Can the Efficiency of Hydrogen Gas Production by Electrolysis Be Increased?

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The efficiency of hydrogen gas production through electrolysis was explored by changing concentration of the electrolyte and its types, material of electrode, and voltage. A solution of different electrolytes with varying concentration was electrolyzed using the Hoffman electrolysis apparatus by applying varying voltages using a DC power source. The time required to generate a known quantity of hydrogen gas was recorded. This study revealed that as the concentration of electrolyte increased, the rate of electrolysis increased as well since the resistance of the electrolyte solution decreases, allowing more current through the system for the same amount of applied voltage. The rate of electrolysis also increased at higher voltages since it provides necessary overpotential associated with the activation energy barrier for the spontaneous redox reaction. In addition, the study revealed that the type of electrolyte could also change the rate of electrolysis. Electrolytes containing anions such as sulfate and chloride (conjugate bases of strong acids) provide higher net-ionic concentration favoring good current flow at a set voltage. Furthermore, doubly charged anions such as sulfate and carbonate found to be more efficient than a singly charged anion such as chloride and acetate because of their increased ability to carry more charges through the solution. Finally, the study indicated that the platinum electrode was an effective electrode compared to carbon electrode since platinum surface catalytically lowers the activation energy barrier for the electrolysis. Thus, the rate of electrolysis for the production of hydrogen gas using platinum electrode is much faster than carbon electrode.

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