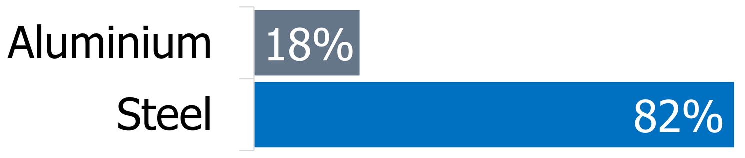
ANNA VOYTYUKOVA
Year 2 EngD

Academic Supervisor: Prof. Matthew Davies
Industrial Supervisor: James Smith
Sponsor: Beckers Group

PAINT RECYCLING FOR END-OF-LIFE CONSTRUCTION CLADDING

Pre-Painted Metal Production

Annually, 1,532 million m² of pre-painted metal are produced using 250,000 tons of paint through a continuous and highly automated industrial process of *coil coating*. 76% of pre-painted metal is used in the construction industry.



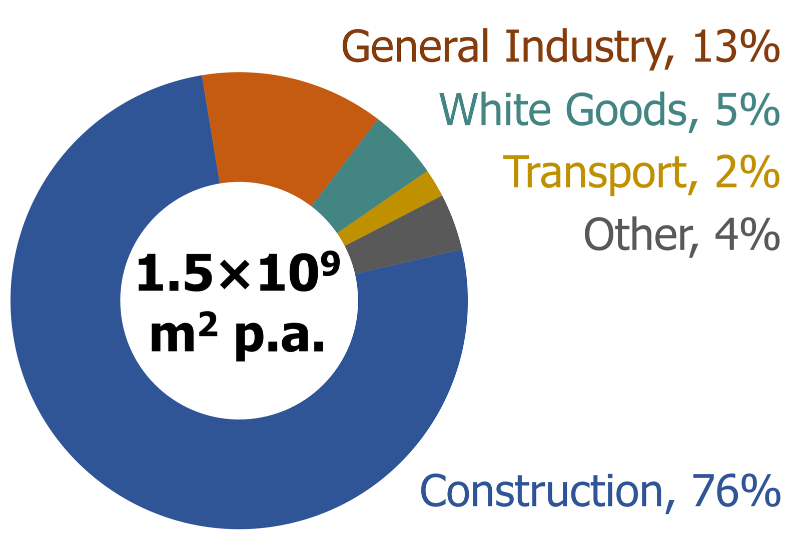


Figure 1. a) Substrates for coil coating; b) Global market of pre-painted metal. [1]

Why Recycle Such a Thin Layer of Paint?

- The coating industry has 98% of its GHG emissions in Scope 3 (compared to 75% in Scope 3 for the chemical industry). [3] To reduce the Scope 3 emissions, companies can implement end-of-life treatment for sold products and replace virgin raw materials with low-GHG-emitting alternatives.
- TiO_2 accounts for 70% of the global pigment consumption [4]. TiO_2 is a major contributor to paint quality, cost and **carbon footprint**. The life cycle assessment shows that TiO_2 in paint (20% wt.) is responsible for approx. 60% of the paint's carbon footprint. [5]
- Recycling metal without removing contaminants such as paint can lower its quality by adding more impurities over time.

End-of-life Pre-painted Metal

Currently, after the construction cladding is removed from buildings, the metal is recycled by melting and recasting. However, the organic coating (paint) is incinerated, resulting in the loss of its valuable constituents.

Paint recycling schemes exist (e.g. PaintCare by the British Coatings Federation [2]) but mainly focus on recycling liquid leftover paint.

Research Project Goals

The research aims to reduce the carbon footprint of the coil coating industry.

Goal 1: To research de-coating methods with respect to their efficiency and environmental impact.

Goal 2: To develop a route to extract valuable constituents for further reuse.

Investigation of the De-coating Methods

Cryogenic Treatment	Induction Heating	Molten Salts	Electro-dezincing	Caustic/Acidic Dezincing	Other

Steel samples coated with various organic coatings were cooled in liquid nitrogen and then bent immediately.

- Polyester melamine and polyurethane acrylate coatings exhibited microcracking without delamination (Fig. 2).
- PVC plastisol coatings delaminated in large patches (Fig. 4a).

