Drinking water production Ameland

Desalination of seawater with electrodialysis

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Motivation

Ameland is an island with unique challenges and opportunities in drinking water production. An increasing demand for drinking water due to growing tourism and a growing permanent population creates challenges. The current drinking water supply largely relies on freshwater bubbles under the island and water brought in from the mainland via pipes. However, this approach is fragile and not fully sustainable. Therefore, this paper investigated whether electrodialysis metathesis (EDM) could contribute to a self-sufficient and future-proof drinking water system for Ameland. In the future, this method will hopefully be a solution to the global shortage of drinking water. Our Ameland may help to take a step towards worldwide sustainable drinking water production.

Figure 1: Map of Ameland (Plaetje:Ameland-Natuur-OpenTopo.jpg - Wikipedia, 2015)

The experiment

We first tested the salt ion concentrations of the seawater. We then created a solution with the same salt concentrations and ran the solution through the EDM desalination stack. Every 15 minutes, a sample was taken. After 60 minutes, we tested every sample's ion concentrations. After that, the results were analysed and we determined the decrease in salt concentrations. Finally, the results were compared to the requirements for drinking water, and the energy was calculated.

Techniques used

EDM is a method of electrodialysis that, unlike conventional ED set-ups, does not use cation- and anion-selective membranes. EDM uses mono-selective membranes: membranes that allow only a particular ion to pass through. This way, two concentrate streams are formed. The usefulness of these two concentrated streams is to prevent the formation of 2:2 salts and promote the formation of 2:1 salts (e.g., CaCl2) and 1:2 salts (e.g., NaSO4). 1:2 and 2:1 salts are more soluble in water than 2:2 salts. As a result, no chemicals are required to prevent scaling.

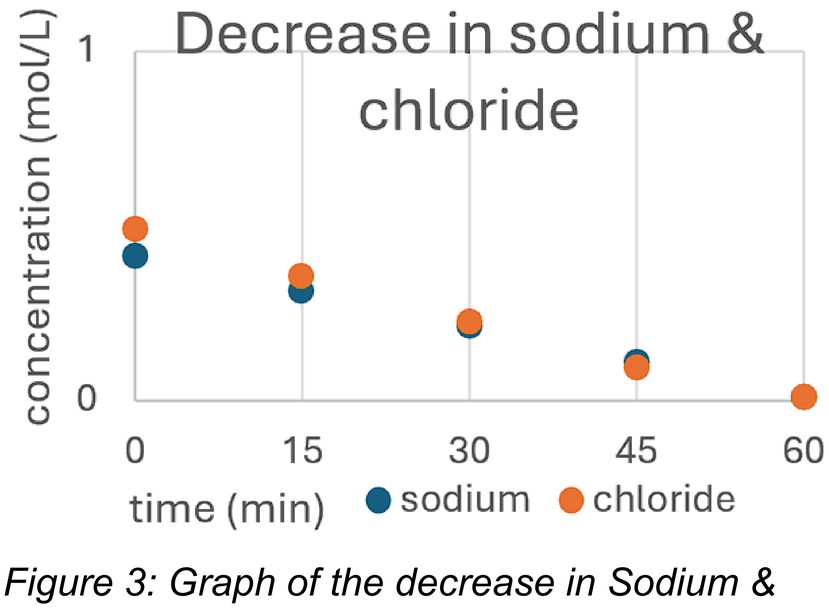

Figure 3: Graph of the decrease in Sodium & Chloride.

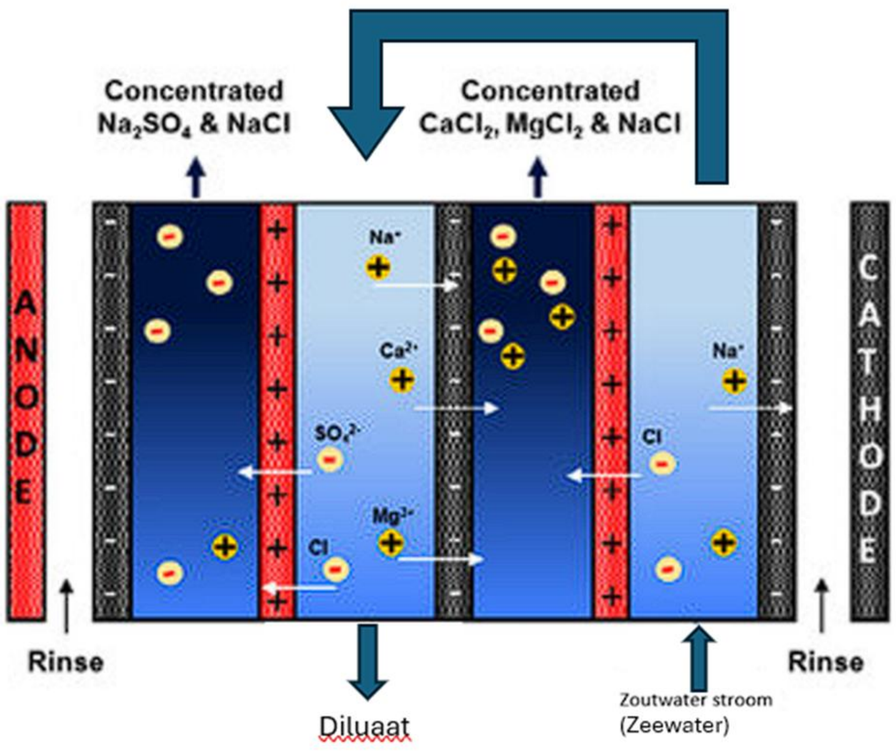

Figure 2: Schematic overview of electrodialysis metathesis (Prado de Nicolás, A. K.-G.-G., 2022)

Conclusion

The quantities of ions that have been found and studied show a decrease of 95.7%. This shows electrodialysis metathesis is a promising way to make Ameland self-sufficient in drinking water in the future.

Discussion

Due to the high energy requirements, research will need to be conducted on the possibility of generating this sustainably and efficiently. In the study, we only looked at the salts in seawater. However, there are many other substances in seawater, such as biomass. So, it is not yet known what problems, if any, can arise when natural seawater is used for EDM.

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