Carbon Capture & Sequestration of a Desalination Plant

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Background

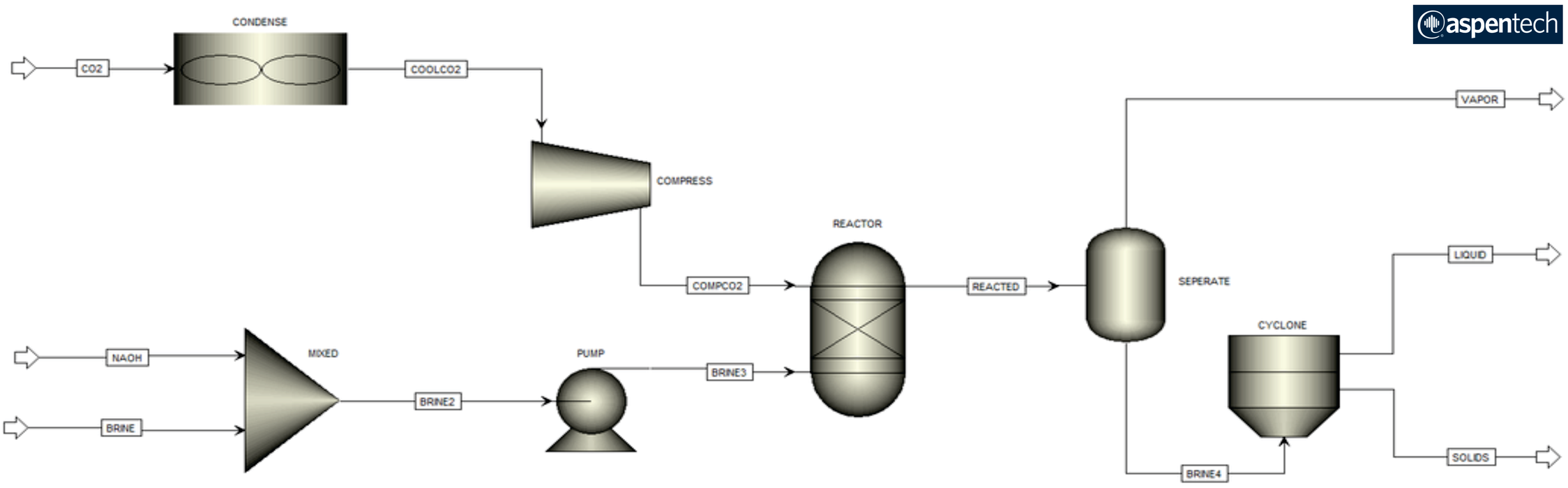
- Carbon dioxide (CO_2) is a greenhouse gas that contributes to climate change.
- Desalination plants produce a brine waste stream which has potential to be used for Carbon Capture Sequestration (CCS) using carbon mineralization.

Design Solution

- Combines CO_2 emissions with the brine from a desalination plant, composed primarily of Na^+, Ca^{2+}, Cl^-, and Mg^+.
- Gas and liquid streams mix in a tubular reactor, maintained at 50ºC, where the precipitates into $CaCO_3$ and $MgCO_3$.
- NaOH is added to maintain the reactor at a pH of ~8.
- A flash separator removes the gas stream, and a hydro-cyclone removes the liquid stream.

Constraints and Criteria

General	Model	Functional model using Aspen Plus V10.
	Maintenance	Minimal upkeep.
	Economic, social, and environmental impact	No severe negative impacts on the environment or the neighboring communities.
Carbon sequestration	Carbon capture	Maximize the capture of the CO_2.
	Carbon emissions	Must produce less CO_2 than what it captures.
By-product	Reusable	Should produce a reusable by-product.
	Marketable	By-product should have market value to offset the operational costs.
Cost	Capital cost	Minimize capital costs.
	Operational cost	Minimize operational costs.



Results

- Captures 99.95% of the CO_2 emissions from the desalination plant.
- 6700 kg of $CaCO_3$ and 1000 kg of $MgCO_3$ are mineralized every hour.
- The capture cost is $2.88/kg.

Capital Cost (USD)	33 million
Operating Cost (USD/year)	59 million
Product Profit (USD/year)	7.5 million

Recommendations

- NaOH regeneration to reduce operational costs.
- Renewable energy could assist in the reduction of operating costs associated with the design.
- Carbon mineralization is an exothermic reaction and the heat generated could be used to generate electricity.
- Future iterations of the model could run the reaction twice to aid in the separation of $CaCO_3$ and $MgCO_3$.

Guangxi Huana New Material Technology Co., Ltd. (2017). Precipitated Calcium Carbonate for Sealants. Retrieved from http://www.huananm.com/en/products.html

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