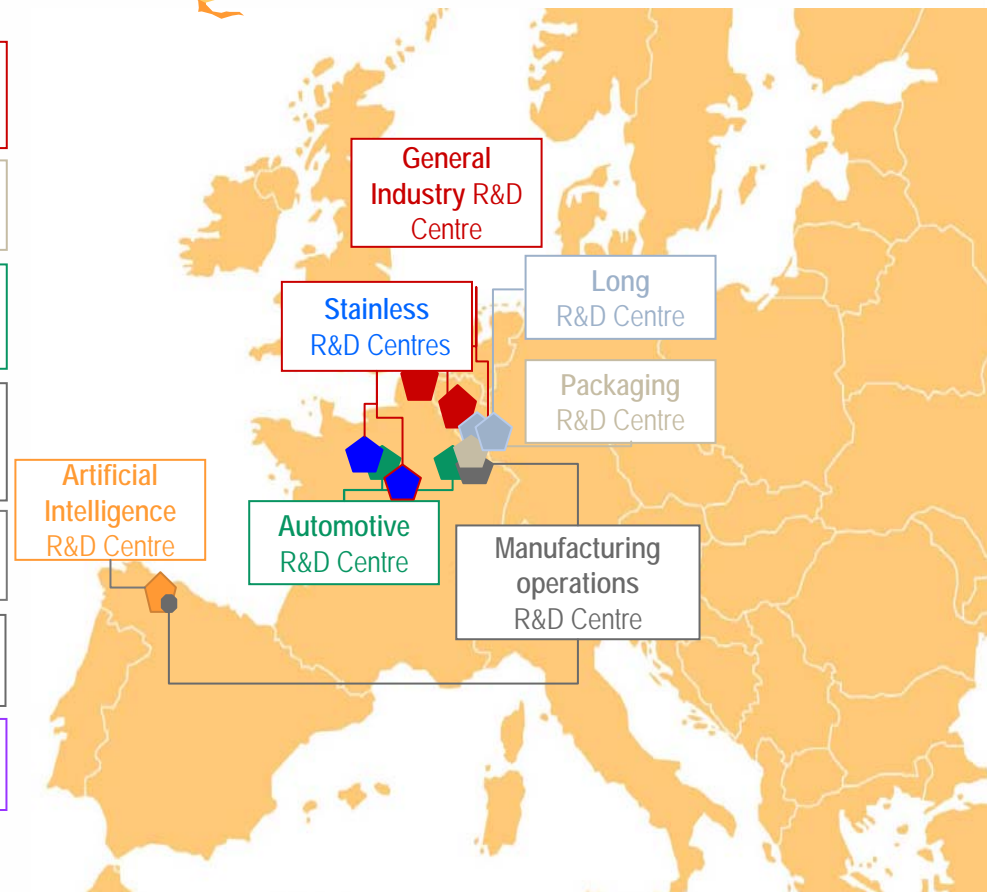
# OCAS in the ArcelorMittal R&D network



East Chicago R&D Centre

Hamilton (CA) R&D Centre

- General Industry: 1 R&D Centre on 2 sites ⇒ in Gent and Liège
- Packaging: 1 R&D Centre ⇒ in Maizières lès Metz
- Automotive: 1 R&D Centre on 2 sites ⇒ in Maizières lès Metz and Montataire
- Industrial operations: 1 R&D Centre ⇒ in Maizières lès Metz + 1 satellite ⇒ in Avilés
- Knowledge Innovation: 1 R&D Centre ⇒ in Aviles
- Stainless & Plates: 2 R&D Centres in Isbergues and Le Creusot
- Long Carbon: 2 R&D Centres in Esch-sur-Alzette and Gandrange
- USA&Canada: 2 R&D Centres in East Chicago and Hamilton



# R&D General Industry

## ArcelorMittal R&D Industry Gent/OCAS

- New substrates and metallic coatings
- Surface functionalization
- Steel solutions & design
- Product safety



## ArcelorMittal R&D Industry Liège

- Organic coatings
- New coating technologies
- Steel solutions & design (construction)



# Outline

- OCAS in the ArcelorMittal R&D network
- E-Passivation: worldwide Cr(VI) elimination
  - 'Smart water' concept
  - Easyfilm E: the 'smart water' in practice
  - Synthesis
  - Outlook



## E-Passivation: worldwide Cr(VI) elimination

- *“Chemical passivation” protects the surface against humidity and reduces the risk of formation of corrosion products during storage and transportation. (extract of EN-standards)”*



