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Formulation of Anti-Corrosion Coatings Using a mill scale-Based Pigment

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INTRODUCTION & AIM

A large part of the steel is shaped into semi-finished products like profiles, strips, sheets, and tubes in rolling mills. The slabs leave the furnace at 1100°C and remain above 600°C during rolling. At this temperature, the surface reacts with oxygen, forming a layer of iron oxide (Fe_2O_3) called mill scale.

Mill scale represents a loss of ferrous material but it also remains useful by-product in different fields. The aim of this study is the valorization of an unavoidable by-product resulting from steel manufacturing at the El-Hadjar Iron and steel (Algeria). In our case, mill scale was used as a pigment in an anticorrosive coating (paint).

METHOD

➢ **Mill scale preparation-** After thoroughly rinsing and drying the scale, it is crushed into smaller fragments using a crushing machine (or crusher). The resulting crushed material is ground using a disc mill and then passed through a vibrating sieve. This process allows for the collection of powdered samples with a particle size of 32µm (Figure 1).

➢ **Paint formulation-** We have made several formulas with different percentages mill scale.

	Formula1 (100P) (%)	Formula2 (100C) (%)	Formula3 (100Pc) (%)	Formula4 (P28.57C) (%)	Formula5 (P42.85C) (%)	Formula6 (Pc28.57Cc) (%)
Iron ore	100	-	-	71.43	57.14	-
Mill scale	-	100	-	28.57	42.85	-
Calcined iron ore	-	-	100	-	-	71.43
Calcined mill scale	-	-	-	-	-	28.57

