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Project sponsors: City of Corvallis and Multiform Harvest

Project Introduction

The City of Corvallis Wastewater Reclamation Plant (WWRP) plans to install a Multiform Harvest reactor and make struvite, a fertilizer, from landfill leachate and anaerobic digester lagoonate. Struvite can be harvested and sold for \$1500/ton.

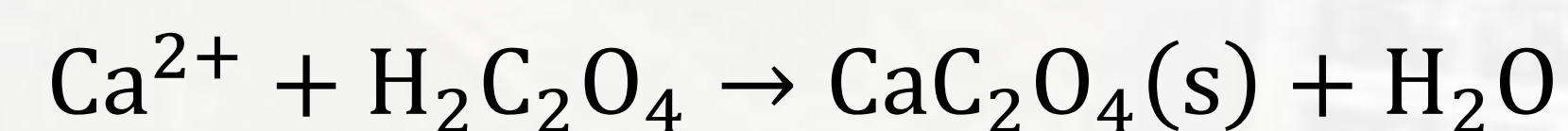


Tests have shown that high levels of calcium interferes with struvite formation by reducing phosphate levels which is one of the key components in struvite. Calcium phosphate is formed as a product instead of struvite.



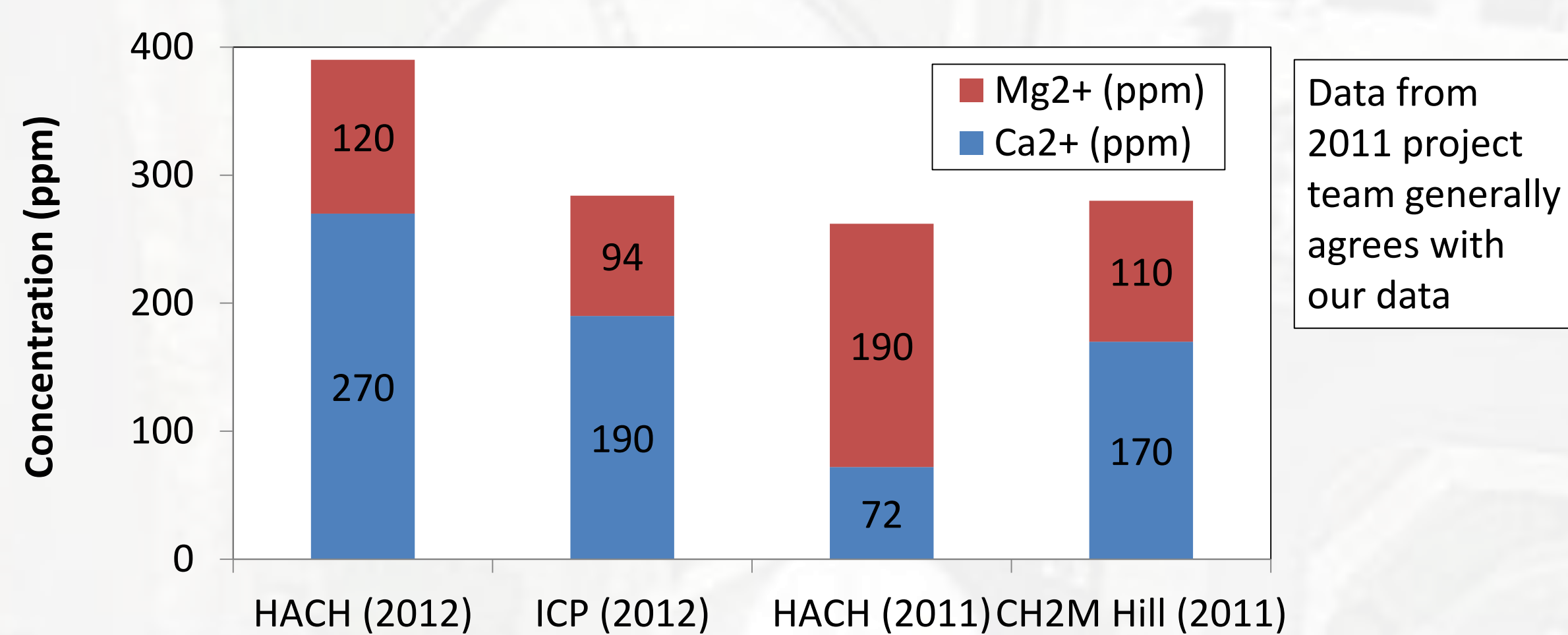
The current solution is to add phosphate additives to account for the phosphate loss but an alternative approach is to add a pre-treatment step to lower calcium levels.