**The film Erin Brockovich, highlighted the discussion about chromium VI problematic.**



# E-Passivation: worldwide Cr(VI) elimination

**Hexavalent chromium is being classified as a hazardous substance in European directives.**

## **Appliances market**

**2002/95/EC restriction on use of hazardous substances directive will ban the use of chromium 6, lead, mercury and cadmium in electrical and electronic equipment (W.E.E.E.) after 1st of July, 2006.**

**(No hexavalent chromium allowed)**

## **Automotive market**

**2000/53/EC end of life vehicle directive will ban the intentional introduction of chromium 6 for corrosion purposes in vehicles after 1st of July, 2007.**

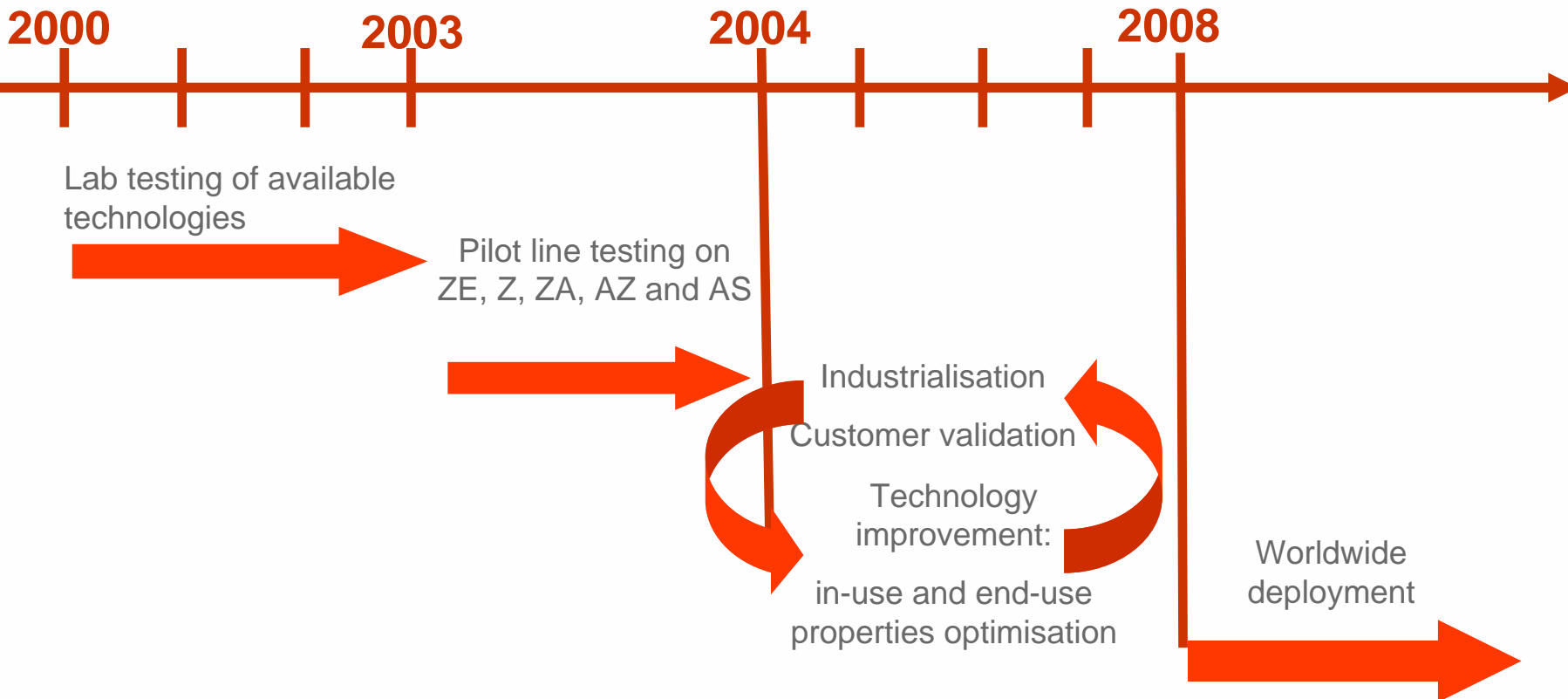
