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TATA STEEL

M2A COATED

The Development of Sustainable Paints for Coiled Steel

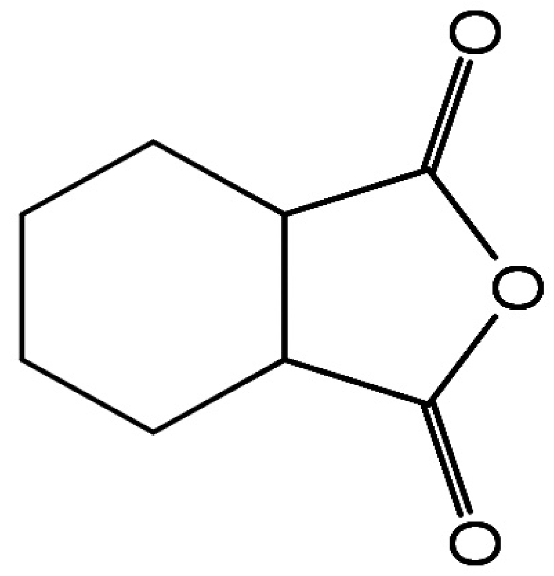
Background

Organic coil coated steels (**OCS**) are produced by applying solvent borne organic coatings to continuously moving strips of steel. Organic coatings are polymer binders such as **polyesters, polyurethanes, PVDF and PVC** where the components are generally fossil fuel derived**.**

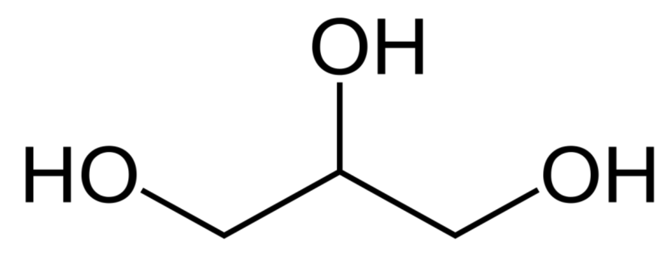
The polymers are mixed with **solvents**, **pigments** and other **additives** to enhance the aesthetic appeal and offer corrosion protection to the underlying steel from hydrolytic and chemical weathering.

This project aims to reduce the reliance on fossil fuels in OCS by exploring sustainable monomers (di-functional acids and di-functional alcohols) to formulate two **novel bio-polyester coatings,** Bio-PE 1 and Bio-PE 2 for a single layer white coating applied directly to galvanised steel**.**

Sustainability in industrial coatings involves the use of compounds from **renewable** and **recycled** sources, waste minimisation as well as materials that are **benign** to the **environment** and **human health** when handling.

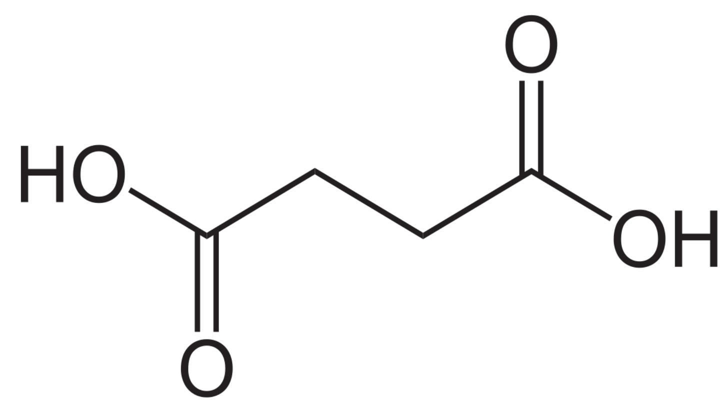


Hexahydrophthalic anhydride (HHPA)

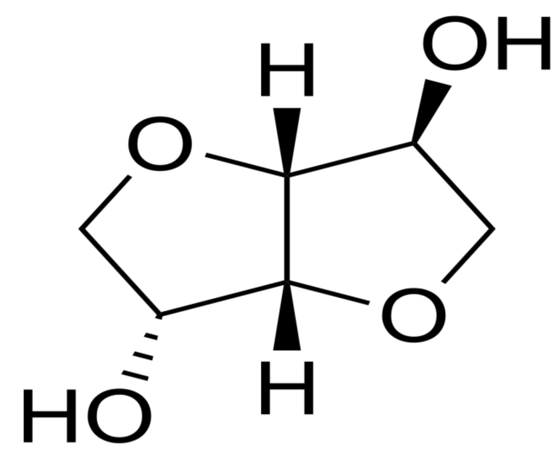


Glycerol

Neopentyl Glycol (NPG)



