Combining brine management with carbon capture

Water shortages are an urgent issue in many areas of the world and it is likely that the construction of desalination plants will increase to meet the rising demand for fresh water. A new study has evaluated a combined process to manage both the brine by-product from desalination plants and capture carbon dioxide.

Desalination separates seawater (or inland saline or salty water) into fresh water suitable for drinking purposes and very concentrated brine (salt water). Desalination is seen as one method of providing drinking water in areas with growing populations and limited water resources.

Over 25 million cubic metres of desalinated water were produced around the world in the year 2000 and disposal of the brine is a major environmental challenge. Options for disposal generally include: discharging it into the sea, potentially affecting marine life, discharging it into deep wells or saline aquifers, discharging it to wastewater treatment plants or recovering the salts in evaporation ponds or by mechanical or heat treatment processes.

In this study, a new approach for disposing desalination brine at coastal and inland locations was investigated. The process converts the brine into useful and reusable products by passing ammonia and carbon dioxide through the brine solution.

Laboratory experiments using brine from local desalination plants were conducted to investigate the optimal conditions for converting the sodium chloride (salt) in the brine into sodium bicarbonate, a product which is used in medicine and cooking, among other applications.

Results of the study suggest that, in the laboratory, the optimal conditions for sodium removal are achieved at 20°C over a reaction time of 2 hours. Ammonia plays an essential role in this process.

The ammonia can be recovered at the end of the operation and, at the industrial scale, ammonia would be recycled within the system. Although the study focused on reducing the concentration of sodium chloride from the reject brine, the process was also able to reduce concentrations of other soluble salts found in the brine by-product. For example, the concentration of metal ions of magnesium and calcium were significantly reduced in the experiments.

In addition, the study evaluated the process as a method for capturing carbon dioxide (CO₂). A gas mixture containing 10 per cent CO₂ and 90 per cent methane was used as the source for the CO₂. Results suggest that the process is effective in reducing the concentration of CO₂ (a 90 per cent reduction after 2 hours under laboratory conditions). Depending on the location of the desalination plant, the process could be used to reduce CO₂ emissions from flue gases, such as from fossil-fuel power plants or exhaust gases from industrial fossil fuel combustion sources, as well as part of the purification process of natural gas.


Contact: muftah@uaeu.ac.ae

Theme(s): Climate change and energy, Sustainable consumption and production, Water