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Title

DESALINATION WASTE REVITALIZATION USING CARBON CAPTURE: PROCESS OPTIMIZATION USING MACHINE LEARNING

By

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Abstract

Over the next five to ten years, desalination will play an ever-important role in our society. Developing nations will look at desalination from the point of water scarcity, while developed nations will consider the perspective of the Water-Energy-Food nexus. With current technology, every liter of freshwater produced, one and a half liter is thrown away as waste. This body of research proposes to employ chemical precipitation in ammoniated brine solutions, that have reasonably high ionic concentrations. CO_2 absorption in Bubble Column Reactors can reduce sodium ions by precipitating $NaHCO_3$. Also, the absorbed CO_2 can reduce chloride ions and induce hydrate formation, by operating the column at a lower temperature (10 – 15 °C).

The Bubble Column Reactor model includes CO_2 absorption, aqueous reaction, and salt precipitation. The kinetic/equilibrium reaction system is simulated and optimized using non-linear programming. The hydrate formation process is modeled and optimized using Machine Learning. The results from the optimization show that brine with 23400 ppm of Na^+ ions and 44000 ppm of Cl^- ions can be reduced by 72.5% and 54.2%, respectively. The absorption process will use 1.15 mol of CO_2 absorbed per mole of NH_3 dissolved with a total of 8.702 mol of CO_2 absorbed.