Succinic Acid



Isosorbide

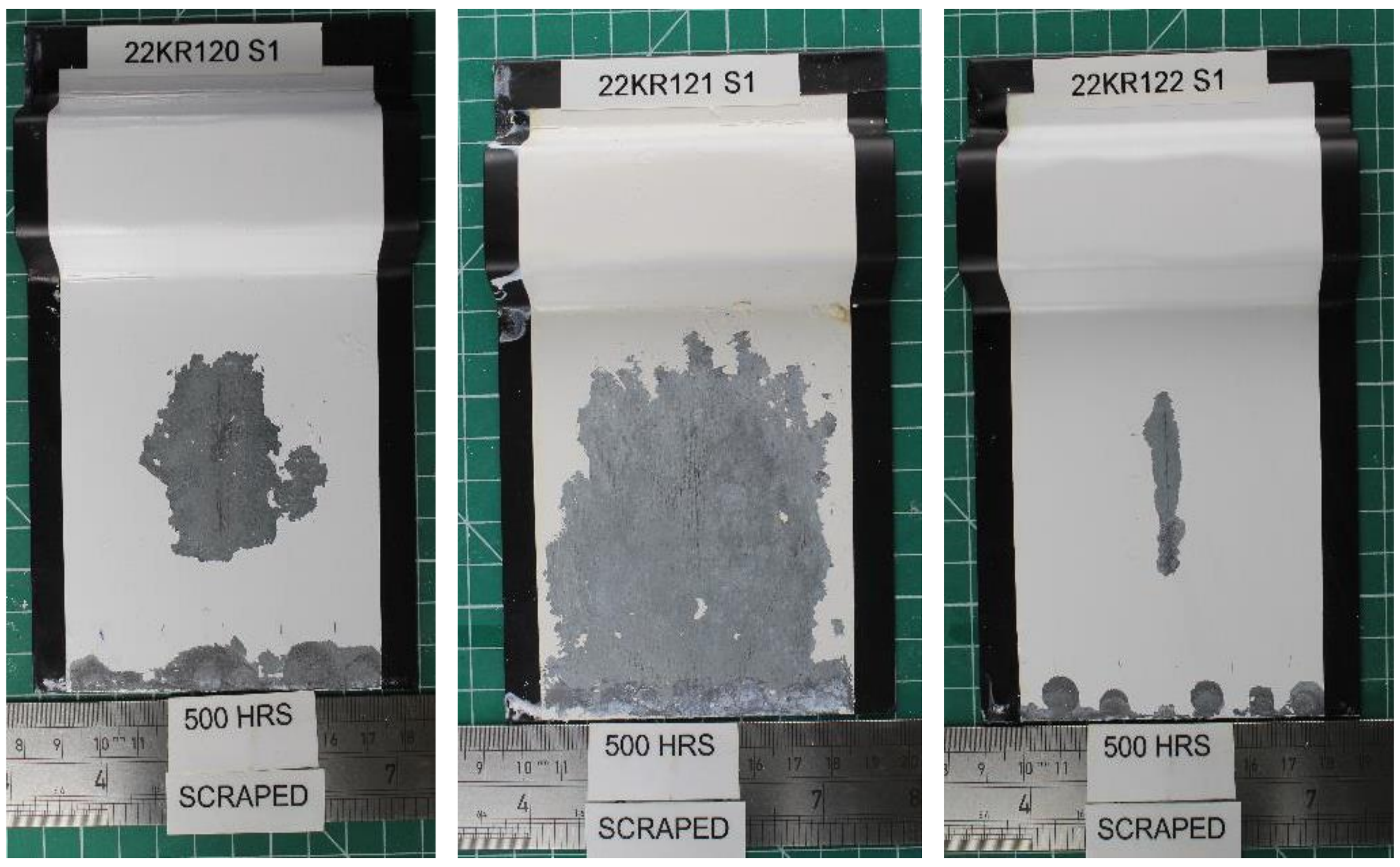


Figure 1, Salt spray results (BS EN 13523-8) 180 X 100mm BESPOKE WA6 Vertical scribe only, for industry standard coating (left), Bio-PE 1 (middle) and Bio-PE 2 (right).

Coating Properties and Weathering

Test	Standard	Bio-PE 1	Bio-PE 2
Gloss	30-40	35-40	35-40
DFT	18-20 µm	16-17 µm	17-18 µm
T bend	2T	1 ½T	0T
Pencil Hardness	H	H	H
D MEK rub	>100	50	80
Reverse Impact @2 kg	40"	15"	40"
Crosshatch Adhesion	4B	3B	4B

Table 1, comparison of mechanical properties of respective coatings.

Although Bio-PE 1 has highest gloss retention after 2000 hours of QUV, Bio-PE 2 has mechanical and weathering properties that are **comparable if not better** than the standard fossil fuel based coating. This demonstrates gradually introducing renewable content into paint formulation can have a **benefit** on coating performance.

