Cathodic Deposition of Cadmium from Diluted Solutions onto Stainless Steel Rotating Disc Electrode

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***Abstract*- The mass transport properties of a stainless steel electrode were characterized based on the electrodeposition of cadmium from diluted solutions containing Cd (II) ions. The study was performed in a three–electrode configuration using 0.5 M of sodium sulfate as the supporting electrolyte with Cd (II) concentration ranging from 50 to 200 mg/L. From the current potential curves under conditions of the experiment, the limiting currents were determined at potential of -1.0 V against a saturated calomel electrode, and were used to calculate the diffusion coefficients, the diffusion and hydrodynamic layer thicknesses and the mass transfer coefficients for Cd (II). Dimensionless Sherwood, Reynolds and Schmidt numbers were fitted to final empirical correlation: $Sh = 0.664 Re^{0.528} Sc^{1/3}$ For 25101<Re>52726 and 449<Sc>787.**

Keywords*- *Electrochemical Deposition; Cadmium; Rotating Disk Electrode; Stainless Steel Cathode

NOMECLATURE

A	=	Electrode surface area, m^2
C	=	Concentration, mol L^{-1} or mg L^{-1} or ppm
c_b	=	Bulk concentration, mol L^{-1} or mg L^{-1} or ppm
D	=	Diffusion coefficient, m^2 s^{-1}
E	=	Electrode potential (vs. SCE), V
F	=	Faraday constant=96500, Coulomb mol^{-1}
i_L	=	Limiting current, A
k_m	=	Mass transfer coefficient, m s^{-1}
n	=	Charge number of electrode reaction
r	=	Disc radius (a characteristic dimension), m
RDE	=	Rotating disc electrode
RE	=	Reference electrode
Re	=	Reynolds number = $r^2 w/v$
s	=	Slope of Livich equation
SCE	=	Saturated calomel electrode
Sc	=	Schmidt number = v/D
Sh	=	Sherwood number = $k\ r/D$

Greek Symbols**:**

δ	=	Diffusion layer thickness, m
δ_H	=	Hydrodynamic layer thickness, m
μ	=	Fluid viscosity, kg m^{-1} s^{-1}
v	=	Kinematic viscosity, m^2 s^{-1}
ω	=	Rotation speed, rpm or m s^{-1}

I. INTRODUCTION

The rotating disc electrode has been used for investigating the hydrodynamic, kinetics and mechanism of electrochemical reaction. The hydrodynamic and the mass-transfer characteristic are well-understood and current density on the disc electrode is supposed to be uniform. However, the current distribution is uniform only at the limiting current where the concentration of the reactant is zero at the electrode surface [1]. Rotating disc electrodes (RDE) represent very practical systems for current-potential curve determination and the RDE, with precise limiting current behavior, probably is the most promising of all solid electrode systems. The rotating disc electrode solves many problems connected with the use of solid electrodes both from the