The proposed pre-treatment step is to introduce oxalic acid to the leachate stream and remove the calcium as calcium oxalate.



Leachate Characterization

Key Species: Calcium and magnesium ions
Available Tests: HACH Hardness Test Kit and ICP-AES

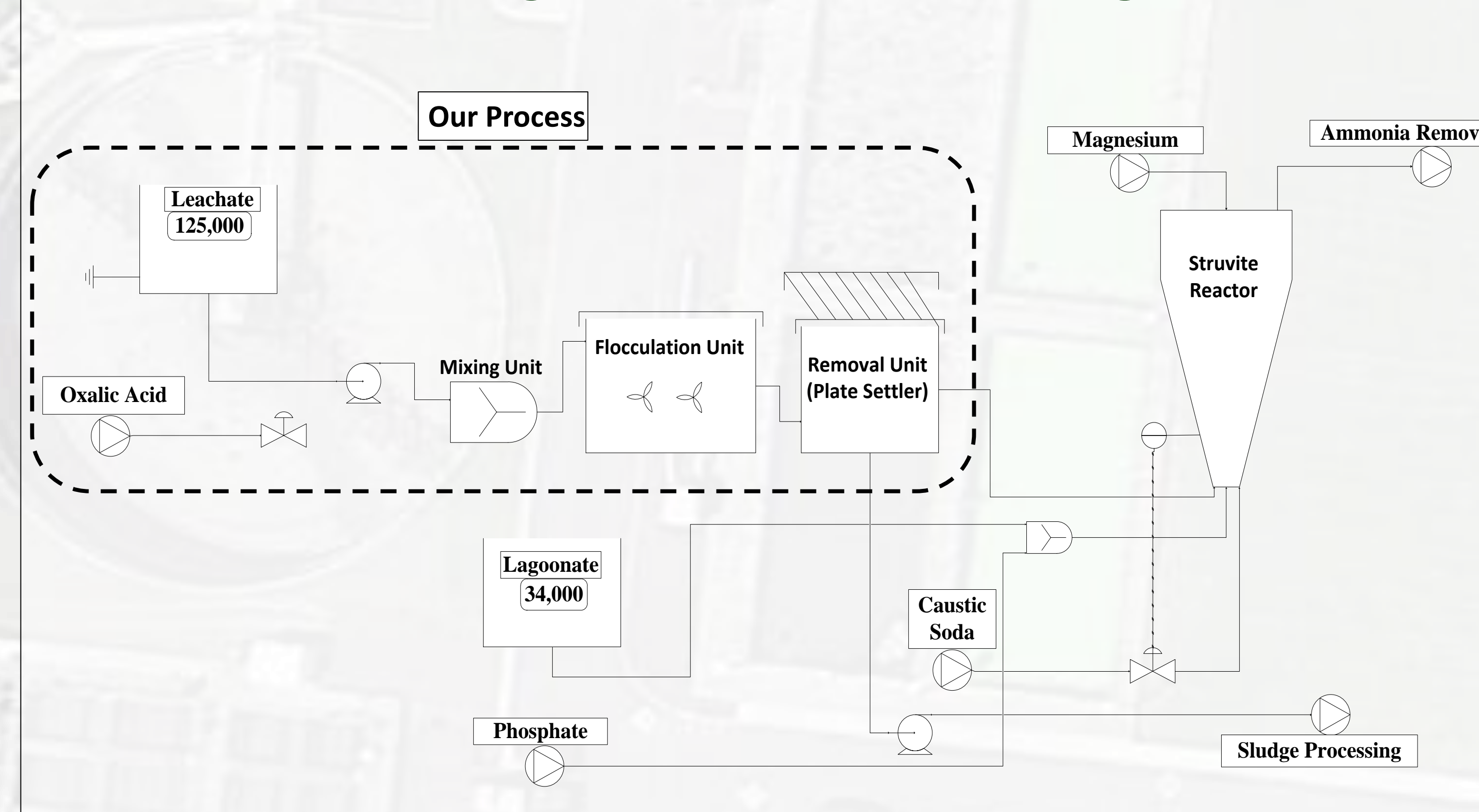


Note: Calcium concentration are expected to increase in the upcoming years due to improvements in landfill capping at Coffin Butte.

