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Alkaline Water Electrolysis Powered by Renewable Energy: A Review

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Abstract

Alkaline water electrolysis is a key technology for large-scale hydrogen production powered by renewable energy. As conventional electrolyzers are designed for operation at fixed process conditions, the implementation of fluctuating and highly intermittent renewable energy is challenging. This contribution shows the recent state of system descriptions for alkaline water electrolysis and renewable energies, such as solar and wind power. Each component of a hydrogen energy system needs to be optimized to increase the operation time and system efficiency. Only in this way can hydrogen produced by electrolysis processes be competitive with the conventional path based on fossil energy sources. Conventional alkaline water electrolyzers show a limited part-load range due to an increased gas impurity at low power availability. As explosive mixtures of hydrogen and oxygen must be prevented, a safety shutdown is performed when reaching specific gas contamination. Furthermore, the cell voltage should be optimized to maintain a high efficiency. While photovoltaic panels can be directly coupled to alkaline water electrolyzers, wind turbines require suitable converters with additional losses. By combining alkaline water electrolysis with hydrogen storage tanks and fuel cells, power grid stabilization can be performed. As a consequence, the conventional spinning reserve can be reduced, which additionally lowers the carbon dioxide emissions.

Keywords: alkaline water electrolysis, renewable energy, hydrogen production, solar energy, wind energy, off-d

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