**(Limit value 0,1 Weight %)**



**The European WEEE-Directive targets collection, recycling and recovery of all types of electrical products.**

# E-Passivation: worldwide Cr(VI) elimination

- Brief history

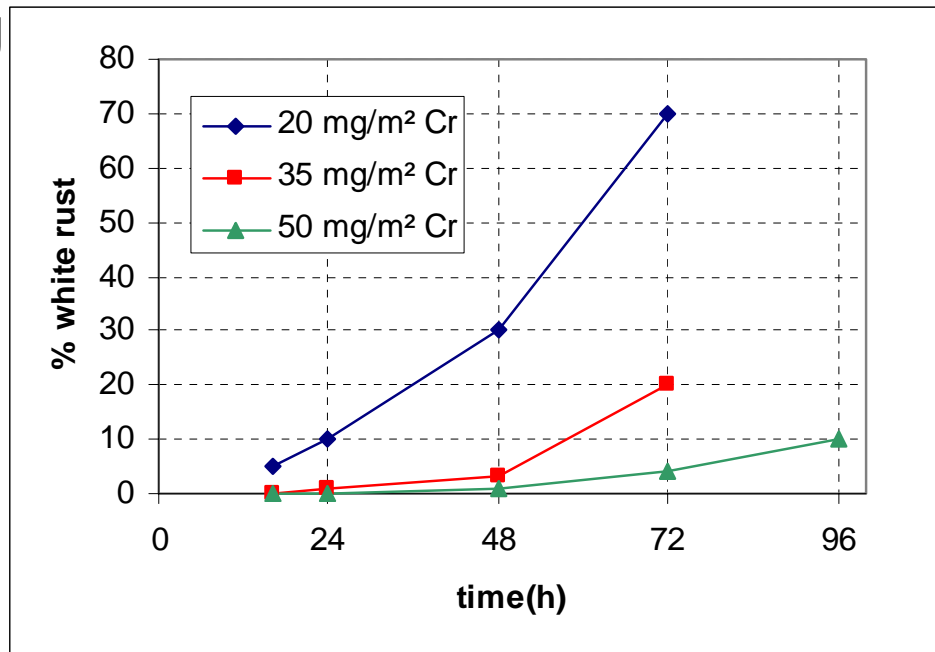


© 2007 – ArcelorMittal – All rights reserved for all countries. Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal. CONFIDENTIAL – Privileged Information – ArcelorMittal's proprietary information.



# E-Passivation: worldwide Cr(VI) elimination

- Lab/pilot line performance
  - Accelerated corrosion testing for technology screening
    - e.g. salt spray testing
  - Determination of the processing parameters
    - Coating weight
    - Drying temperature/process
    - Concentration of the bath
    - Allowed bath pollution
    - ...



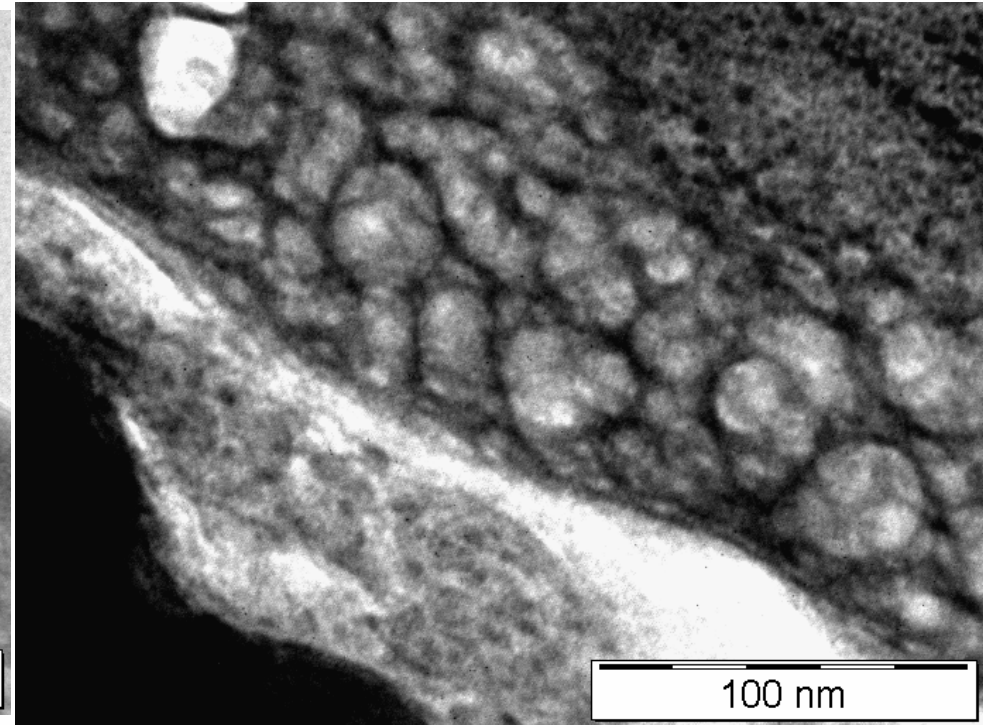
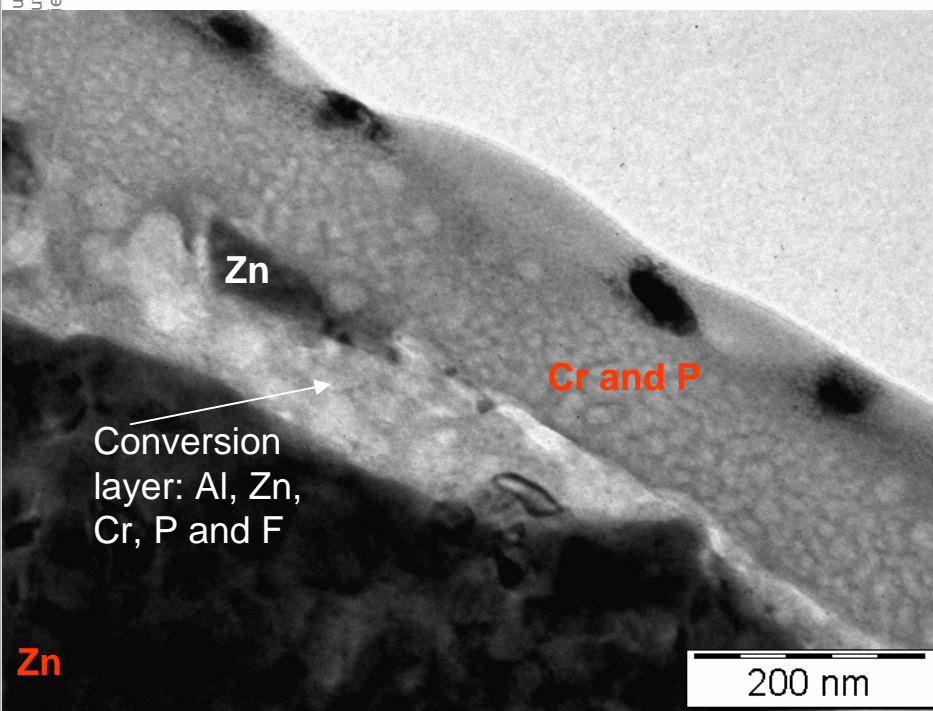
# E-Passivation: worldwide Cr(VI) elimination