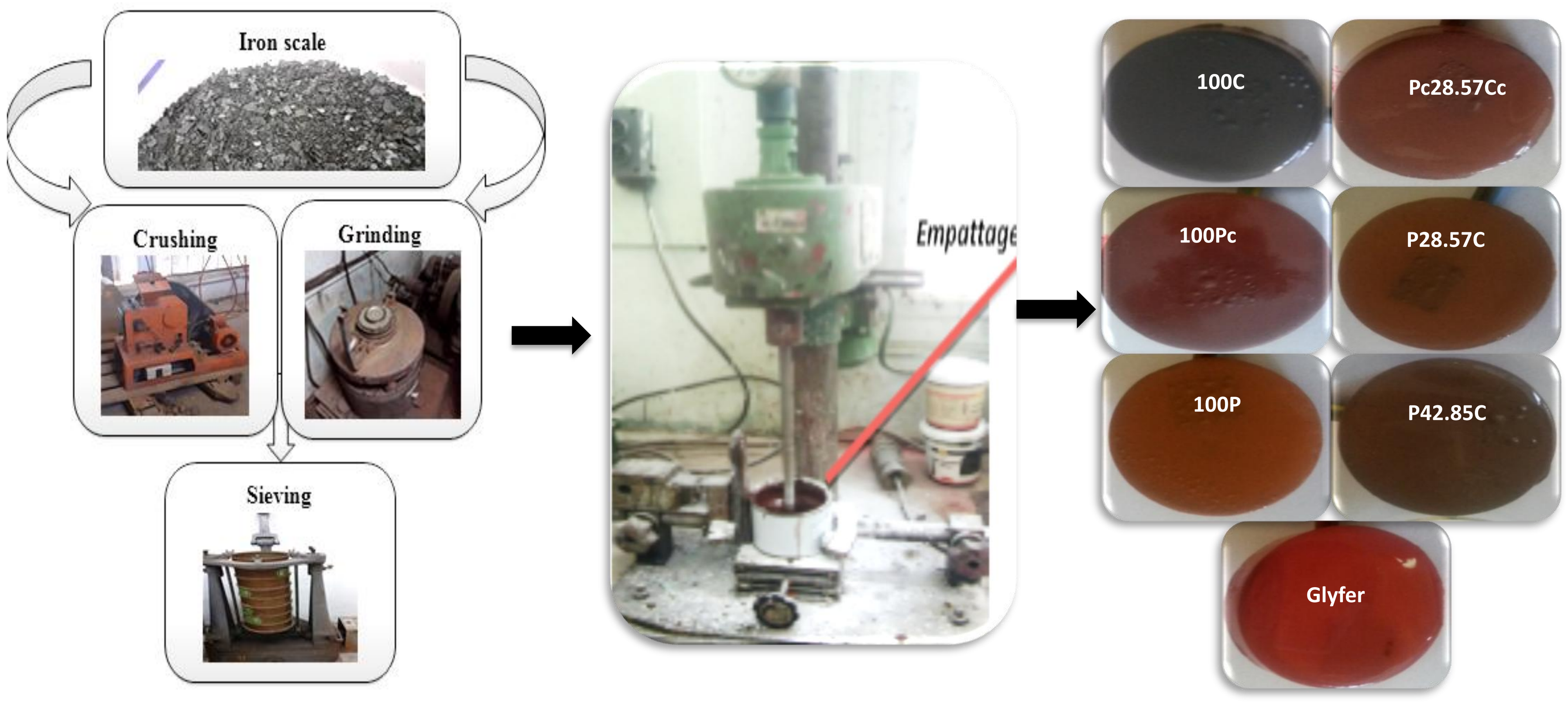

Figure 1. Experimental setup for paint formulation by mill scale

➢ **Corrosion Study-** An anticorrosive paint, "Glyfer," was selected as a reference. For this purpose, an immersion test of samples coated with the different paint formulations in a 3.5% NaCl saline solution will be carried out.

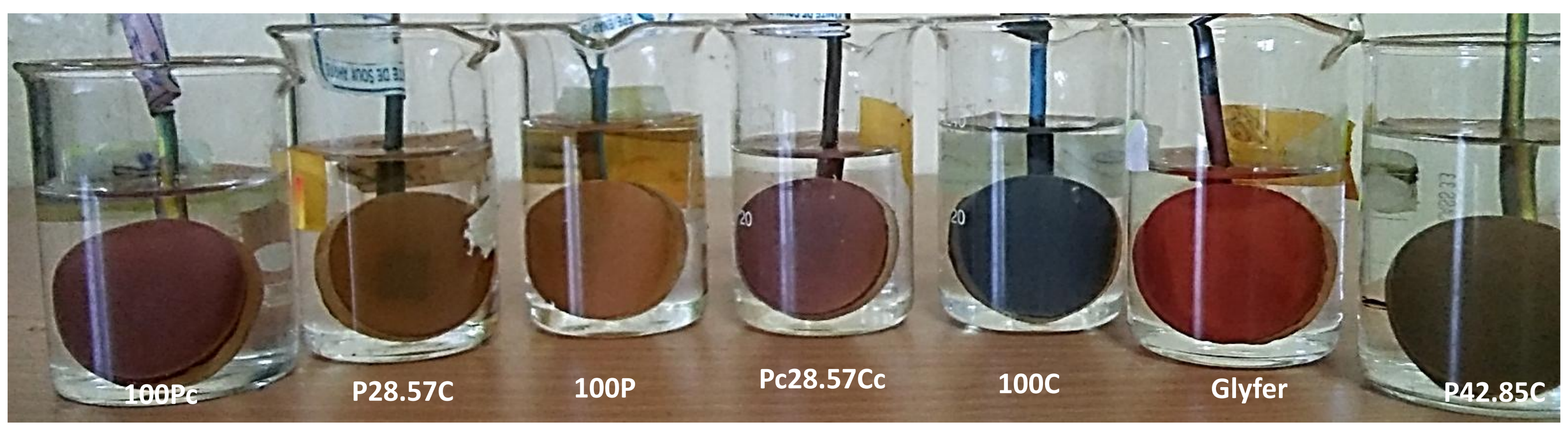

Figure 2. The different samples emerged in a 3.5% NaCl solution.

RESULTS & DISCUSSION

➢After 20 days of immersion, swelling and corrosion pitting were observed on the surface of the coated steel (figure 3).