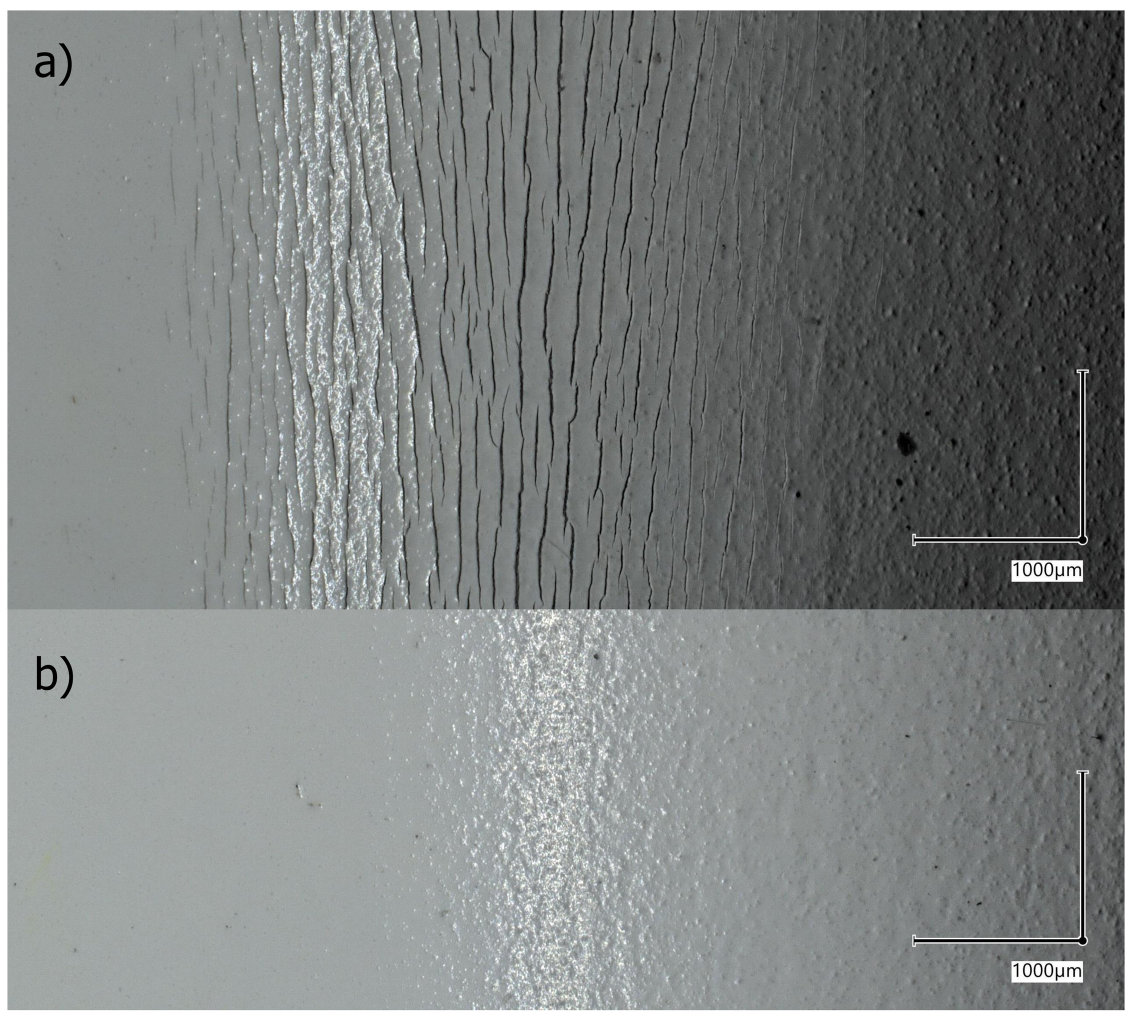


Figure 2. Polyester melamine on HDG steel: a) bent after cooling in liquid nitrogen, b) bent at room temperature.

The zinc coating also fractured after the cryogenic treatment and mechanical stress (Fig. 4b).
All samples bent at room temperature showed no signs of damage in the zinc or paint layers.

