

# Unveiling Performance Trends: Influence of Dynamic Operation on Alkaline Electrolysis Conditioning and Stability

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## Introduction and Objective

The utilization of renewable energies for large-scale hydrogen production through alkaline water electrolysis (AWE) remains a promising avenue. AWE has the reputation to be less flexible in responding to fluctuating energy profiles. Yet, comprehensive analysis of the effects of dynamic operation remains scarce. Most studies have predominantly focused on stationary conditions, with limited investigation into long-term experiments, particularly under dynamic operation. This study delves into exploring the impact of dynamic operation on AWE. Specifically, the impact on conditioning time and degradation rates is studied.

## Methods

To investigate the effects of dynamic operation, a series of experiments employed triangle and square waveform profiles for a lab-scale test cell encompassing various potential ranges for prolonged durations. A systematic approach was adopted to evaluate the influence of dynamic operation. Multiple potential ranges, bounded by a lower limit of 1.4 V and upper limits set between 1.6 V and 2.4 V, were applied for 600 h each. Regular recording of polarization curves and impedance measurements every 75 h provides reference points throughout the experiment series. Comparative analyses were conducted between triangle and square wave operations and further extended to compare dynamic operation against stationary conditions.

## Results

Dynamically operated experiments employing higher upper potential limits demonstrated markedly decreased conditioning times compared to lower limits (Figure 1). Under stationary operation, in general longer conditioning times are required and these are less dependent on the applied potential. Additionally, variations in degradation rates are observed when comparing dynamic and stationary operation.

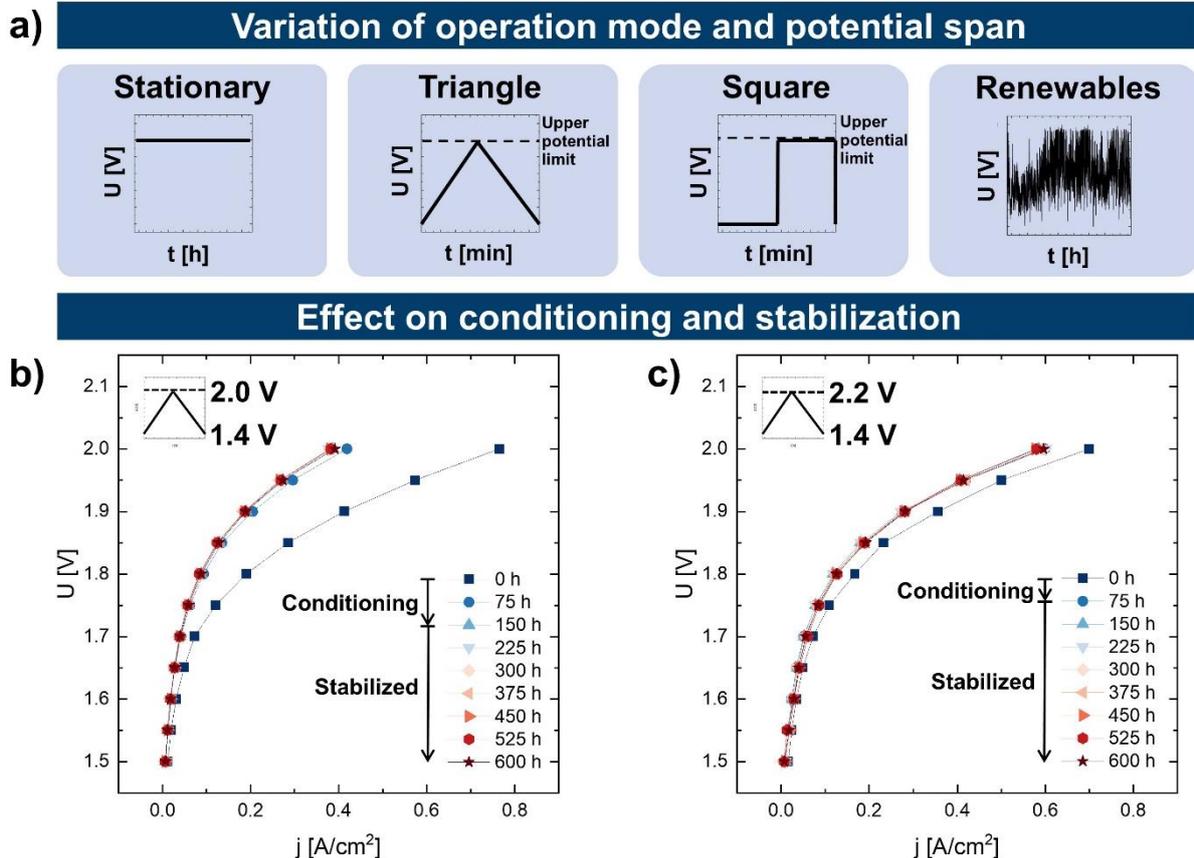


Figure 1: Applied operational profiles and polarization curves. Whereas a) shows the operational profiles, b) shows polarization curves by triangle-wave operation over a duration of 600 h for an upper potential limit of 2.0 V, and c) shows polarization curves by triangle-wave operation for an upper potential limit of 2.2 V.

## Conclusion

This study provides novel insights by conducting long-term dynamic and stationary experiments, an area that is scarcely explored in current literature. Initial results suggest the feasibility of dynamic operation in AWE, potentially improving conditioning times. Furthermore, variations in the resulting degradation rates are observed.

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