Properties of Polyester Resin

Bio–PE resin 1 was synthesised with HHPA, succinic acid, NPG, isosorbide and glycerol for **54 hours**. The non-volatile content (NVC) was 64.7% with a **renewable content of 30%.**

It was suspected that the stereochemistry of isosorbide was responsible for long reaction time of Bio-PE 1 due to an intra-molecular hydrogen bond between an adjacent hydrogen atom and hydroxyl, which made one side of the molecule less reactive leading to a high polydispersity of **7.8**.

Bio–PE resin 2 excluded isosorbide and was synthesised with just HHPA, succinic acid, NPG and glycerol for **30 hours**. The NVC was 67%, a final **renewable content of 23%** was achieved.

Although the renewable content was reduced by 7%, Bio-PE 2 compensates with a reduced reaction time, this saves energy and cost with additional benefit of mechanical and weathering properties which makes the formulation viable to be used by industry.

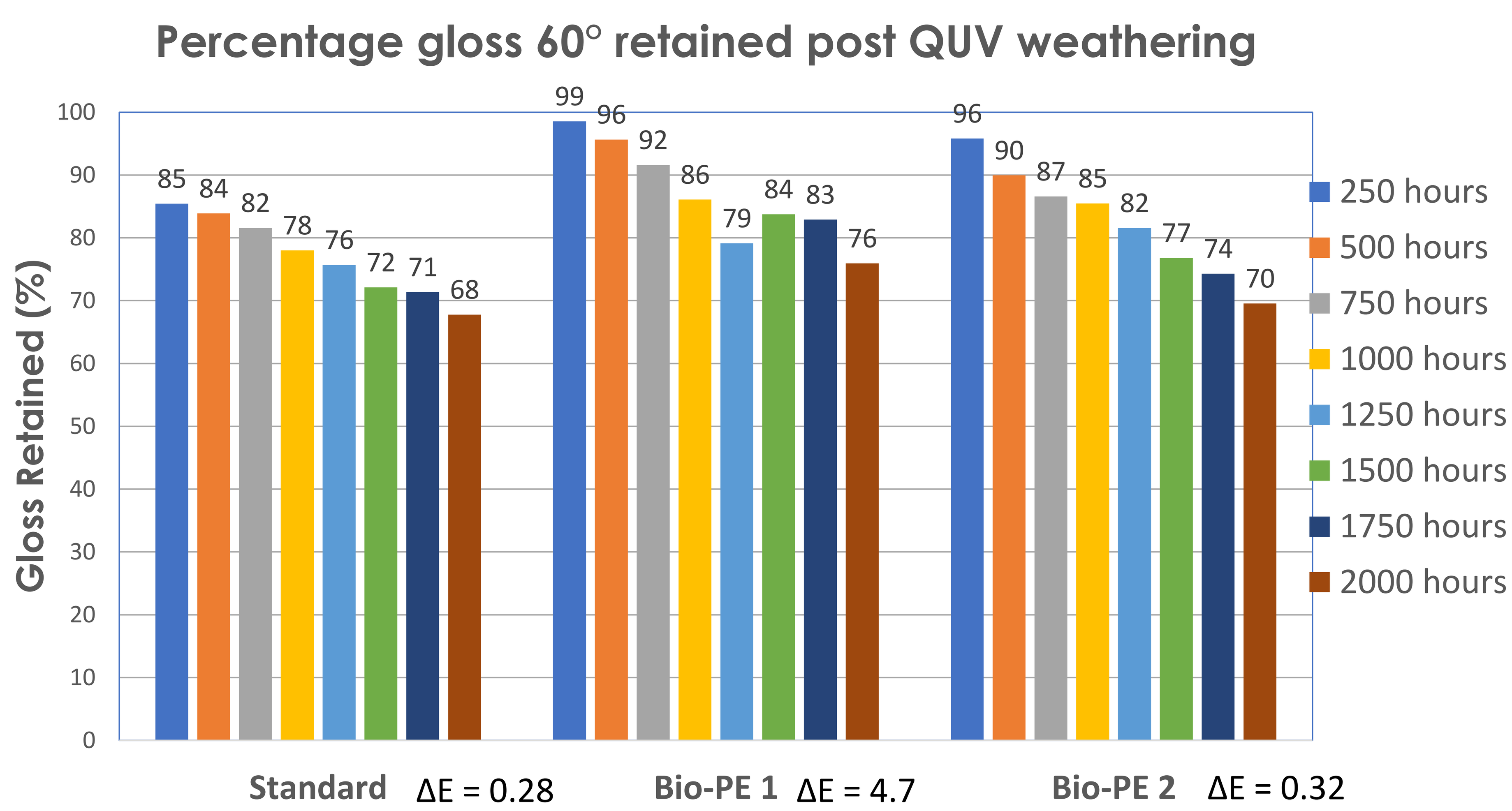


Figure 2, Percentage gloss 60° retained after QUV weathering (BS EN ISO 11507:2007) up to 2000 hours. ΔE values calculated after 2000 hours from initial colour.

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