# Cadmium-polymer paint coatings based on epoxyamine polyelectrolytes obtained by the methods of cathodic electrodeposition

Lwin Ko Ko

## Abstract

Polymer coatings are effective for protecting metals from corrosion and imparting special properties to the surface of products. A well-known industrial method of obtaining anticorrosive coatings is the method of electrodeposition of polymer electrolytes, which is widely used to obtain primer and single-layer coatings. For this, polyelectrolytes are used, which in an aqueous medium, depending on the pH of the medium, are able to change their solubility. The main electrochemical process during the electrodeposition of polyelectrolytes consists in the electrolysis of water, as a result of which the near-cathode layer is alkalized (pH reaches 14), and the near-anode layer is acidified. Accordingly, amine-containing polyelectrolytes dissociating in an acidic medium, due to the occurrence of a chemical reaction with OH-, lose their solubility in the alkaline medium of the near-cathode layer and are deposited on the cathode.

The pigments and fillers of the system are electrophoretically deposited. The formation of the electrode sediment is accompanied by electromosome and syneresis, due to which the sediment is compacted and dehydrated. The time for the electrodeposition of polymer electrolytes is 2-3 minutes, during which a single-layer polymer coating 15-25 microns thick is formed. The formation of an insoluble crosslinked three-dimensional polymer coating is facilitated by the subsequent thermosetting of the precipitate. However, along with the advantages, they also have a significant disadvantage - low, in comparison with metal coatings, hardness.

It is now known to use materials of a mixed type, namely, metal-polymers, which are hybrid systems based on polymers and highly dispersed metal particles

adsorption-bound to them. The resulting heterogeneous systems have flexibility, elasticity, strength, like polymers, and hardness, thermal and electrical conductivity, like metals.

This paper presents a new technological method for obtaining metal-polymer coatings by combining the electrolytic reduction of a metal from its salt and cathodic electrodeposition of amine-containing film-forming electrolytes. It was proposed to use cadmium as a metal for obtaining metal-polymer coatings. The fact is that a galvanic cadmium coating is used to protect ferrous metals from corrosion in particularly harsh conditions, for example, on ships and aircraft. This is due to the fact that the electrochemical potentials of iron and cadmium are the closest. Cadmium coatings have a longer service life than zinc. Despite the limitation of the use of cadmium since 2016 in Russia and the European Union, which means that the cadmium content in products should not exceed 0.01% of the total weight of the product, 40% of the produced cadmium is used for applying anti-corrosion coatings to metals, since the total weight of the coating in the mass of the product is insignificant. All attempts to replace cadmium coatings have so far been unsuccessful. Because of this, in a number of countries, for example, in China and Myanmar, there are no restrictions on the use of cadmium.

**The purpose of this dissertation work** is to study the process of joint electrodeposition on the cathode of a water-soluble epoxyamine oligomeric electrolyte a film-former and a cadmium salt (acetate), to clarify the mechanism (the sequence of deposition of the components of the composite system on the cathode) of this process, to develop an experimental technology for obtaining cadmium - polymer coatings and to study the properties of the resulting coatings.

- Determine the optimal composition of an aqueous composition based on polyelectrolyte and cadmium acetate corresponding to obtaining coatings of sufficiently good quality;

- Investigate the mechanism of joint electrodeposition at the cathode and identify the optimal parameters of the process;
- To study the morphology, composition and structure of cadmium-polymer coatings;
- To obtain a pigmented cadmium-polymer composition and determine the physical-mechanical and corrosion-protective properties of cadmium-polymer coatings.

**Scientific novelty**

For the first time, cadmium-polymer coatings were obtained by the method of electrodeposition of an epoxy amine polymer electrolyte and cadmium acetate at the cathode. The optimal composition and the conditions of joint electrodeposition for obtaining good quality cadmium-polymer coatings have been determined.

Using modern methods of physical and chemical analysis, the sequence of deposition of components of the composite system on the cathode during the formation of a cadmium-polymer coating is established. It is proved that the deposition of cadmium occurs at the initial time, so the cadmium is concentrated at the substrate, forming a protective pair with the metal.

It is proved that the introduction of cadmium into the structure of the coating increases the degree of crosslinking of the polymer film-forming, which is confirmed by a decrease in the temperature of the onset of curing, as well as the calculated value of the molecular weight of the chain segment.

It was found that cadmium-polymer coatings, while maintaining good adhesion and elasticity, exceed polymer coatings in hardness and strength have 1.5 times greater than polymer coatings.