

Effects of water quality on alkaline water electrolysis performance.

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The development of renewable energy is a key element to reach carbon neutrality by 2050. Offshore wind turbines are increasingly used, even far from the coast. However, the cost of electrical transmission infrastructure becomes more and more important with distance and power [1]. A solution to limit the transportation cost related to offshore wind turbines is to transport energy in chemical rather than electrical form using hydrogen [1]. Furthermore, the latter can also be used to limit the intermittency of renewable energy by allowing energy storage. The transport of chemical energy can be achieved in several ways, by ship after densification and storage, by pipelines or by conversion of produced hydrogen into e-fuels using existing infrastructure.

However, an important challenge arises with the use of water electrolysis offshore: the only source of water easily available is seawater, which contains many trace elements besides water. Some of these elements are contaminants for the electrodes or separator and will therefore reduce the lifetime of the electrolyser and its efficiency.

There are two development paths for the use of seawater for water electrolysis: developing new catalysts that are compatible with these impurities, or using seawater pre-treatment. The latter allows the employment of state-of-the-art electrolysers but requires studying the effect of trace impurities present after seawater treatment on the performance of water electrolysers.

Since alkaline water electrolysis is well-known to be less sensitive to water quality than polymer electrolyte membrane (PEM) electrolysis [2], the first is the one being investigated in this work. Our study focuses on the determination of the faradic efficiency in the presence of different trace elements in the 1-1000 ppm range, starting from 1 M KOH electrolyte. Firstly, the two most prevalent anions in seawater, namely chlorides and sulphates, are investigated using KCl and K₂SO₄ salts. Secondly, with respect to cations, Na⁺ is the most prevalent cation in seawater, but it is usually already present in the KOH pellets used to prepare the alkaline electrolyte. Therefore, our study will focus on the second most prevalent cation in seawater, namely Mg²⁺.

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