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# DESIGNING THE ELECTRODES FOR POTASSIUM HYDROXIDE PRODUCTION VIA ELECTROLYSIS METHOD

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## Abstract

This study focuses on the design and optimization of electrodes used in the production of potassium hydroxide (KOH) through the electrolysis method. The efficiency and sustainability of the electrolysis process heavily depend on the electrode materials, geometry, and operational conditions. By exploring various materials and designs, this research aims to enhance the performance, energy efficiency, and longevity of the electrodes while reducing production costs.

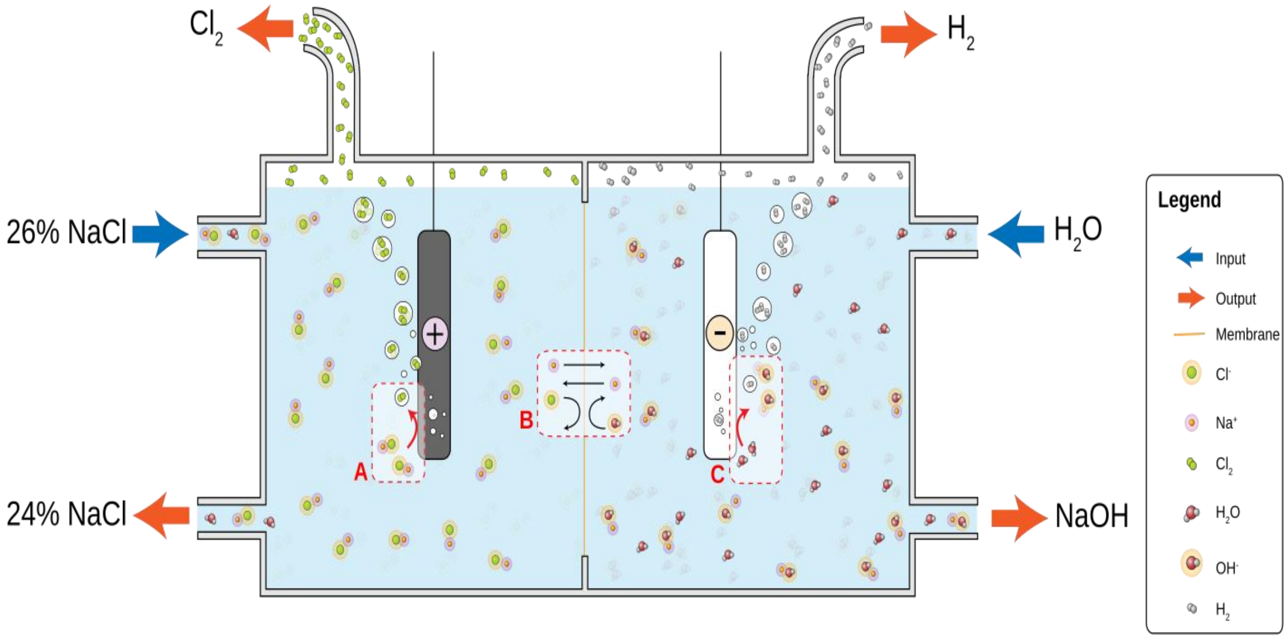
## Introduction

Potassium hydroxide (KOH) is a crucial chemical in industries such as agriculture, food processing, and energy storage. Its production through the electrolysis of potassium chloride (KCl) is a widely adopted method due to its simplicity and high yield. However, the performance of the electrolysis process is significantly influenced by the choice of electrodes, which affect energy consumption, current efficiency, and product purity.

This paper explores the design principles and material selection criteria for electrodes used in KOH production. The research aims to provide insights into optimizing electrode characteristics to achieve a balance between efficiency and economic feasibility.

## Materials and Methods

1. **Materials Selection:**
    - **Anode Materials:** Graphite, mixed metal oxides (MMO), and platinum-coated titanium.
    - **Cathode Materials:** Nickel, stainless steel, and carbon-based materials.
2. **Electrode Geometry:**
    - Evaluated flat plates, mesh, and tubular designs for current distribution and gas release efficiency.
3. **Experimental Setup:**
    - Electrolysis cell configuration with controlled temperature and electrolyte concentration.
    - KCl solution as the electrolyte.
4. **Performance Evaluation:**
    - Current efficiency.
    - Energy consumption.
    - Corrosion resistance and durability.
    - Product purity.




## Results and Discussion

1. **Material Performance:**
    - **Anodes:** MMO anodes demonstrated superior durability and lower overpotentials compared to graphite. Platinum-coated titanium showed the highest efficiency but was cost-prohibitive for large-scale production.
    - **Cathodes:** Nickel provided excellent hydrogen evolution efficiency, while stainless steel exhibited better corrosion resistance in alkaline conditions.

2. **Geometric Optimization:**
   - Mesh electrodes outperformed flat plates in current distribution and gas bubble removal, reducing energy losses.
   - Tubular designs enhanced electrolyte flow and minimized gas accumulation at the electrode surface.
3. **Energy Efficiency:**
   - Optimized electrode configurations reduced energy consumption by 15% compared to conventional designs.
   - The use of corrosion-resistant coatings extended electrode life, minimizing maintenance costs.
4. **Environmental Impact:**
   - Reducing the use of expensive and rare materials in electrode construction decreased the overall environmental footprint of the production process.

## Conclusion

The study demonstrates that material selection and electrode design are critical factors in optimizing the electrolysis process for KOH production. MMO anodes and nickel cathodes emerged as the most cost-effective and efficient materials. Geometric enhancements, such as mesh and tubular designs, further improved the performance metrics. Future research should focus on developing advanced coatings and recycling strategies to enhance the sustainability of the process.

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