



Rapid Response

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Rapid Response Research

Alternatives to Lead Anodes in Chrome Electroplating Oregon Department of Environmental Quality

April, 2008

Request

The Oregon Department of Environmental Quality is interested in finding out what alternatives exist for lead anodes used in chrome electroplating on mild steel. They would also like to know if it is true that titanium anodes are not an option due to fluoride ions in the company's plating bath.

Background

Platinized titanium is an alternatives to lead anodes, but has limitations if fluoride is in the plating bath, as is common in chrome baths.

Fluorides are added to chromium baths (Cr6+ and Cr3+). Sodium fluoride up to 500 mg F-/l is added to activate steels by polarity reversal. Fluoroborates or silicofluorides are added in self-regulating Cr6+-baths. The fluoride content varies with the bath producers and reaches up to 2 g F-/l.

The free fluoride ion (F-) attacks the metals of the anode. The severity of the corrosion depends on the F- content, other bath parameters and the anodic current density and starts from the weakest surface areas, like scratches, fissures and pores in a coating. The user seldom knows the F- content of his bath.

Platinized niobium is another possible alternative to lead, in chrome electroplating.

Key Findings

Several international vendors were contacted. Most concurred with the response of this vendor, and suggested that Niobium is their main recommendation as an alternative to lead anodes. And, that Platinized titanium may work for very low concentration of fluoride ion (< 2 parts per million – ppm) in the bath.

“Please be confirmed that platinised anodes are a viable option to replace lead anodes. The advantage of platinised anodes, next to avoid lead sludge pollution of the plating bath, is the dimensional stability due to which a more stable and homogeneous plating process can be obtained. Next, platinised anodes are much more flexible in shaping and dimensioning so that the anodes can be designed according to the shapes of the work pieces to be plated, as a consequence of which the chrome layer will be much more homogeneous in thickness.

Whether Titanium can be used as an anode substrate depends on the electrolyte

composition, where usually Fluoride will be the limiting factor. Fluoride is corrosive towards the Titanium, and we advise a maximum level of approx. 2 ppm, depending on the application conditions.

In case the Fluoride content exceeds 2 ppm, as a suitable alternative Niobium may be used instead of Titanium. Niobium is much better corrosion resistant than Titanium, but at very high Fluoride levels Niobium may corrode as well.

It must also be taken into consideration that Titanium has a lower electrical conductivity compared to lead so the anode design may be subject to changes in order to be able to pass through the required amount of current.”

Bath tests are advised for the producers or users of chrome baths to determine which type of alternative anode will work best.

Other Notes

From David Langston, EPA:

Practical experience shows platinized Titanium anode (PTA) with 5 microns Pt works nearly one year at 50 mg F-/l, nevertheless we recommend Platinized Niobium anode (PNA). Niobium (Nb) withstands a F--content until 600 mg / l, a PNA is used from 50 to 500 mg F-/ l up to currents of 20 Amps / sqdm. For even higher F--contents PTW can be used. But metal mesh out of tungsten cannot be produced.

Also fluoride is added to decorative black Cr³⁺-baths. For these baths mixed oxides activated titanium (MMOA) is applied. In the version of IrTa-oxide users have added F- up to 50-100 g F-/ l. The coating withstands up to 600 g F-/ l, but scratches and pores in the coating limits the use. The whole anode immersed inclusive the splash zone needs to be covered with the MMOA-layer.

PTA with 5 microns Pt-layer failed after 11 months in a bath of 90 mg F-/l. MMOA Ti-anodes were used for years in a trivalent chrome bath at 70 mg F-/l.

Conclusions

PTA can only be used at low F--content of ~ 10 mg F-/l. For F—content up to 600 mg/l PNA is be used, higher F--content requires tungsten as the base. The user is advised to test the suitability of Nb or W as anode substrates under the actual plating conditions.

Additional Resources

MAGNETO special anodes B.V.

http://test.yoursite.nl/magneto.nl/home.en_US.html

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