

Extrusion-free fabrication of zinc-rich powder coatings by press bonding

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Abstract Since the 1970s, powder coatings have been preferred to liquid coatings because the all-solid composition provides environmental benefits. For heavy-duty applications such as offshore wind power transformers, zinc-rich powder coatings (ZRPCs) are being increasingly used to replace their solvent-based counterparts. However, current ZRPCs can only load ~70 wt.% zinc, which cannot meet the high anti-corrosive requirements that are shown when the coatings have a zinc concentration over 80 wt.%. Above 70 wt.% zinc, powder coatings manufacturers encounter problems with powder homogeneity and extruder screw wear.

Here, we demonstrate for the first time an extrusion-free method to fabricate ZRPCs by employing a press to avoid using the extruder. The polyester clearcoat was first ground into ultrafine particles, mixed and press-bonded with zinc dust, ground and sieved to obtain coating powders. After press bonding, it was observed that the binder and zinc particles formed a raspberry-like zinc-on-binder structure.

With press bonding, the zinc dust content can reach 88.9 wt.% in the coating powders and about 85 wt.% in the coating films. Additionally, the press-bonded zinc-rich coating films with 80 wt.% zinc showed slightly lower barrier effects, a more uniform dispersion of zinc particles and a higher zinc utilization and in turn, better cathodic protection (110 days), higher sealing effect, fewer localized corrosion sites, and narrower corrosion creepage (1.3 mm) after 2500 h of salt spray tests than the extruded coating film. This study contributes to the fabrication of extrusion-free ZRPC with zinc content higher than 70 wt.% and extends the applications of powder coatings in heavy-duty anticorrosive coating industries.

Keywords: zinc-rich; powder coatings; heavy-duty; press bonding; extrusion free