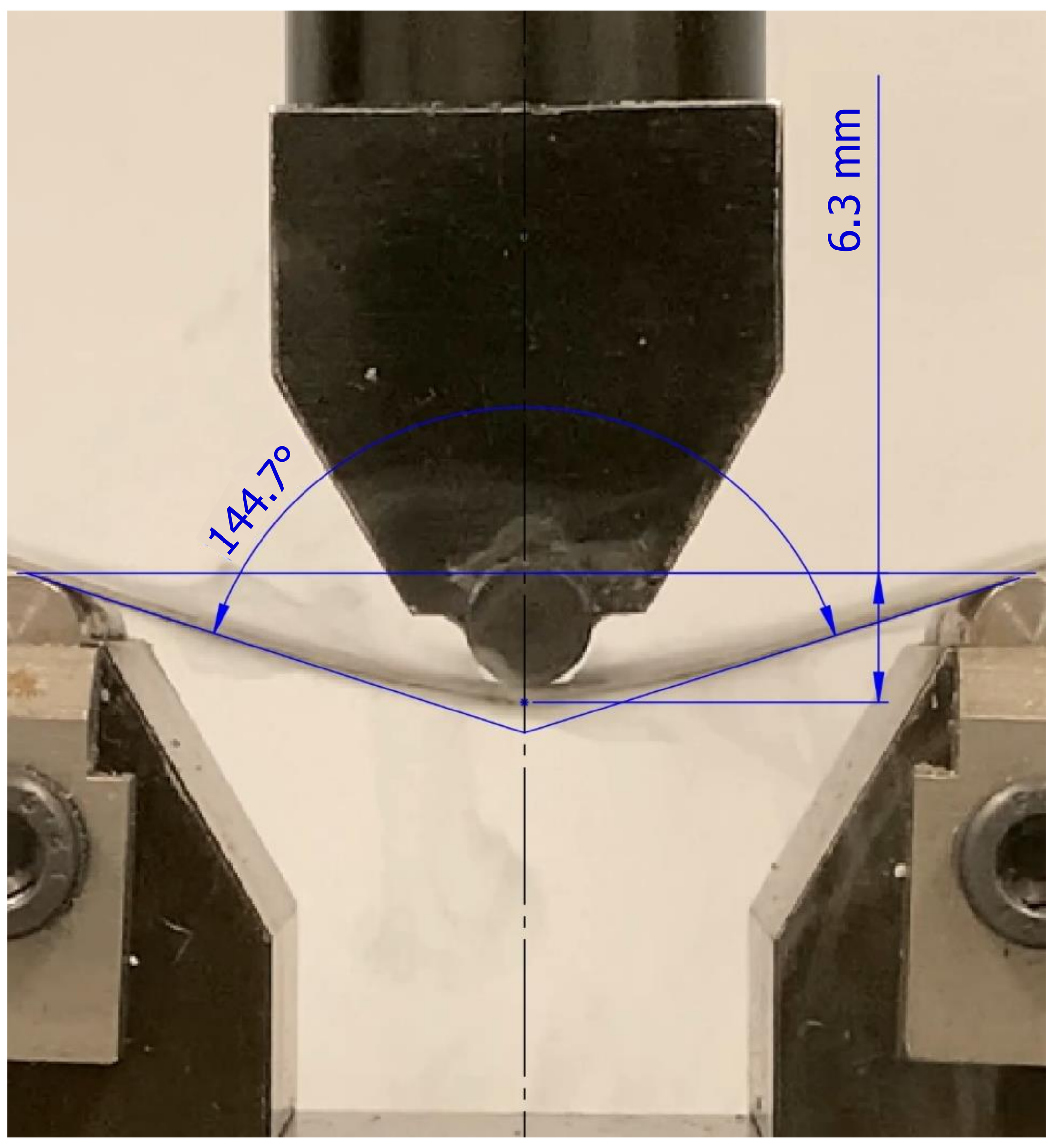


Figure 3. Minimal deflection required for the PVC plastisol coating (HPS200) to delaminate from steel during bending at cryogenic temperatures.