Project Objective

- Lower the calcium ion concentration to around 40 – 70 ppm
- Determine optimal oxalic acid feed ratio
- Characterize the precipitate formed in the leachate
- Perform mass balances on the overall calcium removal process
- Research current removal technologies

Overall Process Design for Struvite Harvesting



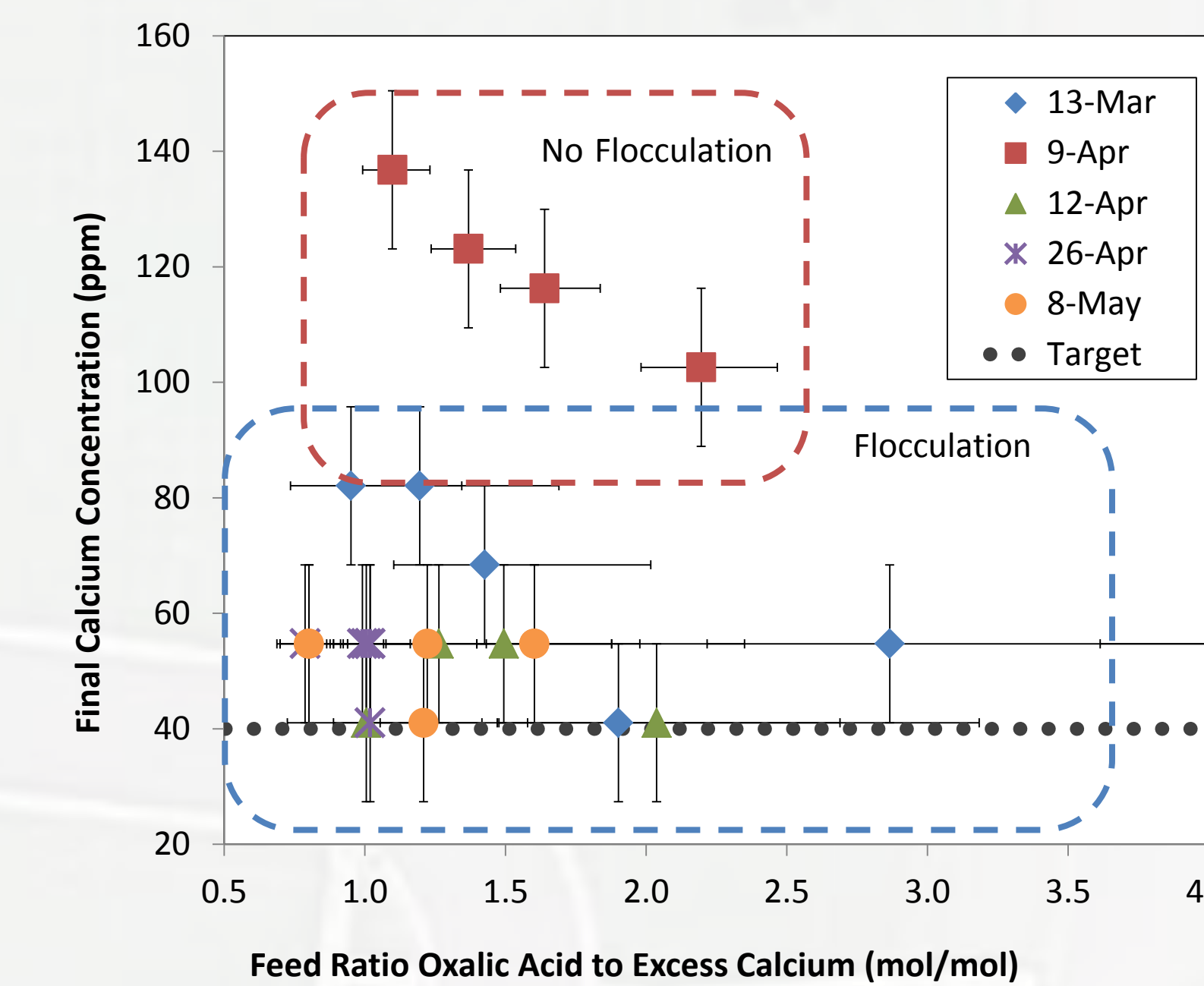
Lab Tests

- Jar tests were conducted to determine the optimal oxalic acid feed ratio
- Feed ratios between 1 – 5 were tested and no significant difference was observed for the final calcium level for higher oxalic acid ratios
- Imhoff cones were used to settle and collect the precipitate
- Column settling test was conducted to generate percent removal curves over time and height
 - 1 minute rapid-mixing (100 rpm)
 - 30 minute flocculation (30 rpm)
- ICP tests to confirm calcium concentrations in raw leachate and treated leachate

