O 19

Smart hybrid organic-inorganic coating offering long-term corrosion protection to aluminium alloy

Natacha DUÉE [(1)], Thomas STIMPFLING [(1)], Florent DELIANE [(1)]

1 - Rescoll, Pessac, France

With the approaching sunset date for the use of Cr(VI), there is an urgent need to find industrially viable alternatives to Cr(IV) surface treatments. Replacement treatments must match or exceed performance expectations, while also addressing safety, environmental and economic concerns. To date, a great deal of research has been undertaken in search of such replacements; however, commercially available alternatives struggle to meet the necessary requirements.
Sol-Gel technology is fast becoming a recognized approach for producing anticorrosion coatings. Such synthesis method enables to obtain a 3µm-thick coating that prevent corrosion up to 350h [1] on unclad 2024 T3 aluminium alloy in neutral salt spray test (NSS). Nevertheless, industrial aeronautical system composed of an anodization, a primer and a top-coat resists up to 3000h of NSS. There is a need of Sol-Gel coating to achieve such performance by combining passive barrier properties provided by the Sol-Gel synthesized matrix and active corrosion resistance brought by corrosion inhibitors when damage occurs . But, other issues have to be solved in order to fulfill industrial requirements: adhesion to the substrate, fissures and cracks of thick coatings, compatibility with corrosion inhibitors, shelf life and pot-life stability and ensuring that the matrix is well synthesised when using a ready-to-mix 2 component liquid varnish.
Research performed by RESCOLL in this field have led to the development of a new smart and green class II hybrid organic-inorganic Sol-Gel coating which offers long-term anti-corrosion protection (3000h of NSS according to ISO 9227), high adhesion to aluminium substrates and improved mechanical properties such as bending and scratch resistance. In addition, application conditions have been studied in order to achieve a 2-component product that can be sprayed and cured at temperatures lower than 120°C. Such properties have been investigated by studying the choice of precursors and their organic-inorganic ratios, and studying the hydrolysis and condensation rate in order to define the best micro-structured inorganic network versus anticorrosive properties. In complement to NSS, electrochemical impedance spectroscopy (EIS) enabled to quantify the coating barrier effect and the activity of inhibitors. Once the synthesis parameters achieved, investigations focused on the Sol-Gel synthesised material stability over time. It has been proven that, by combining structural characterization to EIS and NSS, the reactive components are stable for more than 3 months and that the coating meets the requirements.
This study enabled to determine the adequate synthesis conditions and formulation properties that allow the hybrid organic-inorganic Sol-Gel coating to meet all evaluated specifications. Finding a viable alternative to chromate-based long terms anticorrosive coatings in the next future is no longer a dream!

REFERENCES

[1] S. Bera et Al. Progress in Organic Coatings 88 (2015) 303.

KEYWORDS

hybrid -protection-anticorrosion-coating-