

Analysis of coatings on bridges and tunnels &
health risk analysis before repair
Monitoring of corrosion inhibitors in concrete

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With the participation of Johan Dedeene (Clusta)
and colleagues of Endures

Summary

- OCAS NV

- Inspection and controls of bridges and tunnels

- Structure: concrete, steel and corrosion
- Coatings: characterisation and properties
- Health risk analysis before repair

- Concrete and corrosion

- Repair in tunnels through migration of corrosion inhibitors
- Monitoring of migration of corrosion inhibitors by IR spectroscopy

OCAS activities



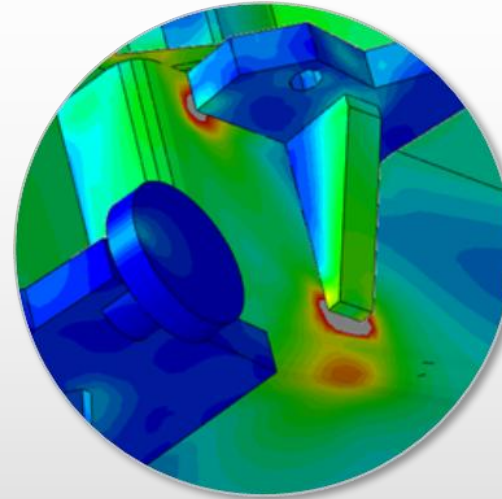
Alloy & metallic coating **DEVELOPMENT**

Focus

- Product and coating development in view of industrial upscaling
- Fit for different industrial sectors in line with market trends and customer expectations

Advanced supporting Tools

- Combinatorial
- Digital
- Nano characterisation



Non-standard **TESTING & MODELLING**

Focus

- Fatigue, wear & corrosion resistance
- Hydrogen embrittlement
- Fit-for-purpose
- Lifetime prediction
- Structural Integrity

Including

- Welded components
- Additive manufactured parts (WAAM)
- Industrial asset reliability

Lab locations



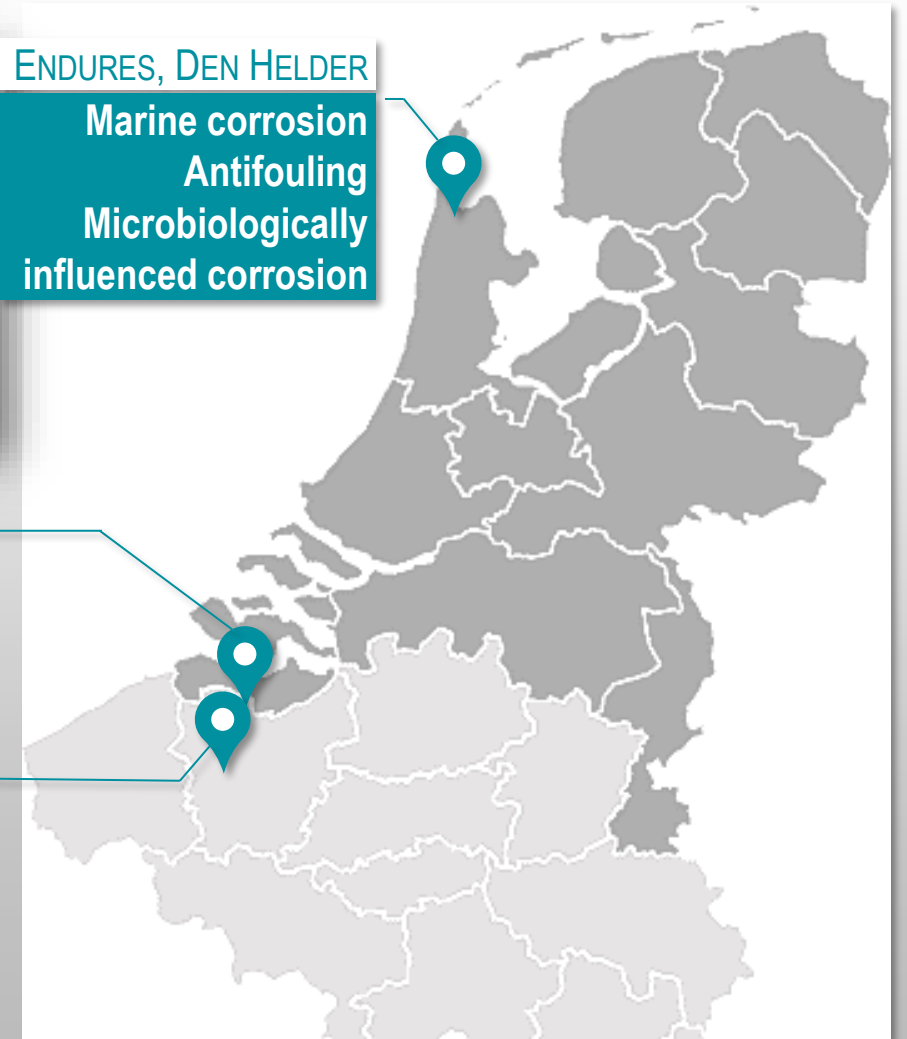
OCAS GENT, HQ ZELZATE
Surfaces & Coatings
Corrosion
Chemical analyses
Microscopy