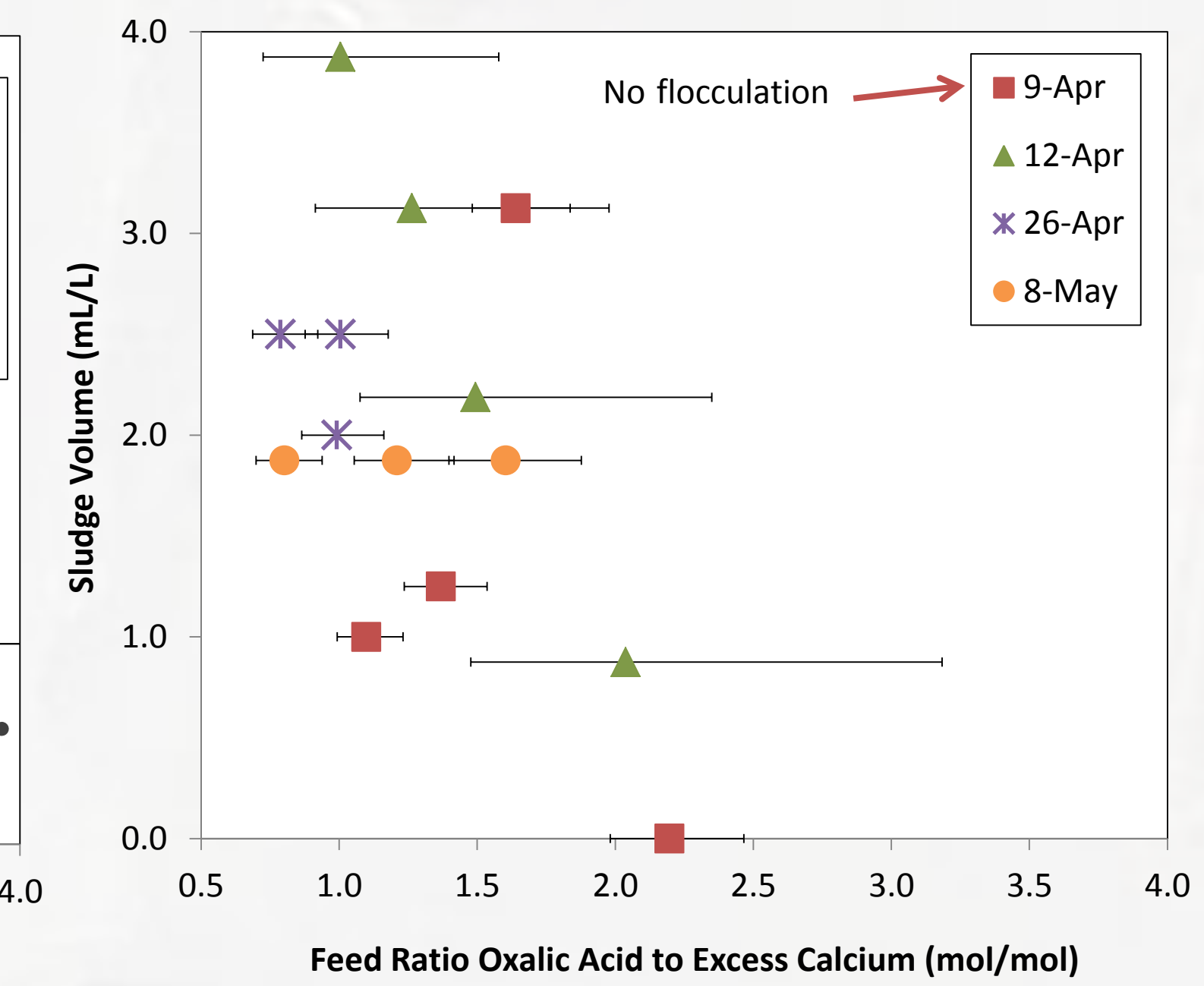


Scaled up settling column (2 m)

