Change of the Decorative Properties of Zinc-Plated Zinc Die Castings over Time

Zinc alloy die casting is often chosen for the manufacturing of various consumer goods, since this process allows manufacturing of parts with a consistent quality and a high cost efficiency. With regard to recycling, using zinc electrodeposition as a surface treatment for zinc die cast offers clear advantages. However, it is often noticed that bright zinc-plated coatings on zinc die cast components change color over time, developing distinct blue spots on the surface. In the present study, zinc-plated zinc die cast components were aged and characterized via Energy-Dispersive X-ray Spectroscopy, X-ray diffraction, and gloss and color analyses to make a conclusion on the mechanism of tarnishing. It was found that over time aluminum from the substrate diffuses through the coating, with the different diffusion rates for the coatings that were deposited from the different electrolyte types. Thus, alkaline zinc showed higher rates of aluminum diffusion compared to acid zinc. It was speculated that aluminum diffusion through the coating followed by oxidation under the influence of ambient moisture and contaminants triggers the observed blue discoloration.