# E-Passivation: worldwide Cr(VI) elimination

- E-Passivation morphology
  - layer build up: FIB slice + TEM imaging

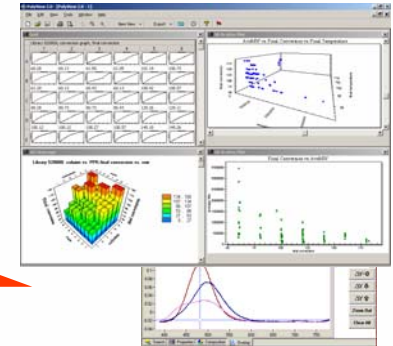
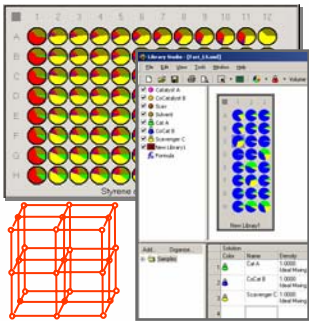
untries  
uthorization of ArcelorMittal  
etary information





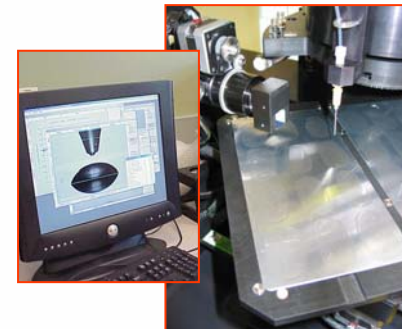
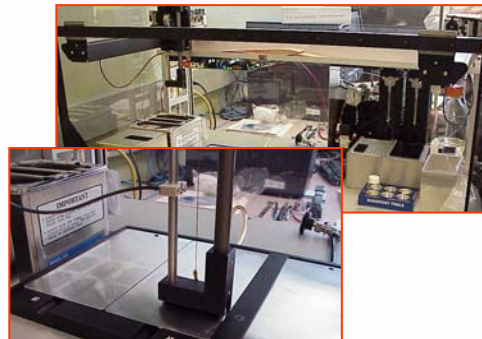
# E-Passivation: worldwide Cr(VI) elimination

- Formulation improvement towards in-use properties
  - Via high through-put screening



