

Incorporation of alternative conductive particles in zinc-rich paints and its influence on mechanical properties and corrosion protection

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Incorporation of alternative conductive particles in zinc-rich paints and its influence on mechanical properties and corrosion protection

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Introduction

Zinc-rich paints
(ZRP)

- known coatings
- widely used to protect steel structures
- used as a primer in high-performance paints in several aggressive media
- high metallic zinc content in the dry film



electrical contact among the particles and between them and the steel substrate

The importance of zinc is the offered steel corrosion protection, that occurs by two mechanisms: **cathodic protection** and **barrier protection**



- zinc concentration
- porosity of the dry film



- adhesion between the paint and the substrate surface

Objective: to modify commercial ZRPs with nanometric zinc, lamellar zinc, and core-shell particles covered with polyaniline to obtain better mechanical properties without losing corrosion protection ability.

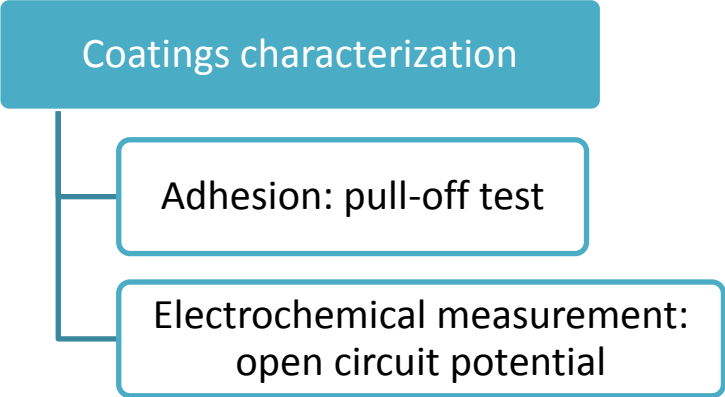
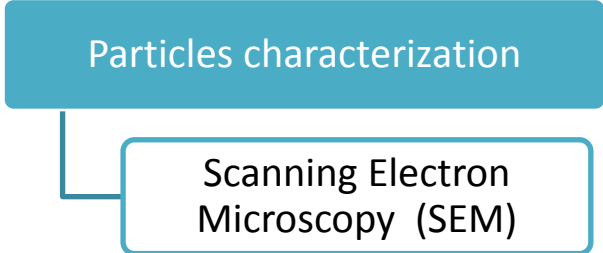
Methodology

Table 1 – Concentration by weight of ZRPs components.

ID	Base formulation	Zinc powder*	Zinc nanoparticles	Lamellar zinc	Conductive polymeric particles
ZRP_reference	22.75 %	77.25 %			
ZRP_N	27.02 %	72.67 %	0.31 %	-	-
ZRP_L	26.65 %	72.67 %	-	0.68 %	-
ZRP_P	27.14 %	72.67 %	-	-	0.19 %

* Traditional micro spheres used in commercial ZRPs.

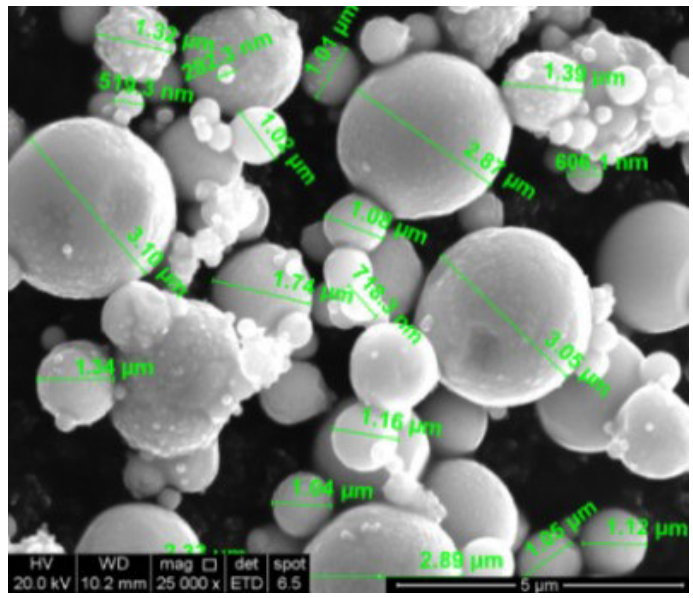
Conductive polymeric particles were synthesized with core-shell morphology: **polymeric insulating core** and **polymeric conductive shell** (polyaniline emeraldine salt).



