In class work W7D1 – Industrial Electrochemistry

(1) For the chlor-alkali process, use your knowledge of electrochemistry to **predict side reactions** (losses in current efficiency) and more broadly propose possible losses in faradaic efficiency. Make sure you know the difference between the two.

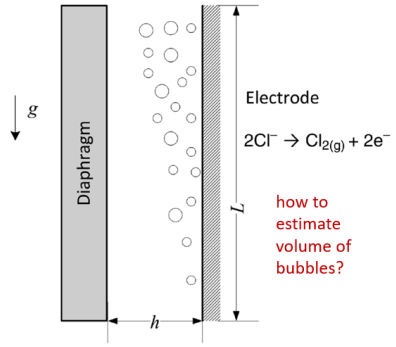
(2) Discuss and propose simple methods to estimate the volume of bubbles in a vertical reactor as shown below:

gas evolution: increases rate of mass transfer, but also increases resistance, can block electrode surface as well.

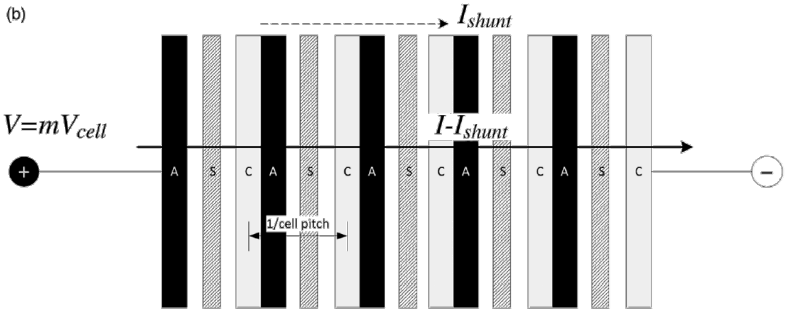
approximation:

$$\kappa_{eff} = \kappa\left(1 - \varepsilon_g\right)^{3/2}$$

ε_g is the volume fraction of gas in the gap



(3) Discuss how a bipolar electrode works without wires to connect it to the power supply. What is driving the current? Sketch the electric potential profile across a cell repeat in a bipolar stack.



(4) Explain what happens at steady state with the below heat flow equation.

$$mC_p\frac{dT}{dt} = \sum_m \dot{n}_m H_{in,m} - \sum_p \dot{n}_p H_{out,p} + \dot{q} - \dot{W} - \sum_j r_i \Delta H_{Rx,j}, \qquad (14.22)$$

(5) Explain the functional form of the voltage losses indicated in the figure below for a liquid KOH alkaline electrolyzer.

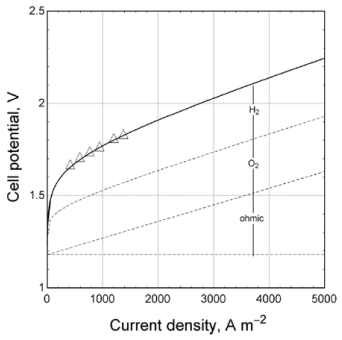


Figure 14.14 Electrolysis of water at 40 °C.
Source: Adapted from Ulleberg 2003.

Cathode : $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Anode : $2OH^- \rightarrow \frac{1}{2}O_2 + H_2O + 2e^-$

Q. Explain the current density dependence of each loss mechanism.