DEPOSITION OF Ni-Co ALLOY COATING ON MILD STEEL FOR IMPROVED CORROSION PROTECTION.

Abstract ID-
MRCBAS051

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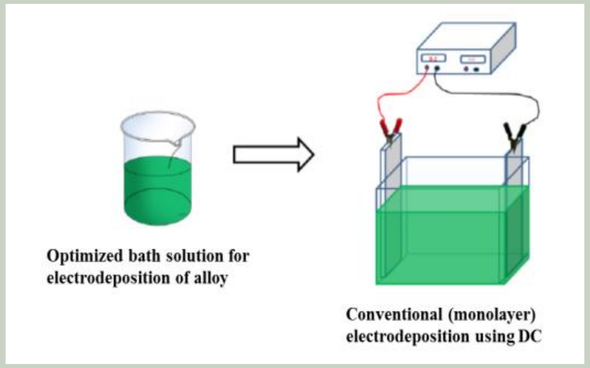
INTRODUCTION

CORROSION

ELECTROPLATING



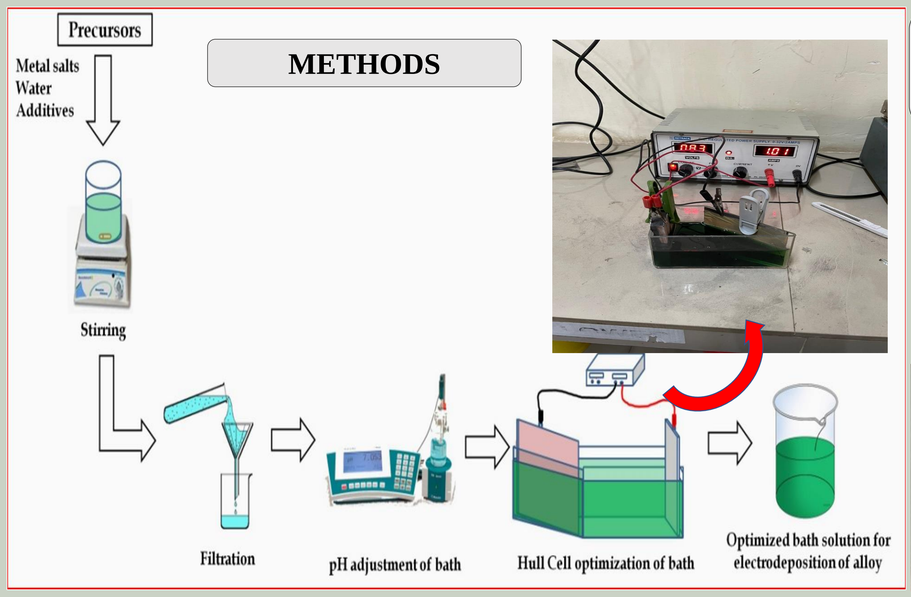
OBJECTIVES

- To optimize the new Ni-Co bath by using the Hull cell study.
- To develop a monolayer of Ni-Co alloy coating on mild steel by using the single bath technique.
- To investigate the effect of current density on Ni-Co alloy coating on mild steel through different characterization tools such as SEM, EDX, AFM and XRD.
- To analyze the corrosion behavior of electrodeposited Ni-Co alloy coatings through electrochemical characterization such as electrochemical impedance spectroscopy and potentiodynamic polarization methods in 3.5 wt% NaCl solution.

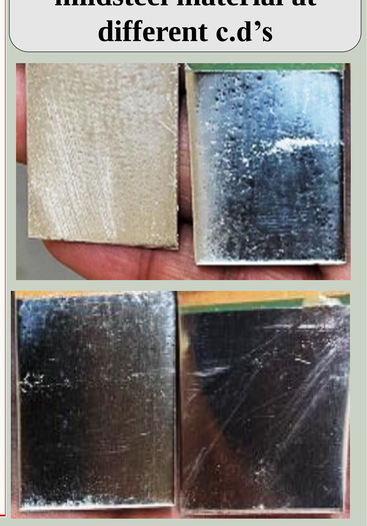
EXPERIMENTAL

The optimized Ni-Co electrolytic bath consists of nickel sulphate, cobalt sulphate, boric acid, sulphalinic acid, ascorbic acid, and glycerol at pH 3.5. Using a 200mL PVC cell and a DC power analyzer (Retrack, India), all Ni-Co alloy depositions (monolayer) were done for 10 minutes with varying current densities from 1.0 to 4.0 A dm^{-2}. After being developed, each of the Ni-Co coated plates are analyzed for their morphology and tested for corrosion rates in which platinized platinum used as counter electrode, calomel as reference electrode and deposited material as working electrode.

