Improving Alkaline Electrolyzers: The Role of Forced Convection in Hydrogen Generation

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As global hydrogen demands reached 20 million tons in 2024, electrolysis "the chemical process of splitting water into hydrogen and oxygen" remains one of the most promising methods for clean hydrogen production. While the cost of materials and production for Alkaline electrolysis is relatively low, challenges like electrode corrosion, and low energy efficiency arise. To address these problems, this project utilized a novel approach called forced convection to accelerate hydrogen bubbles to the surface faster with direct seawater alkaline electrolysis. This forced convection was accomplished by building the electrolysis chamber within another chamber of saltwater, creating a vacuum force pulling more water into the electrolysis chamber as hydrogen leaves. With forced convection, the bubbles' average velocity was 0.143 m/s while without forced convection it was only 0.0248 m/s, as the stream of water intake helped redirect and speed up the bubbles. Additionally, the forced convection increased the lifespan of the electrodes by 20% of its original time. Greater bubble velocities decreases bubble attachment and ensures a better overall efficiency of Electrolysis. This design was further tested with different electrocatalysts grown on the electrodes, and finally powered by a solar panel, creating truly green hydrogen. While more testing with variability of hole sizes and placements needs to be experimented with, this project is the first to successfully decrease bubble adhesion with no external energy involved, confirming the ability of forced convection to increase hydrogen efficiency.

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