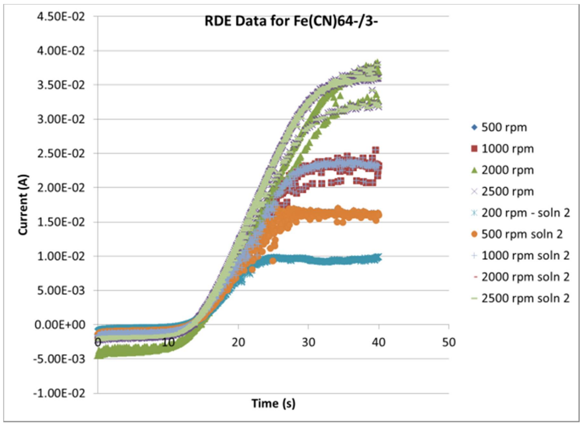
Rotating Disc Electrode

Work-Up and Questions

1) Determine the limiting current as a function of rotation rate and construct a graph of $\omega^{-1/2}$ versus i^{-1}.

Figure 1 shows a plot of current versus time, and the Koutecky-Levitch plot obtained from the data, remembering that $\omega = 2\pi f$.



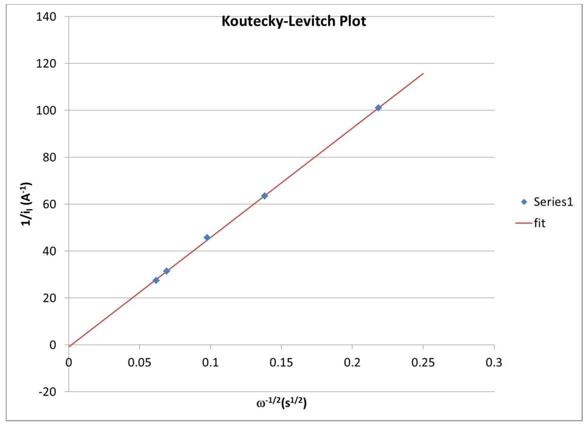


Figure 1. (left) Data at varied rotation rates using the two solutions. (right) Koutecky-Levitch plot obtained from the data.

2) Use linear regression to determine the values for i_k and D_O, assuming $\nu = 1.0074\times10^{-6}$ m^2s^{-1} for these solutions.

The slope of the line in the Koutecky-Levitch plot was 466 $s^{1/2}$ A^{-1}. The intercept was -7.4×10^{-1} A^{-1}. The intercept yields a value of -1.3 A for i_k. The electrode was a Pt disk with diameter about 5 mm.

To calculate D_o,

$$slope = \frac{1}{0.62nFAD_O^{2/3}\nu^{-\frac{1}{6}}C_O^*}$$

$$D_o^{2/3} = \frac{\nu^{1/6}}{slope \times 0.62nFAC_o^*}$$

$$D_o^{2/3} = \frac{(1.0074\times10^{-6})^{1/6}\cancel{m^{1/3}} \times \frac{100^{1/3}cm^{1/3}}{\cancel{m^{1/3}}}}{\frac{466s^{1/2}}{\cancel{A}} \times s^{1/6} \times \frac{1\cancel{A}s}{\cancel{C}} \times 0.62 \times 1 \times \frac{96485\cancel{C}}{\cancel{mol}} \times 0.196\cancel{cm^2} \times \frac{0.15\cancel{mol}}{1000cm^{3}}}$$

$$D_o^{2/3} = \frac{0.100 \times 4.64cm^{4/3}}{819.6s^{3/2}}$$

$$D_O = 1.4 \times 10^{-5} cm^2 s^{-1}$$

The value according to the Handbook of Chemistry and Physics is 1.18×10^{-5} cm^2s^{-1}, quite close to that obtained from these measurements.