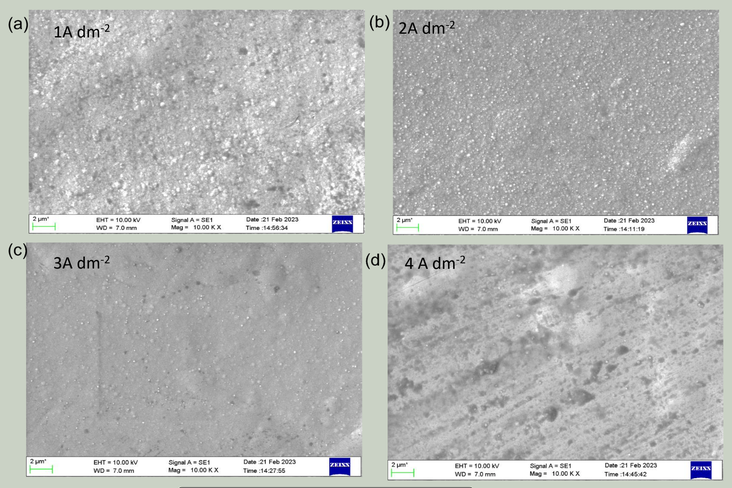
METHODS



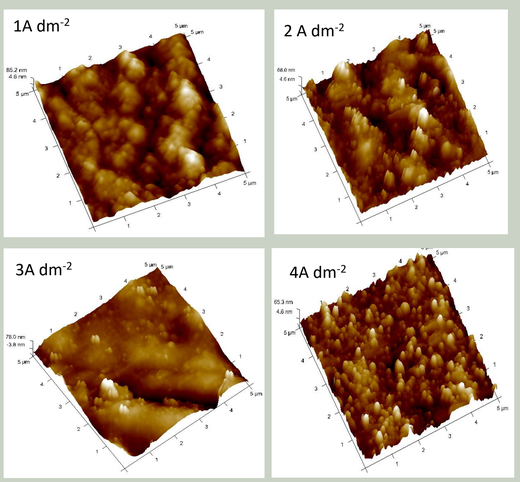
Ni-Co alloy coated on mildsteel material at different c.d's



