PHOSPHORUS REMOVAL IN AGRICULTURAL WATERSHEDS

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Problem Statement

- Excessive fertilizer use in agriculture has contributed to eutrophication of water bodies
- Fertilizer and soil management practices are no longer sufficient due to several factors that cause nutrient imbalances in the Great Lakes
- New treatment systems that can target localized high concentration phosphorus areas may help reach objectives set by the Great Lakes Water Quality Agreement

Design Objectives

- Design an adsorbent capable of achieving at least 40% phosphorus removal in water
- Optimize removal efficiency and cost via adsorption capacity and contact time
- The design must not be directly or indirectly toxic to the environment or human health

Project Overview and Results

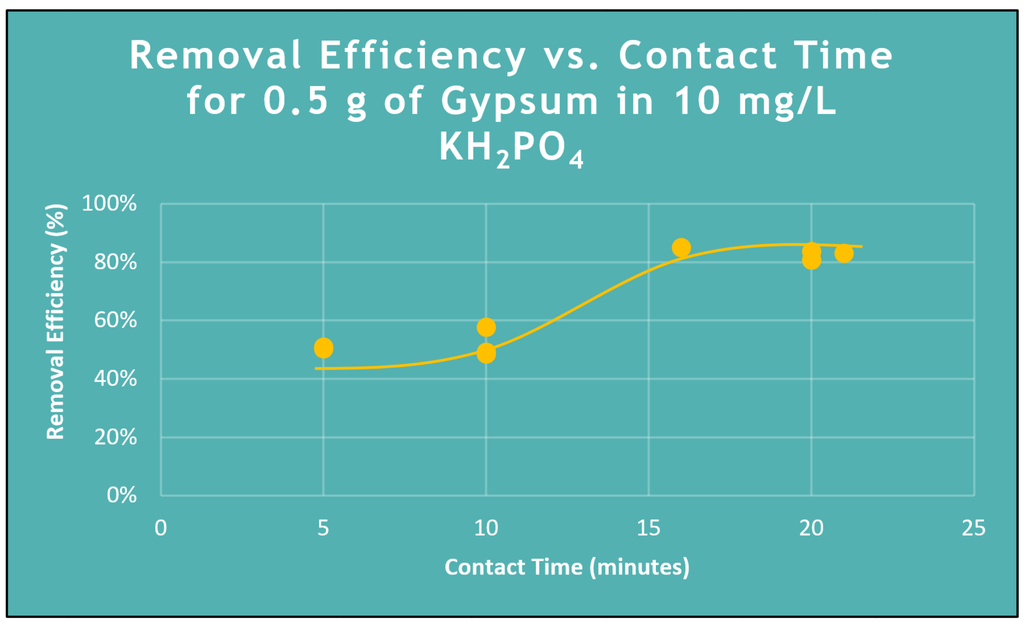
1. Identify the most feasible material for use as an adsorbent

- Egg shells, snail shells and gypsum at a mass of 0.5g in a solution of 10 mg/L phosphorous were tested for removal efficiency

	Egg Shell	Snail Shell	Gypsum
Removal Efficiency	-35%	-33%	68%
Approximate Grain Size	Coarse Powder	Coarse Powder	Fine Powder
Treatment	Baked, Boiled	Baked, Boiled	None

2. Construct an adsorption efficiency curve to obtain ideal removal efficiency

- An ideal contact time of 20 minutes for gypsum was found using the conditions stated above



3. Compare adsorption capacities by adjusting mass of adsorbent

- Additional masses of 0.01g, 0.05g and 0.1g were tested to determine the ideal adsorption capacity corresponding to 40% removal efficiency

Final Removal Results for 20 Min. Contact Time	
Gypsum Mass (g)	Removal Efficiency
0.05	15%
0.05	25%
0.1	62%
0.1	55%
0.5	80%
0.5	81%

4. Recover the adsorbent for phosphorus extraction and possible reuse

- A weight percentage of 0.025 sodium alginate was successful in precipitating used gypsum

Conclusions

- 40% removal efficiency can be obtained using between 0.05 and 0.1 g of gypsum for 0.1 g of phosphorus in a 10 mL solution at a contact time of 20 minutes
- Future work will include field implementation and further testing of removal efficiency for lower initial concentrations

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