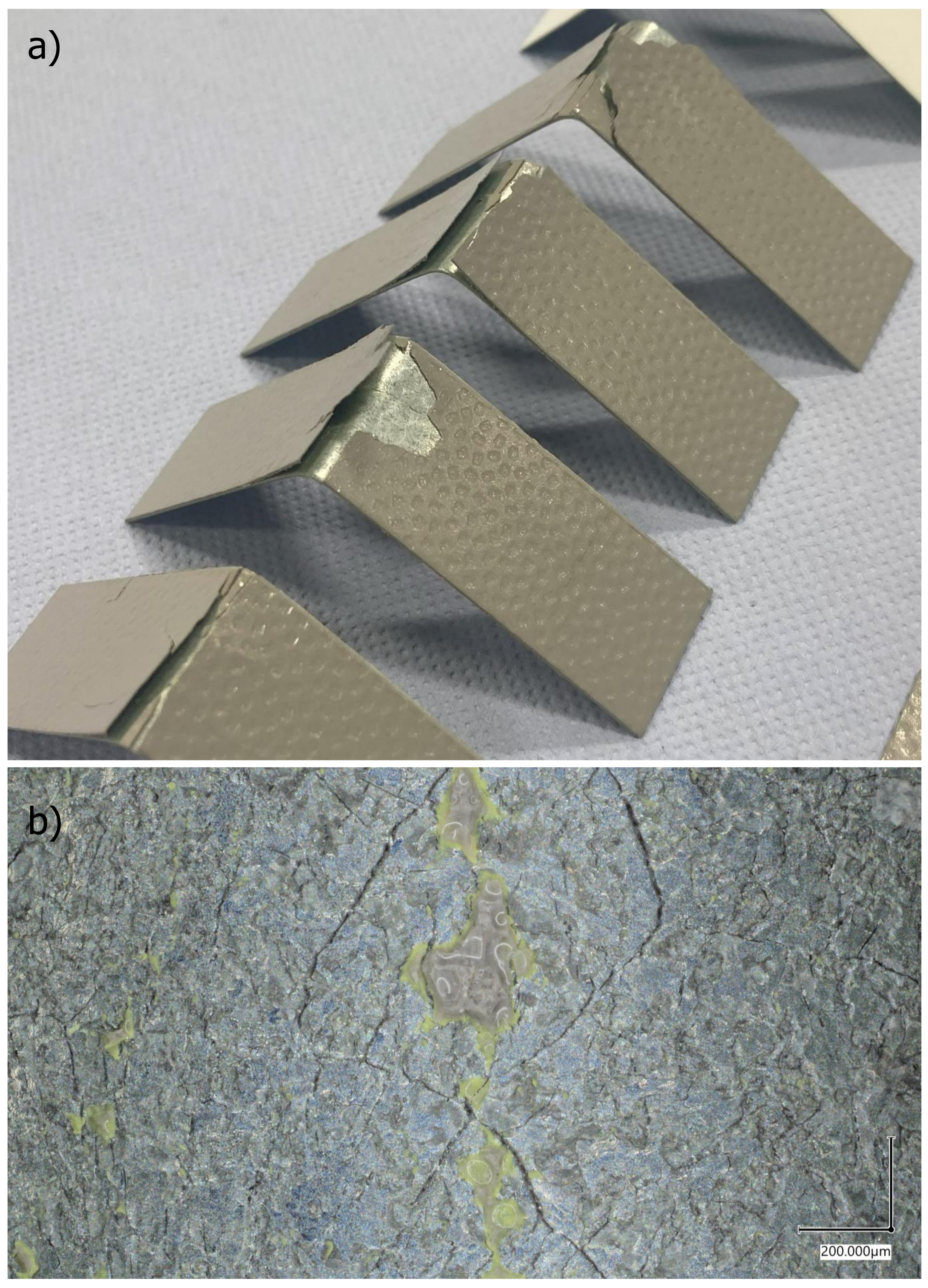


Figure 4. a) Plastisol PVC samples (HPS200, 9cm x 2cm) bent immediately after the cryogenic treatment;
b) cracked zinc coating.

[1] T. Goodwin, 'The EU Green Deal – Challenges and Opportunities for Coil Coating in Europe', presented at the COATED M2A The Future of Coil Coating, Swansea University, Jul. 12, 2024.

[2] British Coatings Federation, 'BCF Annual Handbook and Membership Directory 2023/24', British Coatings Federation Ltd, 2023. Accessed: Feb. 29, 2024. [Online]. Available: https://issuu.com/britishcoatingsfed/docs/handbook_2023_final_digital

[3] P. Durany-Fernandez, 'Road to Net Zero', British Coatings Federation, Version 1, Nov. 2023. Accessed: Feb. 26, 2024. [Online]. Available: https://cdn.ymaws.com/coatings.org.uk/resource/resmgr/webpage_files/net_zero_roadmap/BCF_Net_Zero_Roadmap_Digital.pdf

[4] S&P Global Commodity Insights, 'Chemical Economics Handbook: Titanium Dioxide', S&P Global Commodity Insights, Jul. 2021. Accessed: May 03, 2024. [Online]. Available: https://www.spglobal.com/commodityinsights/en/ci/products/titanium-dioxide-chemical-economics-handbook.html

[5] Dow Coating Materials, 'EVOQUE™ Pre-Composite Polymer Technology Life Cycle Assessment Summary', The Dow Chemical Company, Form No: 884-00331-0813-NAR-EN-GS Rev. 9-6, Sep. 2013. Accessed: Feb. 27, 2024. [Online]. Available: http://storage.dow.com.edgesuite.net/dowtv/coating/DCM_Evoque_LCA.pdf

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