Background/Introduction/Motivation

- Earthen canals are a common way of transporting water for agriculture.
- Flow losses from canal seepage have been estimated to be 17-70%.
- Canal seepage also degrades soil and water quality.
- The goal of this project is to improve water quality and quantity through the reduction of canal seepage with polymer sealants.

Evidence of Canal Seepage

Poudre Valley Canal, LaPorte, CO

We recently measured the flow losses from the Poudre Valley Canal to be 14 cfs, or 833 acre-feet, per month over just a 3 mile reach. This amounts to about $71 million lost per month.
In the lab, we measure how the hydraulic conductivity of a soil changes when polymer is added:

- Soil = sand (baseline for right now); coarse gravel and a geocomposite drainage layer were also used to distribute flow.
- Vary polymer added to water (biopolymer and synthetic polymer).
- Measure mass of outflow from columns versus time.
- Calculate hydraulic conductivity using Darcy's law.
- By measuring outflow before and after addition of polymer, we can calculate percent reduction in hydraulic conductivity.

The ultimate goal is to determine which polymers are most effective at reducing the hydraulic conductivity of the column systems to select polymers and addition rates for future field testing.
Results – In the Lab

<table>
<thead>
<tr>
<th>Polymer</th>
<th>% Reduction in Hydraulic Conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>pullulan, desalinated</td>
<td>44.9%</td>
</tr>
<tr>
<td>sodium alginate, low viscosity</td>
<td>6.9%</td>
</tr>
<tr>
<td>xanthan gum</td>
<td>80.5%</td>
</tr>
<tr>
<td>linear anionic polyacrylamide (Magnafloc LT30)</td>
<td>78.01%</td>
</tr>
<tr>
<td>stockopam</td>
<td>86.6%</td>
</tr>
<tr>
<td>Magnafloc LT22S</td>
<td>23.76%</td>
</tr>
<tr>
<td>Magnafloc LT27AG</td>
<td>88.69%</td>
</tr>
</tbody>
</table>

Figure 1. Hydraulic conductivity of columns before and after addition of Pullulan polymer.
Spring Break in the Field (Poudre Valley Canal)
Discussion/Next Steps

- Changing variables: soil type, amount of suspended sediment, and varying polymer application rates
- Identifying the most effective polymers.
- Implementing the lab findings at a field scale

Conclusions

- Earthen canals leak… a lot!
- Multiple synthetic and polysaccharide biopolymers were shown to be effective in reducing the flow in column experiments
- Stockopam was most effective (87% reduction in hydraulic conductivity), so far
- Lab work is a lot of work.

Figure 2 Application of LAPAM by CSU and colleagues in (a) the Rocky Ford Highline Canal in Colorado’s LARV, and (b) the Tarah Canal in Pakistan. Lund et al. (2021).
What benefits did you get from your SURE experience?

- Real engineering lab and field experience
- More confidence in our engineering ability
- Insight into the work of a graduate student
- Opportunity to work with CSU professors and graduate students
- Deeper knowledge of the geotechnical side of civil and environmental engineering

And friendship!

References & Acknowledgements

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Thank you!