Brine Diffusion

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Mixr — Injecting Better Solutions

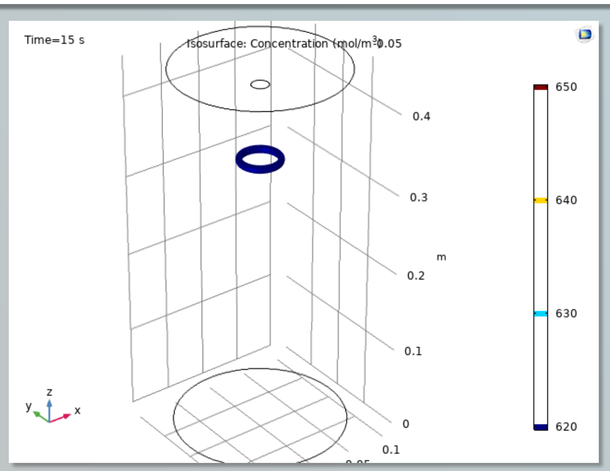
Background

Ecomerit Technologies is working to combat water shortages in California through an offshore reverse osmosis desalination plant. To approve the plant, Ecomerit needs to prove that the waste outflow conforms to the California Ocean Board's regulations. The goal of the Mixr project is to characterize the outflow of the desalination plant to help Ecomerit's design and approval process.

Overview / Design Specs

Desalination waste is brine: a high density solution with twice the salinity as ambient seawater. Brine mixing with the surrounding ocean is influenced by the negative buoyancy of the difference in density between brine and seawater, and diffusion.

COMSOL Model Verification

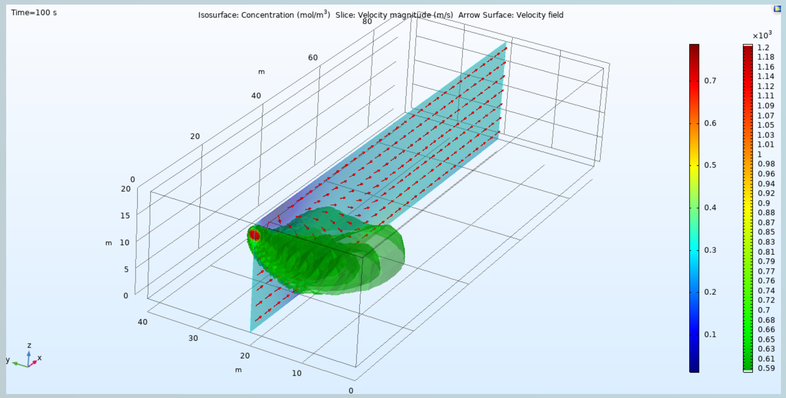


COMSOL simulation to verify the physics of the numerical model. Used in a visual and numerical comparison to physical testing.

Experiment

To verify the physics of the COMSOL model, a droplet of brine is injected into a cylinder of water and the depth and diameter of the droplet are recorded over time. The brine was injected with a syringe, using a consistent position and initial velocity, with salinities varying from 10 to 30 parts per thousand.

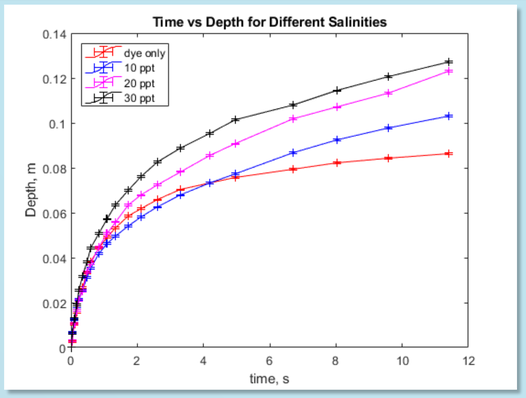
Full Scale COMSOL



"Moving frame" of plume in ocean shows its progression over time:

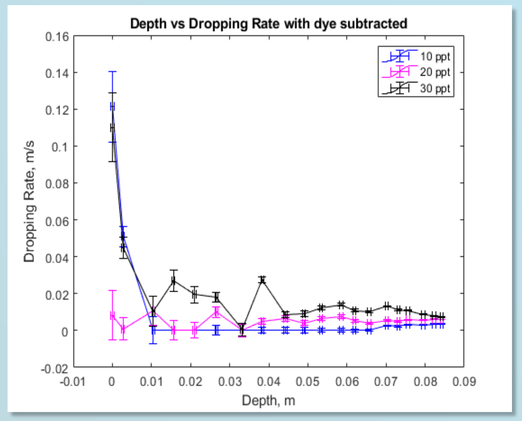
- Vortex makes a scroll shape
- No breakup modeled
- Majority of plume mixes with instability

Time vs Depth



Initially, the droplet is influenced by the injection velocity, then by the salinity of the injection, and finally reaches a constant velocity.

Depth vs Dropping Rate, Modified



The velocity of the control, dye and fresh water, is subtracted from the salinity trials. This artificially removes the effect of initial injection velocity and shows how velocity profile is affected by gravity alone. In all three cases, the velocity converges to a constant value, indicating that at a certain depth. Regardless of initial salinity, the final salinity will be similar.

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