

NEW FINISHES FOR ZINC ALLOYS (*)

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Since 1958, the International Lead Zinc Research Organization (ILZRC) has pursued a number of projects which have resulted in new methods of polishing and finishing of zinc alloys. This paper surveys the six important developments which have arisen as a result of ILZRC research in the finishing field.

ELIMINATION OF BUFFING BY A NEW FINISHING AND PLATING CYCLE

In the current practice of copper plating on zinc die castings all the castings must be buffed before plating. A lot of blistering also occurs during processing and storage after plating. To avoid this problem, ILZRC sponsored research projects which resulted in a new copper plating process. This process, by which buffing can be eliminated, entails a 3 to 4-minute copper strike in an ultrasonically agitated pyrophosphate solution followed by 12 to 20 minutes of bright, levelling copper in an acid copper solution.

The advantages of the new process are: (1) Buffing is eliminated since excellent levelling is obtained over vibratory-milled or spot-polished parts (2) Remarkable pore-filling capacity is exhibited (3) Deep recesses and blind holes are protected by the pyro-phosphate bath against excessive attack during plating (4) It is easier to control and maintain (5) The pollution problem is reduced (6) This new process overcomes all the disadvantages of present day copper striking procedures.

NEW DURABLE NICKEL-CHROMIUM PLATING SYSTEMS FOR ZINC ALLOYS

In each of the five exposure programmes initiated by ILZRC at 12 or 18 months intervals since 1962, it has

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been shown that zinc die castings plated with bright or duplex nickel and microcracked chromium exhibit good resistance to corrosion. Systems incorporating microcracked chromium always proved better than those systems which included duplex nickel and crack-free, microporous or conventional chromium. Composites including only 15 μm of duplex nickel and microcracked chromium supplied greater protection than those containing 30 μm of duplex nickel and conventional 0.1 - mil chromium. The microcracked chromium contained 400 to 800 cracks per linear centimetre in a uniform closed network. Thickness was 0.75 μm . It was plated in two layers in chromic-sulphuric-fluosilicic acid solutions. Selenic acid was added to the second bath.

Chromium containing a large number of microscopic pores coinciding with dispersed insoluble particles integrated in the final layer of bright nickel delayed basis metal corrosion on die castings plated with 2 or 4 layers of nickel. Fine pitting and staining led to dulling of the microporous chromium surfaces. Microcracked chromium resisted pitting and staining for longer periods and was more effective in delaying basis metal corrosion.

On die castings plated with 30 μm of duplex nickel and 0.25 μm of conventional chromium, invisible cathodically precipitated films of hydrated chromium oxide delayed nickel-corrosion pitting and basis metal corrosion. It was noted that such films exhibit an impedance value of 80 to 90 ohm-sq.cm. after drying.

AUXILIARY ANODES FOR NICKEL AND CHROMIUM PLATING

A number of practical difficulties are encountered while plating complex die castings with nickel and chromium using the conventional process. Firstly, the thickness of the nickel and chromium coatings varies considerably and secondly, it is seen that recessed areas corrode faster than other areas that receive a greater share of the current. In this context, ILZRO examined the feasibility of using auxiliary anodes at recessed areas and checked the effectiveness of this method by comparing thickness distribution patterns with and without the auxiliaries. It was seen that on castings such as automobile headlamp housings, the use of auxiliaries inside each lens opening increased the thickness by nearly 300%. Therefore, the plating time was shortened to adjust the minimum thickness to the specified requirements and then the amount of nickel deposited with auxiliaries was compared to that deposited without them.

The use of auxiliaries brought about a reduction of 60% in nickel consumption for door handles. The plating time was shortened by 30% and nickel consumption was reduced by 40% with auxiliaries placed near the push-button aperture. A proportionate decrease was obtained in the chromium plating time.

ADHERENCE OF DECORATIVE PAINT ON CHROMIUM PLATED ZINC

There is poor adherence of paint on chromium surfaces which are contaminated with grease, oil, minerals, alkaline residues and other foreign materials. Another cause for the poor adherence of paint is the rinsing after chromium plating of the die castings with deionized water containing 20 ppm of dissolved minerals which leave residues. It is, therefore, recommended that rinsing be done with water containing less than 5 ppm of dissolved minerals. Field work has indicated that these ILZRC recommendations are effective and have produced good results in several plants painting selected areas of chromium plated zinc die castings for decorative effects. Surfaces affected by dirt films which are deposited before painting can be cleaned by immersion in hot solutions (70° to 75°C) of chromic acid (0.25 to 0.5 g/l). However, it is imperative that greasy dirt films should be cleaned first with hot alkaline solution.

ZINC ANODIZING

The anodizing process brings about a dramatic improvement in the corrosion resistance of zinc. However, anodizing should not be thought of as competing with the cheaper chromate conversion coatings which are adequate for many applications. The new technique was developed by the Consolidated Mining & Smelting Co. of Canada Ltd. (Cominco) in a programme sponsored by ILZRC. A family of four anodized finishes now provides zinc with inexpensive, quality coatings which exhibit high corrosion resistance and have the added advantage of increased aesthetic appeal. The four colours available are brown, green, grey and dark grey. Anodizing can be applied to wrought or die cast zinc parts, galvanized zinc or even over sprayed zinc. Corrosion resistance under neutral salt spray is excellent. For instance, tests on one of the coatings designated APCF showed an index number of 100, signifying no corrosion after 8 days of exposure to the ASTM 5% NaCl salt fog test.

Zinc anodizing produces a film of the barrier-layer type, porous structure overlying the initial barrier-layer. In zinc anodizing, a complex fritted compound of fused particles is formed by anodic spark discharging beginning at about 65 to 70 volts. The coating is hard, porous, absorbent and has excellent masking properties. It is thicker, harder and more corrosion resistant than zinc chromate or phosphate conversion coatings. Because of the porous nature of the coating, the anodized film is very receptive to paint, enamels, lacquers, protective coils and waxes.

CLEAR, COLOURLESS COATINGS FOR ZINC ALLOYS

Research was conducted by DeBell & Richardson, Inc. under the sponsorship of ILZRC, which led to the development of clear colourless lacquers that help preserve the lustre of polished zinc. An initial exploratory test in 1963 screened ten primers and 23 top coats by accelerated ultraviolet, salt and humid aging, and showed maximum promises for a system composed of soyabean oil-modified epoxy resin ester primer covered by a thermosetting acrylic topcoat containing 2% benzotriazole ultraviolet light absorber to protect the epoxy resin underneath and this coating system compared very favourably in appearance with the chromium plated panels employed as controls. In this series of tests, however, none of the coatings was able to match the high reflectivity of the chromium plated samples. A more extended study was undertaken in 1964 to improve the reflectivity and explore the full range of useful epoxy primers, acrylic top coats and ultraviolet light absorbers.

The results of the second study indicated that a thermoplastic acrylic resin solution, applied over the same primer as used in the first test and employing the same or similar ultraviolet light absorbers, performed at least as well and perhaps slightly better than the thermosetting acrylic coating which produced the best results in the first study. However, there was one difficulty in the second series of coatings developed. Accelerated aging caused slightly greater loss of reflectivity in the coated panels than the plated panels with the exception of one chromium plated control part, when exposed to salt water. The results of the second study show that in an optimum cleaning procedure zinc products should be polished with a water-based spray buffing compound, cleaned in boiling 1:1:1 trichlorethane vapour and dried for 5 minutes at 120°C.

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