Oxalic Acid Dose Test Results

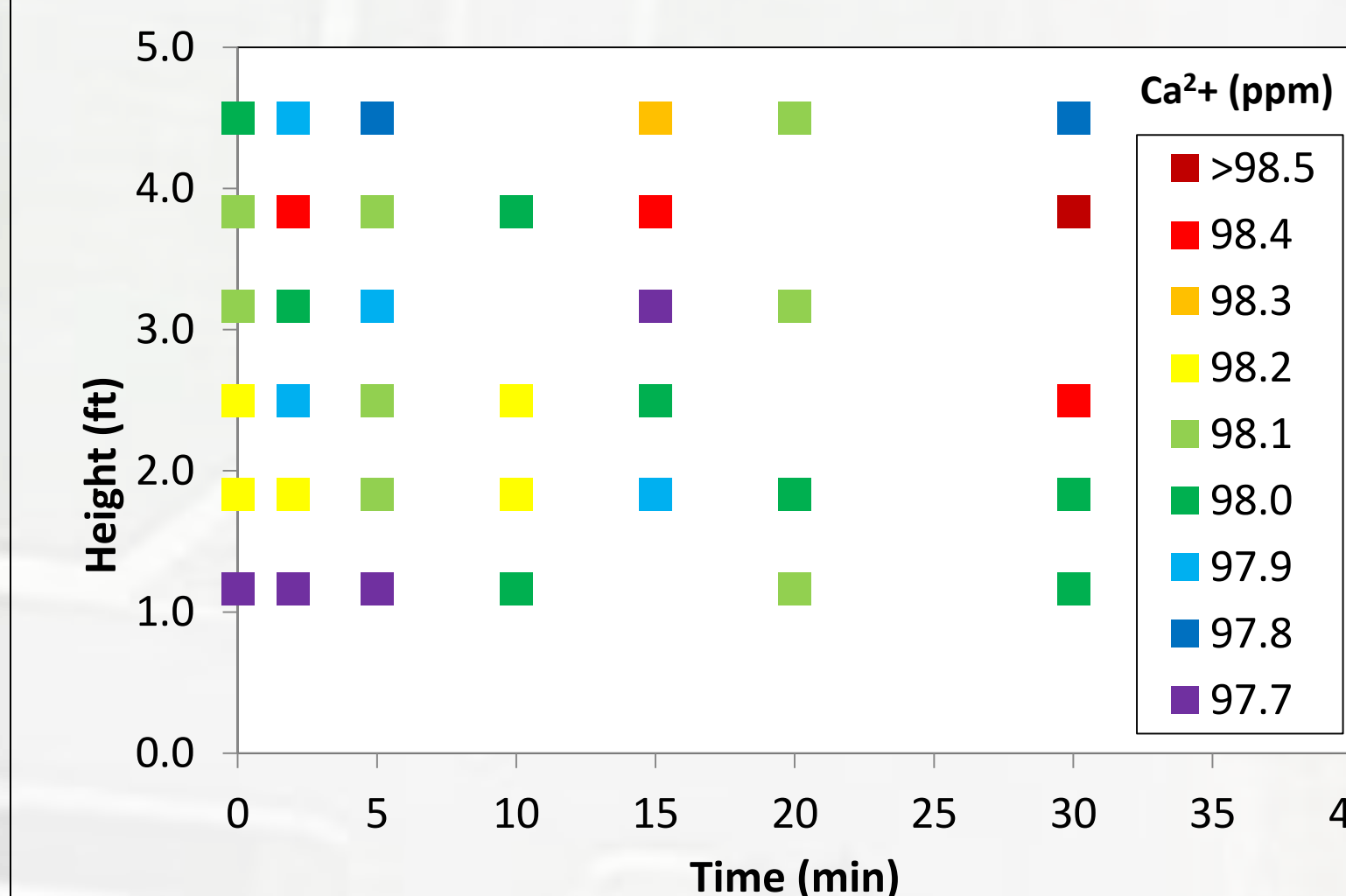


- Without Flocculation:**
- Removal improves with increased acid feed ratio
- With flocculation:**
- Higher Ca²⁺ removal
 - No significant benefits of using higher acid ratios