Design

Data Analysis



Formulation

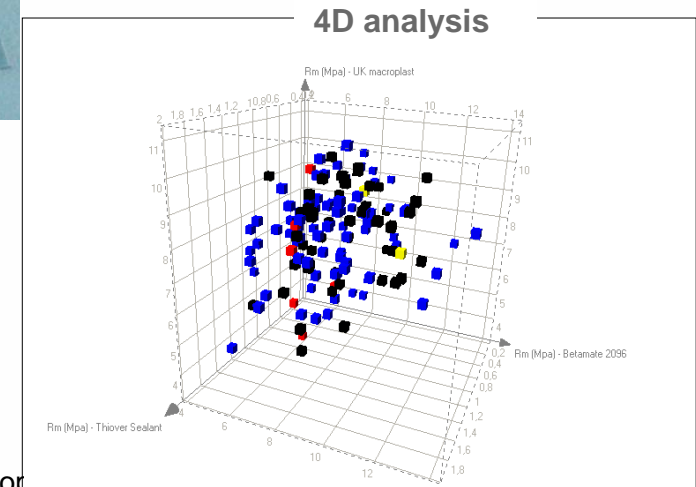
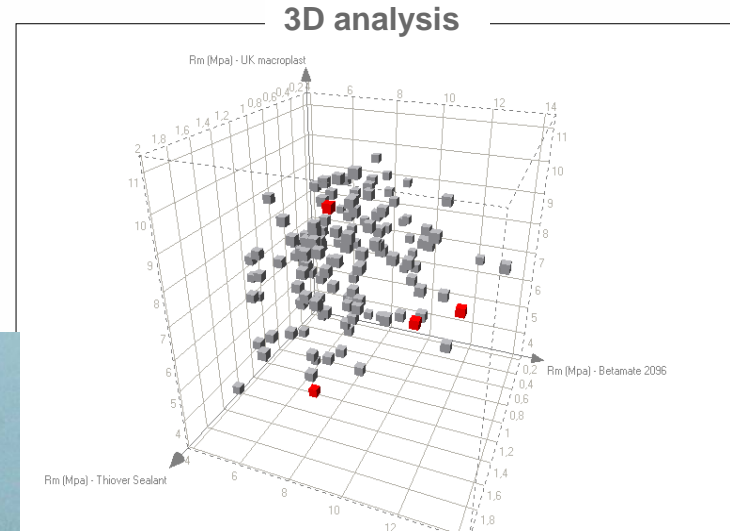
Coating application

Characterisation

© 2007 - ArcelorMittal - All rights reserved for all countries. Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal. CONFIDENTIAL - Privileged Information - ArcelorMittal's proprietary information

# E-Passivation: worldwide Cr(VI) elimination

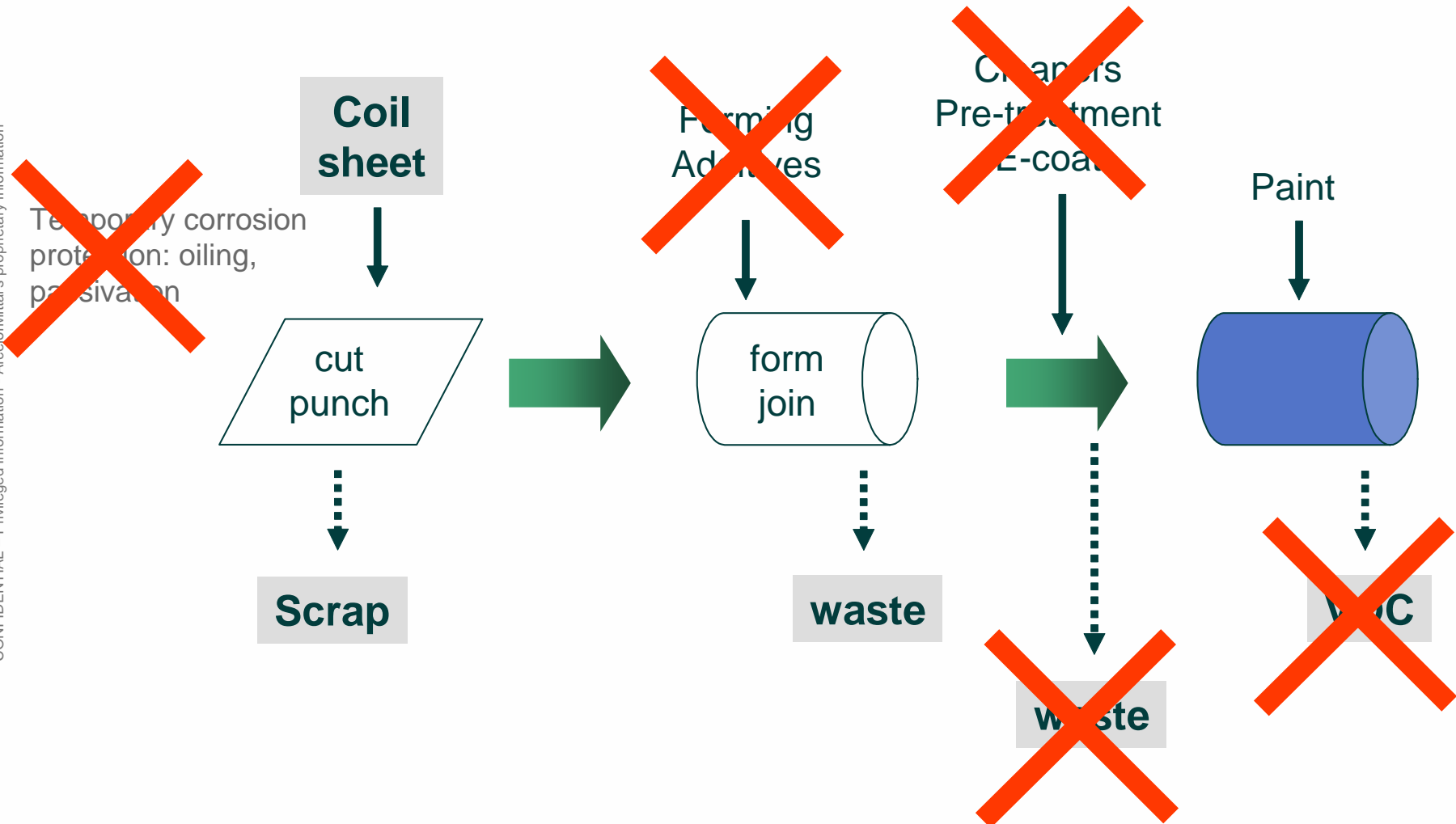
- Formulation improvement towards in-use properties
  - Via high through-put screening
    - E.g. adhesive bonding
      - 144 formulations
      - 3 model adhesives
      - Up to 500 pull off tests
      - Analysis via data mining tools
      - Selection of 2 additives for further macro-screening



