Exercice: The Hull cell

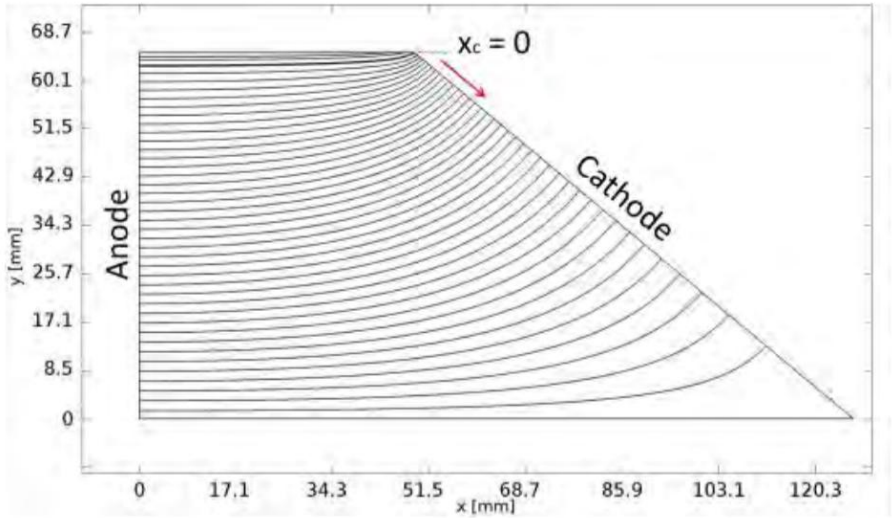

Figure 2. 250 ml Hull cell current density streamlines

$$I_c = I(5.1 - 5.24 \log x_c)$$

I_c - cathode current density [A/dm^2]
I - total current in the cell [A]
x_c - coordinate along the cathode [cm]

Cathode surface area = 66.3 cm^2

Cu and Ni are codeposited at pH 9 in a Hull cell with a total current of 1 A

$E^0(Cu^{2+}/Cu)$ = 0.16 V vs NHE, $[Cu^{2+}]$ = 0.05 M, j_{lim} = 275 mA.dm^{-2}
$E^0(Ni^{2+}/Ni)$ = -0.23 V vs NHE, $[Ni^{2+}]$ = 0.2 M, j_{lim} = 555 mA.dm^{-2}

1) Can you estimate the composition profile along x_c?
2) Can you predict the current efficiency?

We consider that only HER occurs as a side reaction and that $j_{HER} = j_{tot} - j_{lim,Cu} - j_{lim,Ni}$

3) What nucleation and growth mechanism, and resulting morphology can you expect?
4) How could you change these results by modifying the electrolyte formulation?
5) What could be the limitations of the Hull cell. How could you overcome them?