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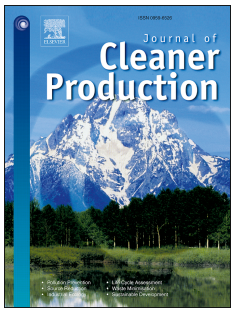

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Cleaner Chlorine Production Using Oxygen Depolarized Cathodes? A Life Cycle Assessment

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Abstract

Chlorine and caustic soda are two indispensable chemical commodities co-produced in the so-called chlor-alkali electrolysis. Chlor-alkali electrolysis is today a target for cleaner production because of its large electricity demand causing considerable environmental impacts. The electricity demand of chlor-alkali electrolysis can be reduced by 30 % using oxygen depolarized cathodes (ODCs) instead of the standard cathodes (STCs) used today. However, ODCs require additional resources and do not produce hydrogen in contrast to existing chlor-alkali plants. This work investigates if the reduction in electricity demand also contributes to cleaner production. For this purpose, environmental impacts from chlor-alkali electrolysis using ODCs are compared to the impacts from best available existing chlor-alkali plants using STCs. The life cycle assessment includes manufacturing, operation and disposal of the plants. To account for utilization of hydrogen from existing chlor-alkali plants, two alternative utilization scenarios are studied: energy recovery by combustion of hydrogen and use of hydrogen as chemical commodity. Seven environmental impact categories are studied in detail using the ReCiPe method. Chlor-alkali electrolysis using ODCs yields lower environmental impacts in up to six environmental impact categories. Plant operation contributes most in six out of seven impact categories. Chlor-alkali electrolysis using ODCs has thus potential to contribute to cleaner production in the chlor-alkali industry.

Highlights

- Life cycle assessment (LCA) of chlor-alkali electrolysis using oxygen depolarized cathodes
- Global warming impact reduction by 8 % to 12 % compared to existing plants in Germany
- Reductions in up to five more environmental impact categories
- World-wide potential for reduction of environmental impacts identified

Keywords: chlor-alkali electrolysis, oxygen depolarized cathodes, electricity demand reduction, life cycle assessment, environmental impacts