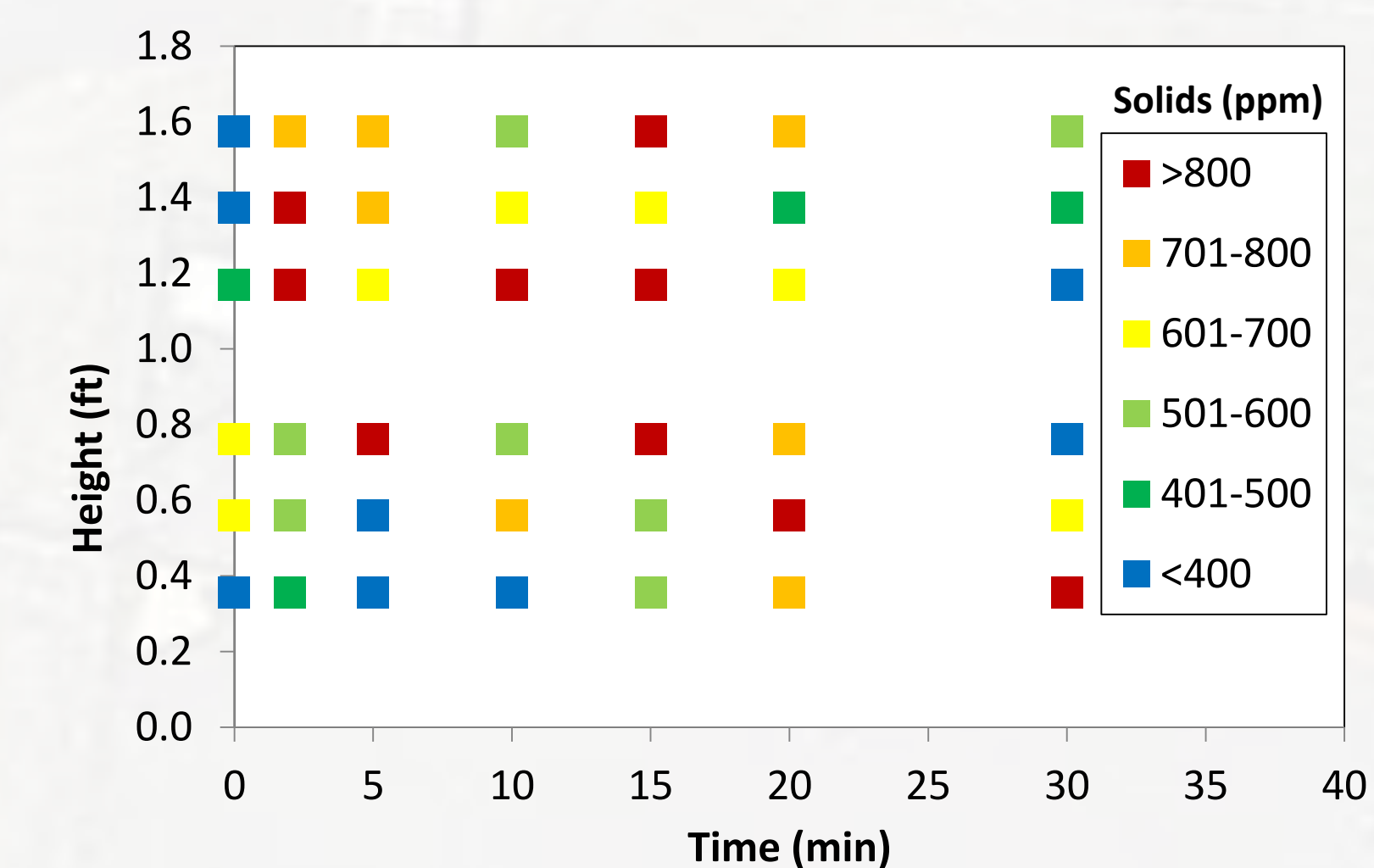


- Generally higher solids production at lower acid feed ratios, but too much scatter to be significant
- Flocs settle better (qualitatively) at lower acid feed ratio

Column Test Results



Calcium concentration after flocculation complete. Concentrations are generally low and column is well mixed. High values are likely from experimental error.



Solids concentration during flocculation and 10 min. after. Solids concentration generally increases initially and then decreases at upper levels as particles settle after flocculation.

Other Results

- Flocculation (slow stirring) enhances particle settling and Ca²⁺ removal
- Flocs break up when shear stress is applied
- Magnesium is not consumed in the reaction
- Specific gravity of solids: **1.63±0.77**

Acknowledgements

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- John Hoppner (City of Corvallis)
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