# Outline

- OCAS in the ArcelorMittal R&D network
- E-Passivation: worldwide Cr(VI) elimination
- 'Smart water' concept
  - Easyfilm E: the 'smart water' in practice
  - Synthesis
  - Outlook

# 'Smart water' concept



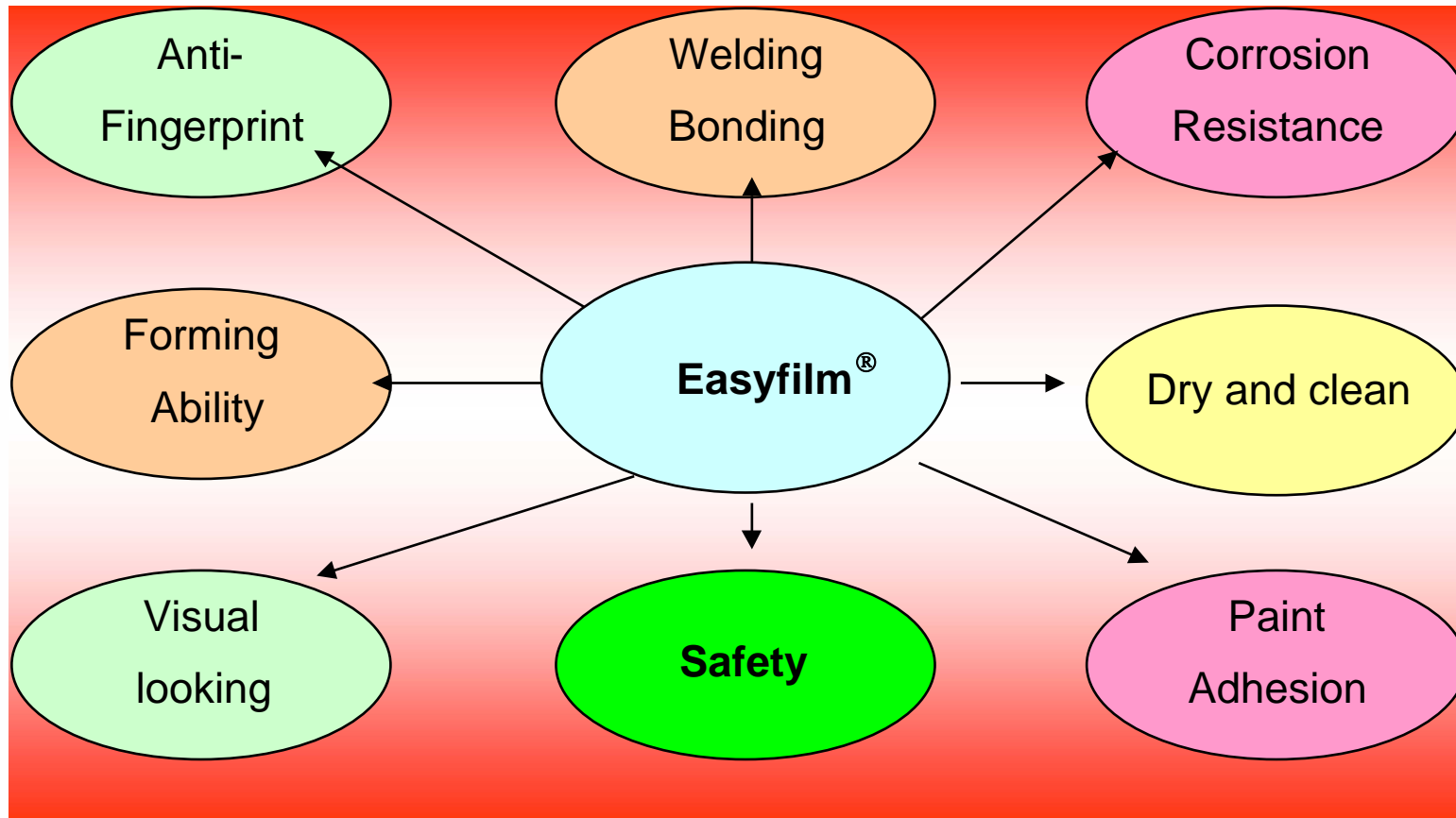
© 2007 – ArcelorMittal – All rights reserved for all countries. Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal. CONFIDENTIAL – Privileged Information – ArcelorMittal's proprietary information.