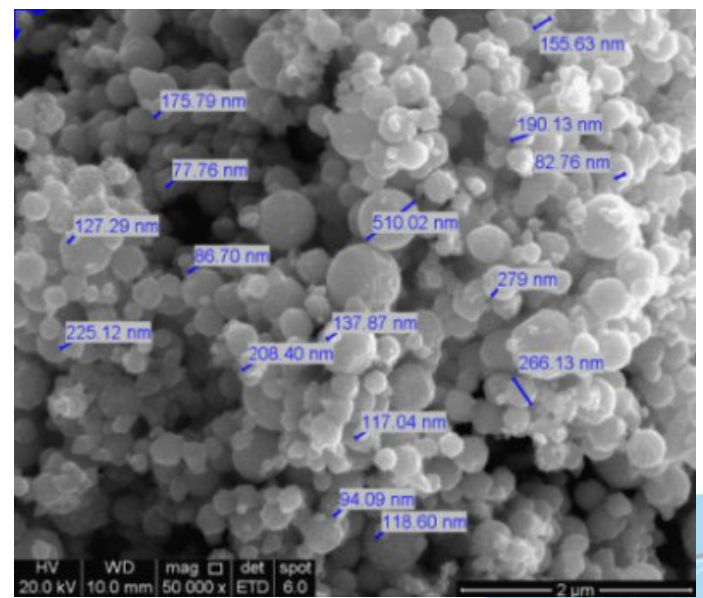
Results and Discussion

Alternative conductive particles morphology

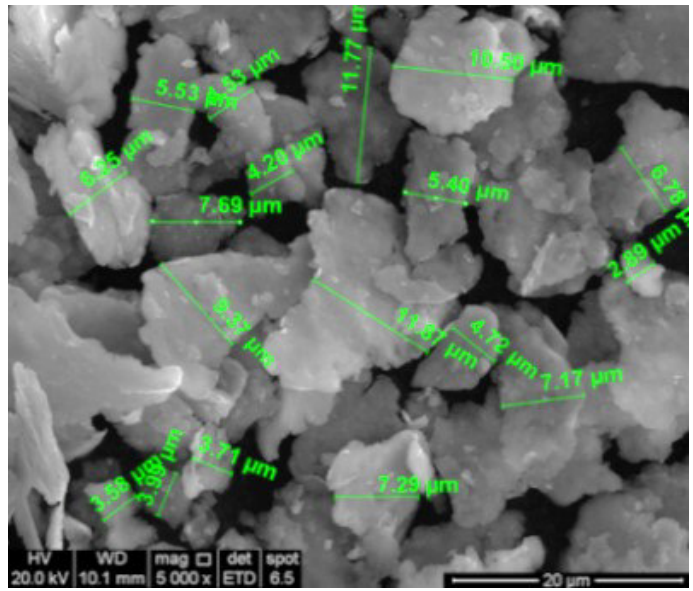
Zinc powder



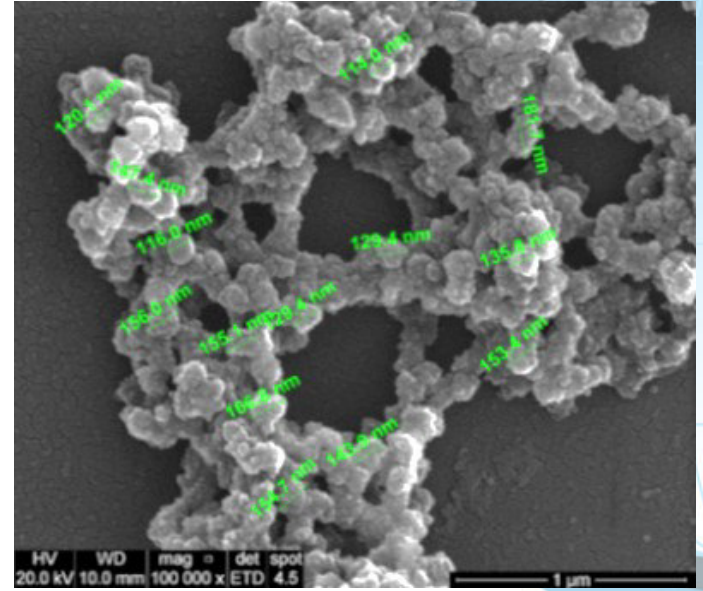
Zinc nanoparticles



Lamellar zinc



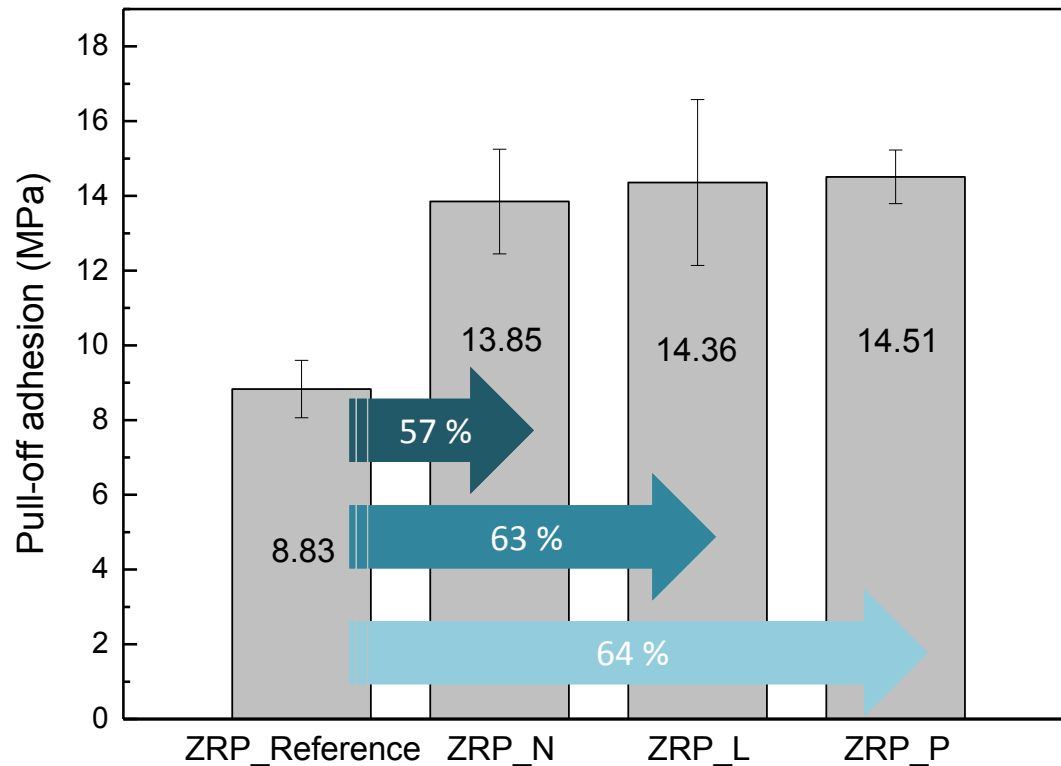
Core-shell particles



Results and Discussion

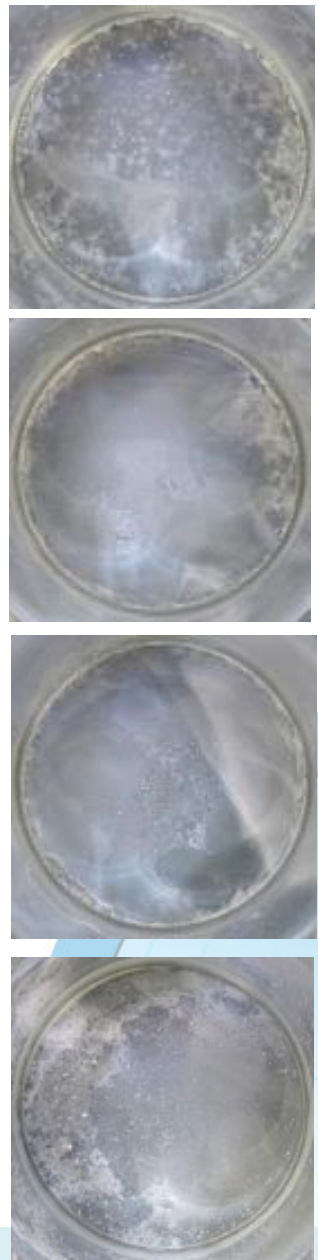
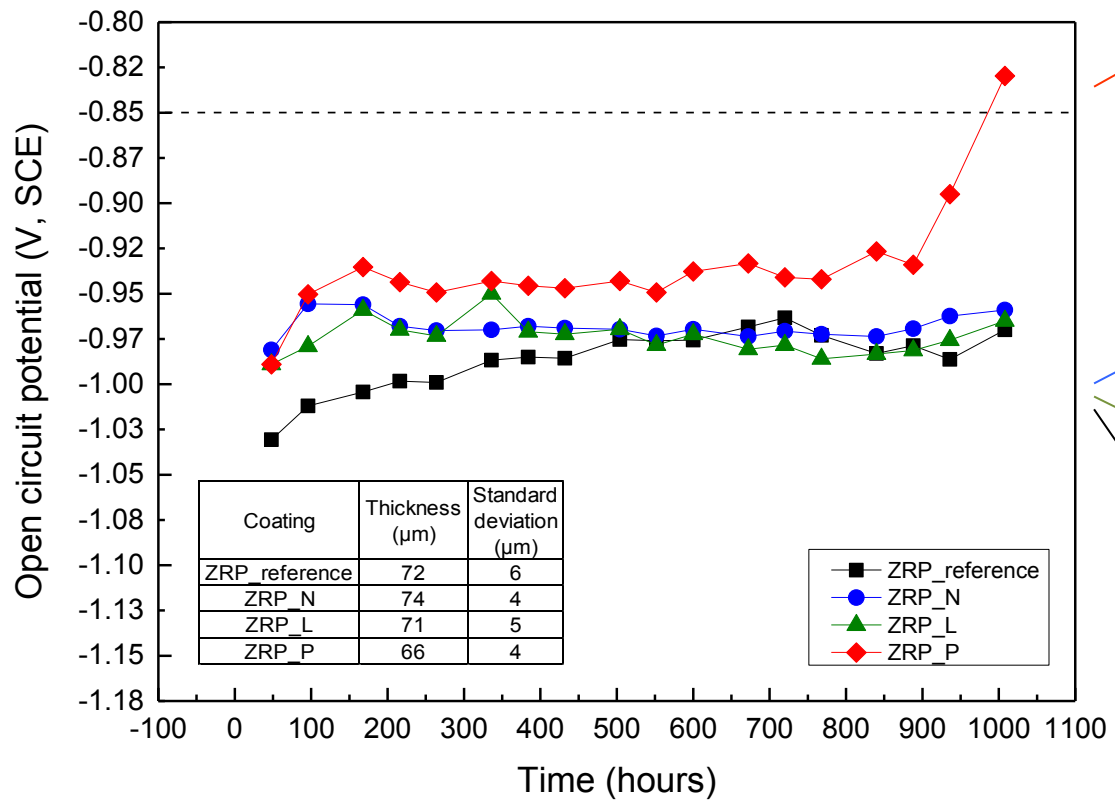
Pull-off adhesion

- All the samples presented a detachment between the paint layer and the substrate, indicating a **good cohesion** of the coatings.
- The **decrease of the total zinc concentration** in the modified ZRPs is responsible for the **increase in adhesion**.



Results and Discussion

open circuit potential



Brazilian standard PETROBRAS N1277-2017: no failure should be observed after 1000 h of immersion, including corrosion of the steel, and the measured electrochemical potential should be more negative than -0.85 V (SCE).

- ZRP_reference, ZRP_N, and ZRP_L protect the substrate cathodically.
- ZRP_P protect the substrate cathodically for 975 h. In 1000 h of immersion: barrier protection.

Conclusion

Better mechanical performance than the ZRP_reference and satisfactory corrosion protection properties were verified for three studied coatings (ZRP_N, ZRP_L, and ZRP_P) with alternative conductive particles.



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