OCAS GENT, ZWIJNAARDE
Metal processing
Welding
Electromagnetism
Hydrogen
Large scale testing
Mech. characterisation



ENDURES, DEN HELDER
Marine corrosion
Antifouling
Microbiologically influenced corrosion



Facts 2024

>150
employees
highly skilled
staff



40
trainees
internationally
recruited



>100
global customers
active in various
industrial sectors



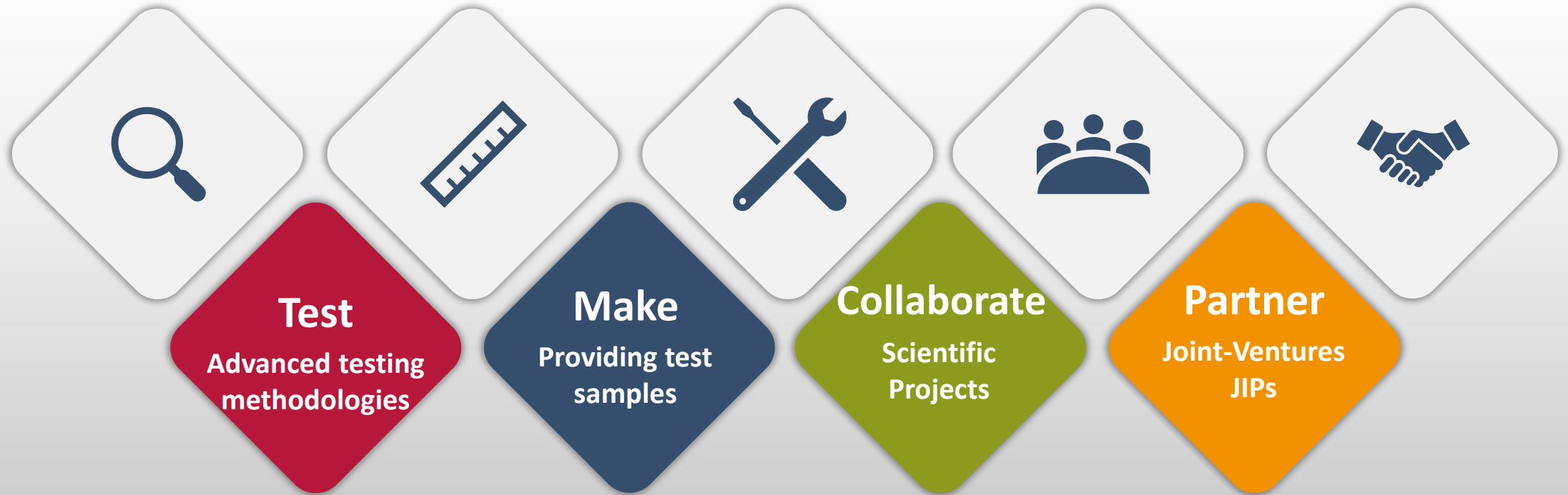
20 000
m² labs
at our sites in Zelzate &
Zwijnaarde



>180
institutes
scientific & academic
worldwide network



Working with OCAS



OCAS offers its competencies, know-how, equipment and methodologies to facilitate and help our customers succeed in achieving their R&D goals

Health & Safety analysis – bridges and tunnels

PROBLEM:

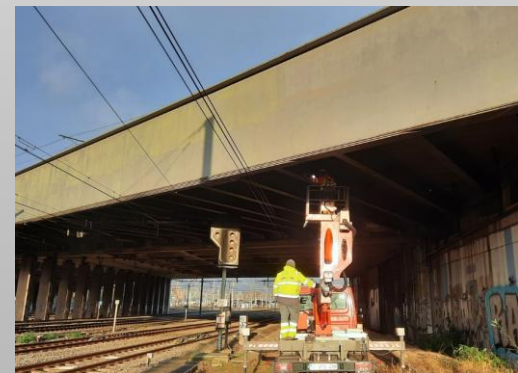
- Data gathering & risk analysis before maintenance & repair on bridges (*steel and concrete*)
- Includes **health risk evaluation on dangerous substances** & impact on waste management

APPROACH:

- Inspection & paint samples taken
- **Paint analysis**: composition and hazardous compounds, incl. CMR substances, Pb, Cr(VI), Polycyclic Aromatic Hydrocarbons (PAHs), PolyChloroBiphenyl (PCB)
- **Dust analysis** collected in various areas in tunnels
- **Evaluation of coating degradation** (blistering, rusting, cracking, flaking according to rating scheme)

CONCLUSION:

- List of bridges/tunnels that need repairs
- List of safety precautions to be taken before the works can start



Bridge and tunnel inspection in Brussels

Collaboration: Clusta, Endures, Ocas



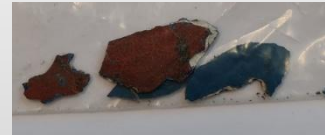
- Bridge Maintenance & Repair: **the tasks**



- Coordinated the project and helped with the samplings and steel analyses. The analysis of asbestos was subcontracted to an accredited company.