# Outline

- › OCAS in the ArcelorMittal R&D network
- › E-Passivation: worldwide Cr(VI) elimination
- › ‘Smart water’ concept
- Easyfilm E: the ‘smart water’ in practice
  - › Synthesis
  - › Outlook



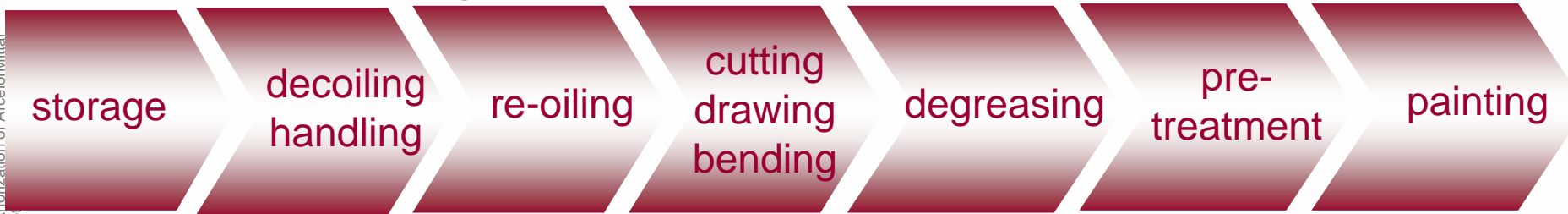
# Easyfilm E: the 'smart water' in practice



© 2007 – ArcelorMittal – All rights reserved for all countries  
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal  
CONFIDENTIAL – Privileged Information - ArcelorMittal's proprietary information

# Easyfilm E: the 'smart water' in practice

## Traditional steel processing flow chart :



## Using Easyfilm® :



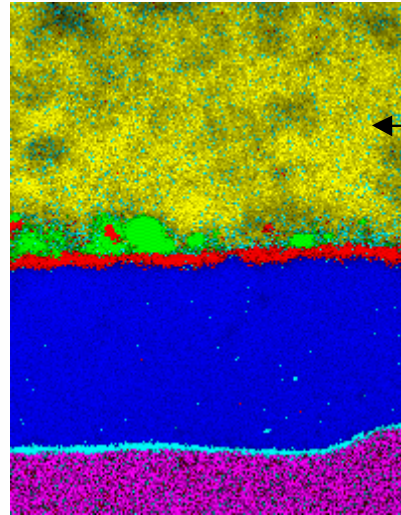
## Gains :



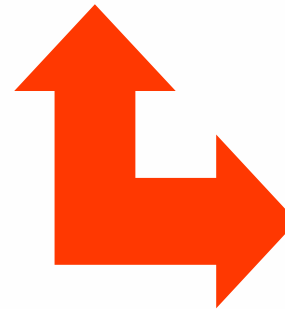
© 2007 - ArcelorMittal - All rights reserved for all countries. Use or reproduction without prior written specific authorization of ArcelorMittal. Confidential - Proprietary. Cannot be disclosed.

