Electrochemical Characterization of Raney Nickel Electrodes for Alkaline Water Electrolysis: From Laboratory to Industrial Scale

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The most mature water electrolysis technology is alkaline electrolysis, where an aqueous solution of KOH is used as the electrolyte. While this technology has been used for decades, there is still a lot of potential to improve the performance of these devices. Much research is focused on the optimisation of the electrodes containing novel catalyst materials that lower the activation energy barrier of the electrolysis process. However, one of the issues described by Ehlers et al.[1] is that the current academic electrolysis research is done under conditions that are far from practical (e.g. at low current densities, room temperature, and dilute electrolytes).
In this study, we characterise a commercial Raney nickel electrode in various setups using a systematic series of experiments, including a typical laboratory-scale three-electrode setup, two different flow-cell setups and a 10-kW electrolysis stack of 17 cells (Figure 1). In addition to the cell geometry (electrode area ranging from 1 cm^2 to 960 cm^2), the varied measurement conditions include temperature (ranging from room temperature to 80 degrees Celsius), pressure (from atmospheric pressure to 15 barg), electrolyte concentration (from 0.1 M to 30 $_{wt}$% KOH), and the level of Fe impurities in the electrolyte. The resulting electrochemical data received from different measurement setups and measurement conditions are compared, and insights about the challenges related to correlating laboratory experiments to industrial-scale experiments are provided.

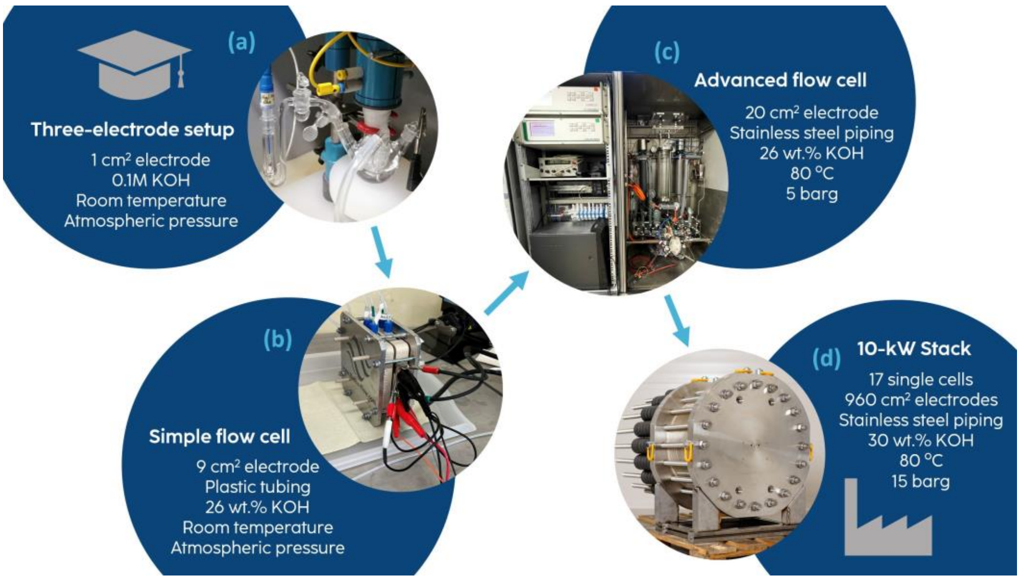

Figure 1. Alkaline electrolysis measurement setups with the typical measurement conditions used to study Raney nickel electrodes within this work – a laboratory-scale three-electrode setup (a), two different flow-cell setups (b, c) and a 10-kW electrolysis stack of 17 cells (d).

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References
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