- Inspection of coatings by a accredited inspector, including on-site tests (thickness, adhesion, porosity, ...) and paint samplings for analysis.



- Analyses of the paint flakes collected by Endures focusing on carcinogenic, mutagenic, or toxic for reproduction (CMR) substances, heavy metals analysis (in particular Pb) and Polycyclic Aromatic Hydrocarbons (PAHs) determination. Risk assessment before starting any maintenance work on bridges.



Bridges inspection in Brussels

- Steel:
 - Thickness measurements by ultrasound
 - according to ISO 16809
 - Visual observation
 - Corrosion, defects
 - Steel analysis (S235, S335 grades)
 - Technical support of OCAS; steel grade and weldability



Bridges inspection in Brussels

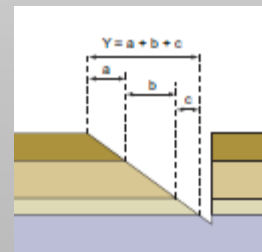
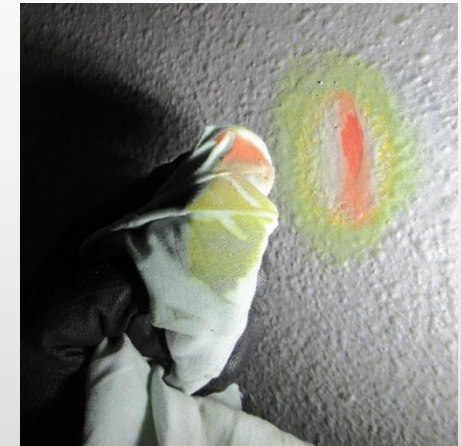
- Paints, coatings:

- Thickness measurements by Coating Thickness Gauge

- according to ISO 2808 7B.2
 - Average value of 15 measurements per sample

- Type of paints

- Paint system according to the resistance after solvent (MEK) test
 - Identification of the different layers of coating and corresponding thicknesses (PIG, Paint Inspection gauge)



PIG : épaisseur de chaque couche (micron)	
	A.02
Couleur	Epaisseur
Zinc	40
jaune	20
Rouge 1	60
Blanc 1	80
rouge 2	40
blanc 2	40
Total	280

Bridges inspection in Brussels

- Paints, coatings:

- Evaluation of degradation of coatings

- Blistering, rusting, cracking, flaking according to rating scheme (ISO 4628-1 to 5)

- Paint adhesion

- Cross-cut test (for paint thickness lower than 250 μm), ISO 12944
 - Pull-off test (adhesive, cohesive failure, %, rupture force), ISO 4624
 - Wet sponge porosity detection (ASTM D5612)



Class 1

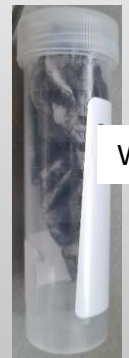


Class 5



Bridges inspection in Brussels

- CMR (Carcinogenic, Mutagenic and toxic for Reproduction) analysis, on paint flakes
 - **Lead (Pb) analysis: NFX 46-031**
 - Extraction in acid solution (HCl) and ICP-MS analysis
 - **Toxic elements and heavy metals**
 - Extraction in a strong acid solution(nitric/hydrofluoric) and ICP-MS analysis
 - Mn, Fe, Co, Ni, Cu, Zn, Ag, Pb, As, Cd, Cr, Hg, Se
 - **PAHs (Polycyclic Aromatic Hydrocarbons), coal-tar-based compounds**
 - Extraction with solvents and GC-MS analysis
 - **PCBs (Polychlorinated biphenyls), organochlorine compounds**
 - In dust: sampling with wipes and extraction with solvents and GC-MS analysis
 - Asbestos sampling/analysis in the paints was subcontracted to other laboratory
- Risk analysis
 - According to the concentration of elements and if coatings are degraded, corroded
 - When repairs are planned: pickling, shot blasting, ...
 - Health & Safety risk assessment
 - Waste management



Wipe with PCB



Monitoring of corrosion inhibitors in concrete



PROBLEM:

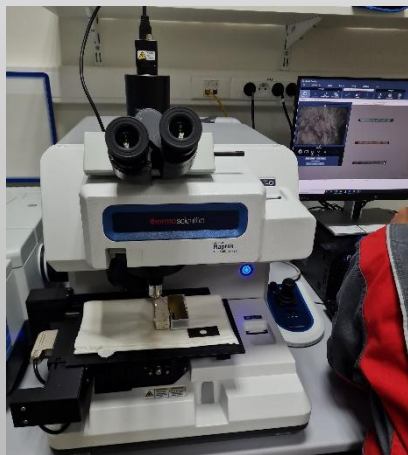
- The customer wanted to repair corroded concrete areas in different tunnels
 - Application of 2 different corrosion inhibitors to the concrete
 - The inhibitor would migrate a few cm (6-8 cm) to reach the steel to be protected.

APPROACH:

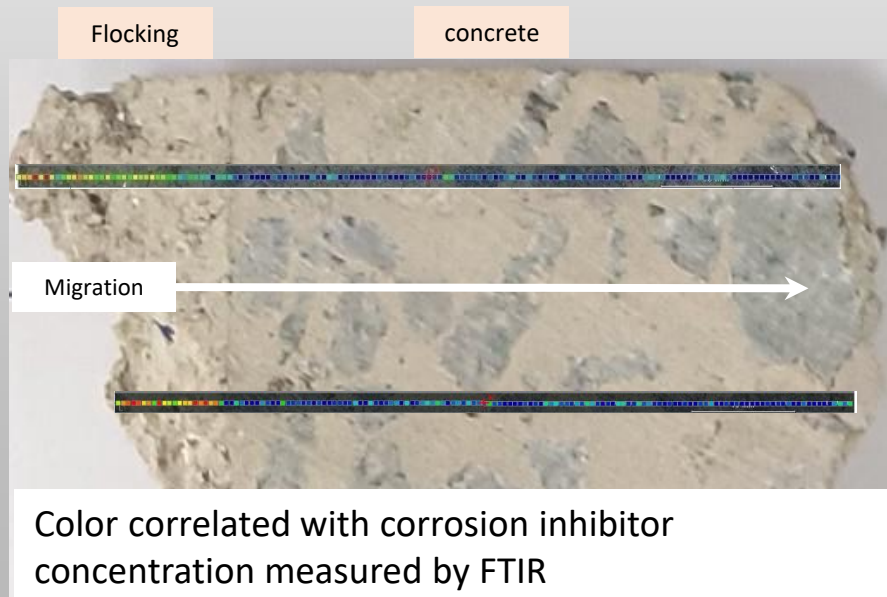
- Ocas has developed a methodology based on FTIR analysis to monitor the migration of the inhibitors

CONCLUSION:

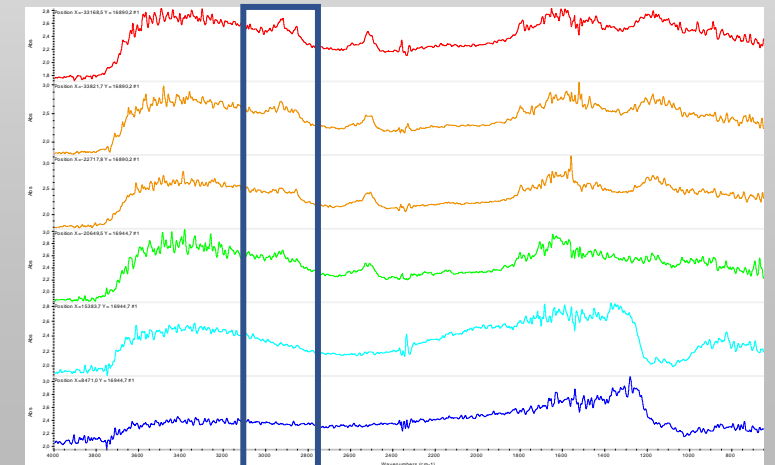
- One inhibitor was better than the other (migration through the concrete, including the fire-resistant flocking)



FTIR (microscope)

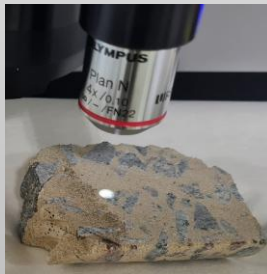


Specific IR Peak of corrosion inhibitor



Conclusions - perspectives

- The health risk analysis on various structures is mandatory before repair and/or maintenance because of possible exposure to dangerous compounds
- We have other case studies :
 - Traveling cranes repair: exposure to Pb and hexavalent chromium
 - Museum: presence of PAHs and heavy metals in ceiling concrete coatings
 - Sheet pile walls and ship lifts: release of PAHs from coatings
- OCAS can develop new methodologies for you, as we did for the migration of corrosion inhibitors in concrete.
- We are currently conducting new research on microplastics released into water!





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