# Easyfilm E: the 'smart water' in practice

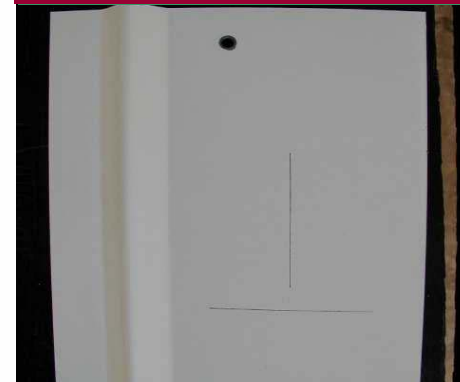
Cross section



Possible customer top coat  
(with TiO<sub>2</sub> paint pigments)



Lacquered Easyfilm



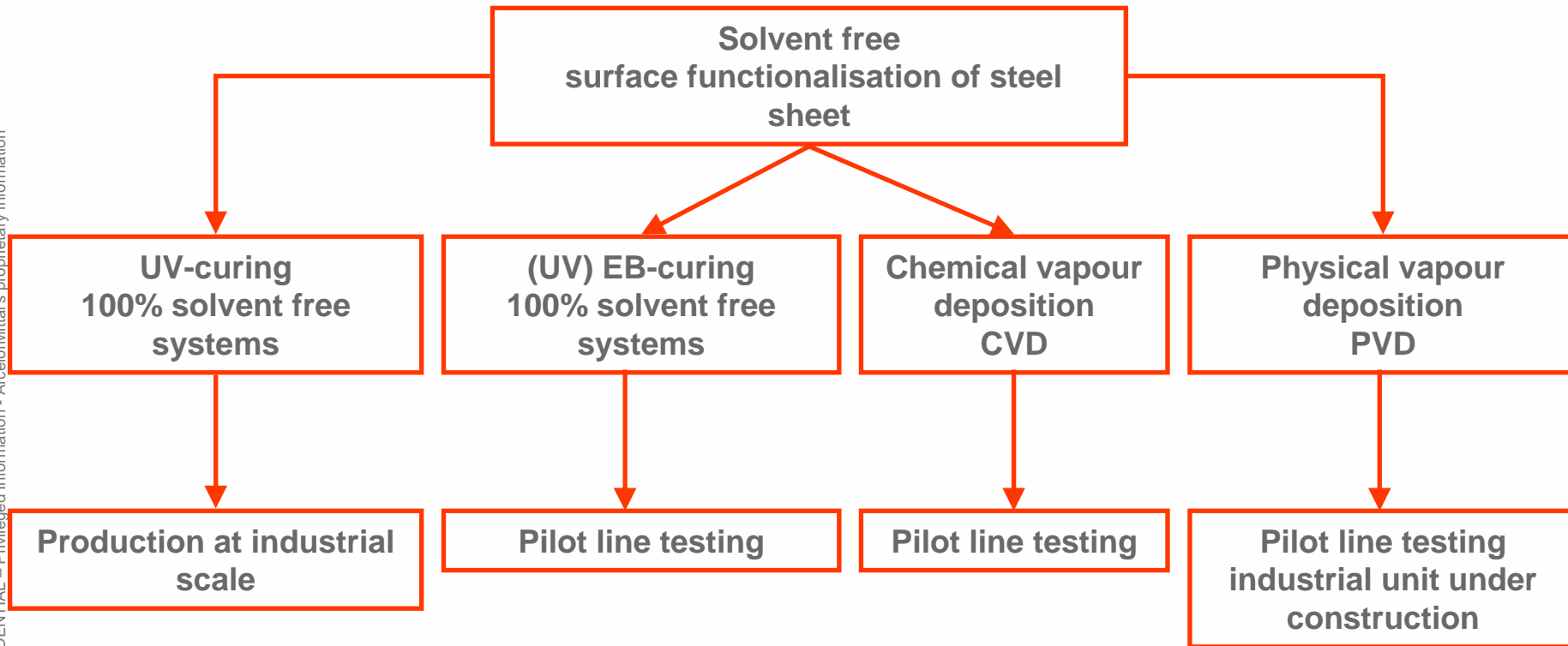
1 year tropical exposure in  
Guyana :  
excellent paint adherence

© 2007 - ArcelorMittal - All rights reserved for all countries. Produced without prior written specific authorization of ArcelorMittal. Cannot be used for any purpose without prior written specific authorization of ArcelorMittal. ArcelorMittal's proprietary information.

# Synthesis

- Environmental friendly smart surfaces for steel sheet aim towards:
  - Ready-to-use semi-finished products
  - Environmental friendly processing
    - By adapted chemistry
  - Environmental friendly product finishing
    - By a reduced amount of production steps
    - By adapted chemistry
  - By means of
    - In depth surface analysis/characterisation
    - Advanced technologies like HTE, ...

# Outlook



© 2007 – ArcelorMittal – All rights reserved for all countries  
 Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal  
 CONFIDENTIAL – Privileged Information – ArcelorMittal's proprietary information