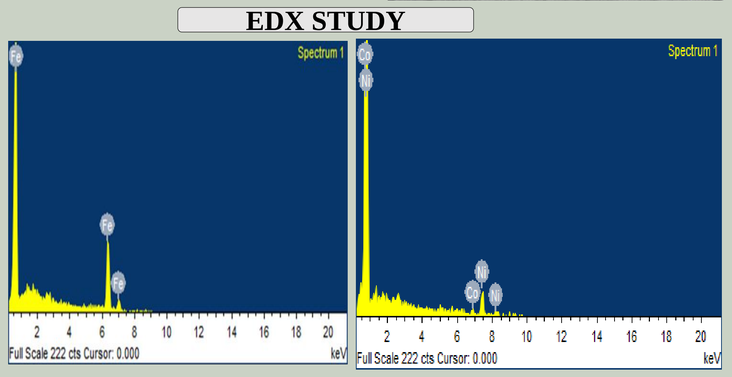
SEM STUDY



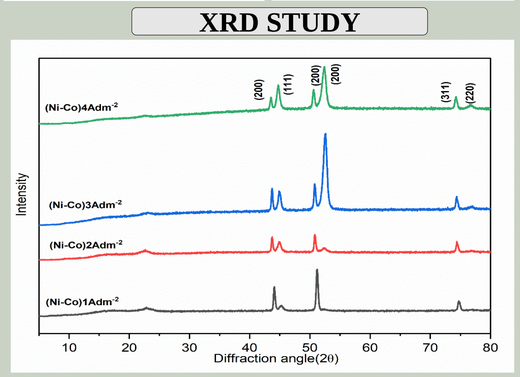
AFM STUDY



EDX STUDY



XRD STUDY



RESULTS AND DISCUSSIONS

Corrosion and roughness parameter of the deposited Ni-Co alloy coatings

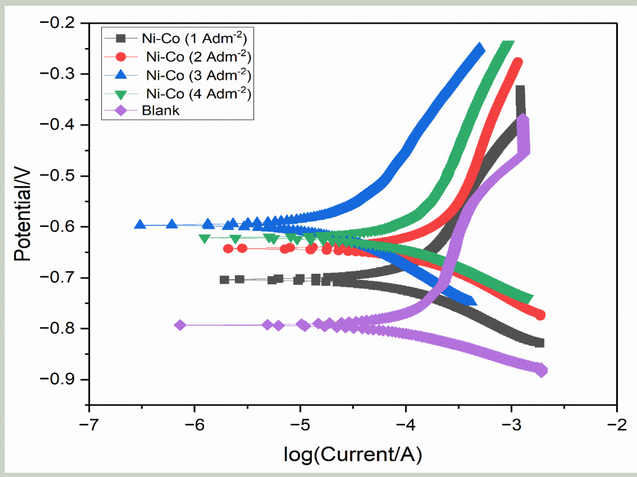
C.d(Adm^{-2})	Wt% Ni in the deposit	Wt% Co in the deposit	Average Roughness (Ra nm)	-E_{corr} (mV vs SCE)	I_{corr} (μAcm^{-2})	Corrosion Rate X 10^1 (mil/year)
Blank	-	-	-	791.0	188.0	7.10
1.0	73.74	26.26	14.9	704.9	133.0	5.36
2.0	79.75	20.25	14.2	643.6	114.6	5.18
3.0	85.19	14.81	13.1	597.6	29.5	1.18
4.0	72.12	27.88	36.8	622.1	113.0	4.62

Bath composition and operating parameters for the optimized Ni-Co bath

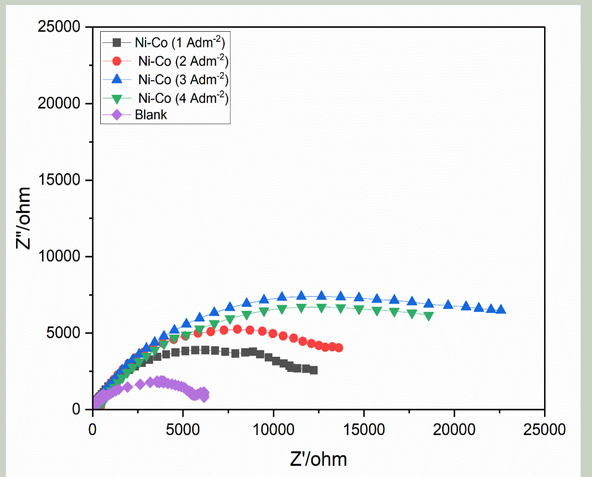
Bath constituents	Composition, g L^{-1}	Operating parameters
Cobalt Sulphate	8	Anode: Graphite
Nickel Sulphate	266.67	Cathode: Mild Steel
Boric Acid	15	pH: 3.5
Sulfalinic Acid	0.5	Temp: 303 K
Ascorbic Acid	2	
Glycerol	8mL/L	

CORROSION STUDY OF Ni-Co ALLOY COATINGS

TAFEL EXTRAPOLATION METHOD



EIS STUDY



CONCLUSIONS

- Ni-Co alloy coating has been developed from a sulfate bath at different current densities, and their corrosion resistance activity was studied in 3.5 wt% of NaCl medium.
- Ni-Co alloy coating deposited at 3.0 A dm^{-2} showed the highest corrosion resistance at 1.18 X 10^1 mil/year as compared to other c.d deposited coatings.
- The decrease in corrosion rate is attributed to increase of more noble Ni content in the deposited coatings.

ACKNOWLEDGEMENTS

The authors are thankful to the Department of Chemistry for providing lab facilities

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- Qiao G, Wang S, Wang X, Chen X, Wang X, Cui H. Ni/Co/black phosphorus nanocomposites for Q235 carbon steel corrosion-resistant coating. Advanced Composites and Hybrid Materials. 2022 Mar;5(1):438-49

Presented at MRC-2023, Manipal Academy of Higher Education, Manipal.