➢The polarization curves of the different paint formulas are shown in Figure 4.

➢Formulas based on calcined pigment do not have corrosion resistance.

➢Formula P28.57C has the greatest corrosion potential compared to the others and the closest potential to the reference formula “Glyfer”

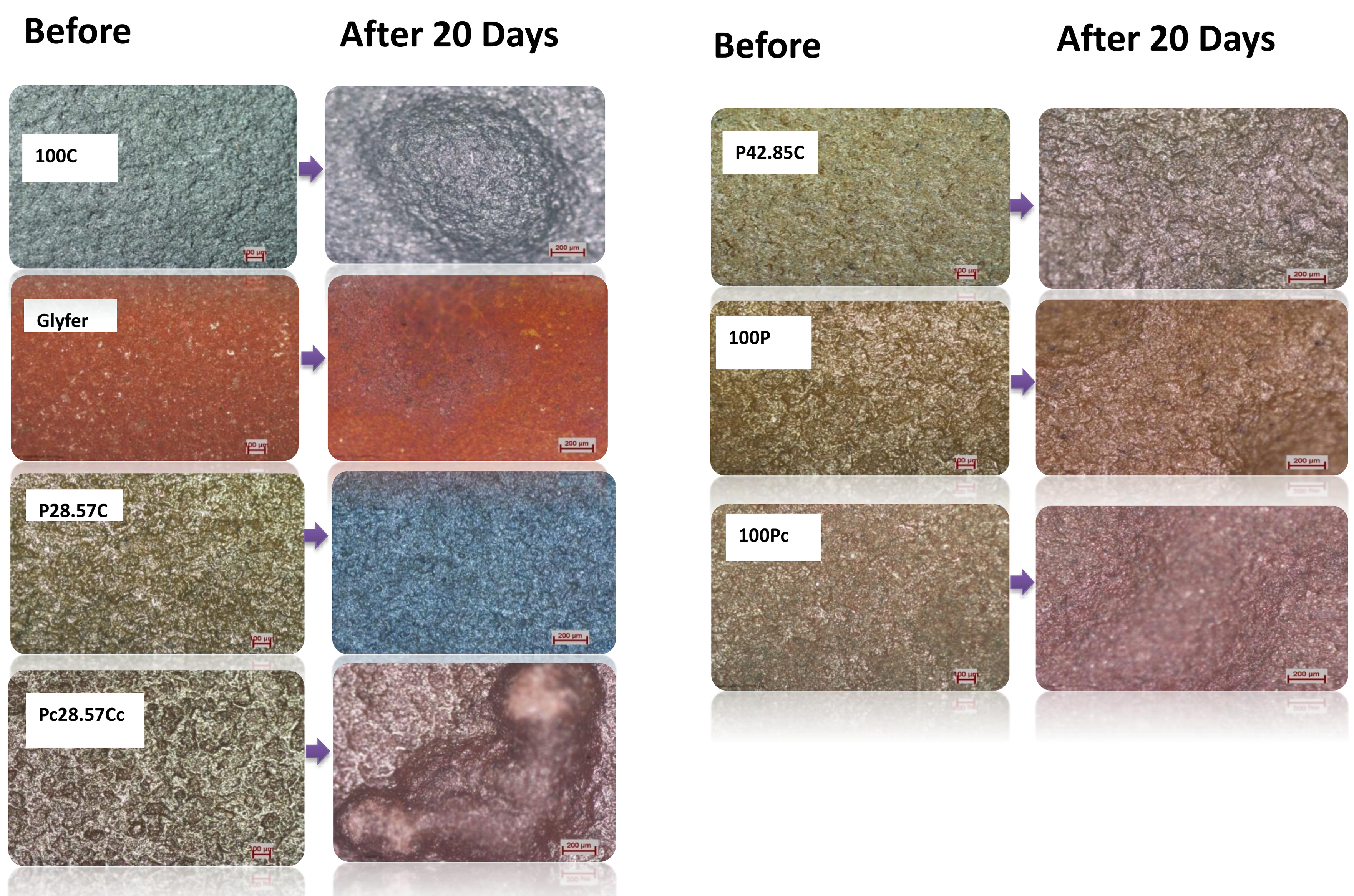

Figure 3. Samples after immersion in 3.5% NaCl solution under optical microscope

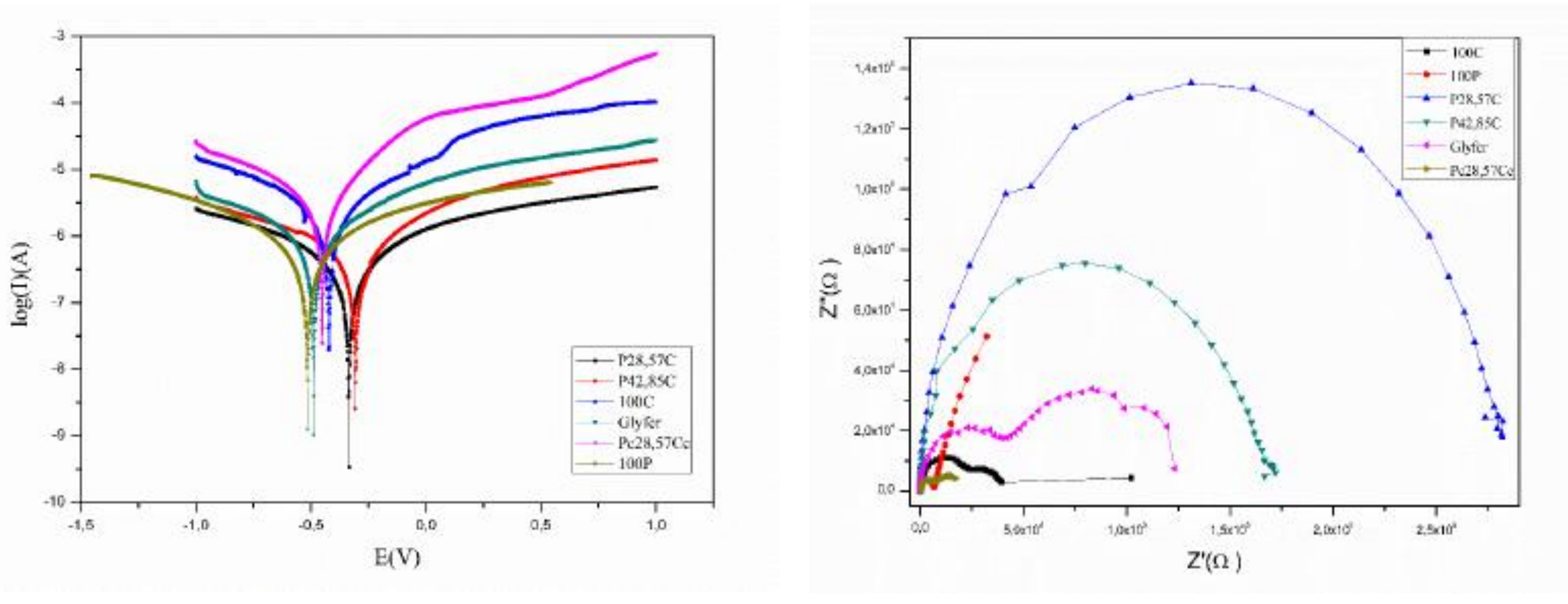

Figure 4. Electrochemical analysis (Tafel, Impedance) for the samples

CONCLUSION

This study explores the valorization of mill scale in anti-corrosion paint. Electrochemical analyses showed promising results, particularly for the formulation containing 28.57% mill scale, which demonstrated the best corrosion resistance, characterized by a low corrosion current and a high potential

FUTURE WORK / REFERENCES

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- T. Umadevi, et al., “Recycling of steel plant mill scale via iron ore sintering plant, Iron making and Steelmaking”, Vol.39, No.3, p.222- 226, 2012.
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