Alternatives to Lead Anodes

Dimensionally Stable Anodes used in Hard Chrome Plating

In the hard chrome plating process, dimensionally stable anodes offer several advantages in comparison to conventional systems, such as lead anodes. Their significantly lower energy consumption, shorter downtimes and reduced disposal costs have a major impact in the long term.

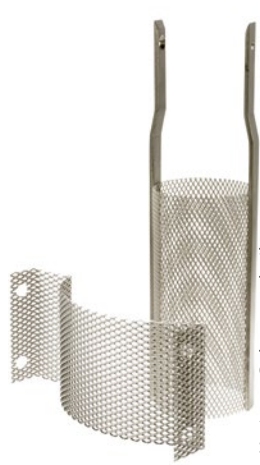
Governments all over the world have put protecting the environment near the top of their list of priorities. In Europe, the REACH directive has resulted in the introduction of more stringent regulations. In the USA, there has been strong pressure from the public in this area and suppliers are discovering green production as a marketing tool and a means of differentiating themselves from their competitors. The subject has also been an important consideration in Asia for some time. Companies that want to set up manufacturing plants in China are faced with environmental legislation which meets Western standards. Decision-makers in the electroplating industry also need to take this trend into consideration and make the right long-term decisions when investing in machinery. In the hard chrome plating process, dimensionally stable anodes have significant advantages in comparison to conventional systems. Until now, lead anodes have been the standard solution for hard chrome plating, but it is likely that lead will have to be replaced sooner or later. There are a number of arguments in favour of lead anodes. They provide good, although not excellent, results and they have a low purchase price. In a highly competitive mass market like that for chrome plating, many suppliers try to avoid high initial investment costs. But the question is whether their calculations remain as impressive in the long term.

Concealed costs of disposal and maintenance

Most users are familiar with the disadvantages of lead anodes. They are costly to maintain and dispose of and also involve concealed costs that are often underestimated. Lead anodes are not dimensionally stable and can become deformed. Once this has happened, an homogenous coating distribution can only be achieved with extensive maintenance work. Even then, mechanical finishing in the form of grinding or polishing is normally required. In addition, there is definite room for improvement in the quality of the coatings.

However, in the light of environmental issues, all of these things are not the most serious problems. Lead chromate sludge builds up on the floor of the tank. It is a hazardous substance and needs appropriate disposal measures which are time-consuming and expensive. Employees are also exposed to this hazardous material during the cleaning and disposal processes.

When the total costs of chrome plating are considered, downtimes must be included in any calculations of cost-effectiveness. But what alternatives are available on the market? Platinised titanium anodes (Pt/Ti) have had a good reputation over a long period, have been used in hard chrome plating processes for decades and are suitable for a wide range of applications. There are few arguments against platinised anodes, but the main one is that often raised by buyers. They are much more expensive to purchase than conventional lead anodes.



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Platinised titanium anodes have long-term dimensional stability and require little maintenance, which makes them a cost-effective alternative to lead anodes.

Assessing the cost-effectiveness of platinised anodes

However, after closer consideration it soon becomes clear that platinised anodes not only offer significantly higher quality results. In the longer term, their considerably reduced electricity consumption, resulting from the lower oxygen overvoltage and the higher conductivity of the system components, and their shorter downtimes and lower disposal costs all have an impact. Definitive information about the payoff period can only be given in individual cases, but the break-even point is often reached after around two years.

In particular those companies that need to chrome plate cylindrical components would be well advised to take a closer look at dimensionally stable anodes. Against the background of the environmental considerations and the longer-term investment in machinery, it is important to consider all the technologies available on the market.

The ideal cost/benefit ratio

Dimensionally stable anodes represent an effective method of chrome plating and offer an ideal cost/benefit ratio because of their reusable components. In the medium term, the ongoing costs of lead systems are significantly higher, because Pt/Ti anodes can be replatinised. A credit note for the residual precious metal amounting to around ten percent is normal in this case. In addition, no recurring costs for reusable components such as frames and power supplies are incurred. As a result, the costs of replatinising the anodes can be reduced by 40 to 50 percent.

In technological terms, platinised anodes have significant advantages over their lead counterparts. The high-purity platinum coating on a titanium substrate is highly corrosion resistant, which results in a significant increase in the service life of the anodes, together with much longer maintenance intervals and shorter downtimes. In addition, the anodes are much lighter in weight than their lead equivalents, which means that they can be installed and removed more quickly.

The manufacturing process for Pt/Ti anodes involves applying the coating with high-temperature electrolysis. Platinum or other precious metals are applied to refractory metals, such as titanium or niobium.

High-temperature electrolysis produces higher quality results

During the high-temperature electrolysis process, the coating is produced on the anode in molten salt with a 1 to 3 percent platinum content at a temperature of 550°C. Current densities between 1 and 5 A/dm^2 and a coating voltage of 0.5 to 2 V allow for deposition rates between 10 and 50 µm/h. The anodes to be coated pass through an airlock into an enclosed system with argon gas where the molten salt is located.

Anodes coated using high-temperature electrolysis are significantly superior to products coated with platinum in aqueous electrolytes. The purity of the coating is at least 99.9 percent, which is much higher than in aqueous solutions. The ductility, adhesion and corrosion resistance of the platinum coating are considerably better, while the internal stresses are kept to a minimum. The coatings that are applied using these anodes are also of much higher quality. The coating thickness distribution is much more uniform, because of the dimensional stability of the anodes.

Improved coating thickness distribution

Another advantage of Pt/Ti anodes is that they are individually designed, tailor-made solutions. Detailed consultancy from the company manufacturing them ensures that the products can accommodate the maximum number of component shapes while also providing a customised solution. This allows the coating thickness distribution to be accurately controlled and gives improved results.

Cylindrical anodes made from expanded metal are the most common solution. In order to maximise the surface area, designs with an optimised mesh size are used. The expanded metal anodes enable gases to escape more effectively and increase the movement of the electrolyte to give a higher coating current density and smaller distances between the anode and the cathode.

A range of applications for platinised anodes

Many industries are exploiting the benefits of anodes platinised using high-temperature electrolysis, including the lighting sector. Umicore Galvanotechnik has been applying platinum coatings to molybdenum wires and tapes for companies in this area over a long period. Each year the company coats around 700 kilometres of tapes and wires for special lighting applications. This type of electroplating is also relevant for a wide range of other industrial applications. Pt/Ti anodes are widely used in the semiconductor and PCB industries, as well as in the automotive and water treatment sectors. ▮

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