Ion Exchange for NOM Removal in Drinking Water Treatment

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NOM in Water

- **Natural organic matter (NOM) ubiquitous in surface waters & requires treatment**
  - Aesthetics
  - Disinfectant demand
  - Precursors for disinfection by-products (DBPs)

- **Challenges for small and/or remote communities**
  - Variable source waters, often variable NOM concentrations
  - Technology requirements:
    - Easy to operate and maintain
    - Robust
    - Affordable

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  - NF/RO
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  - Field testing
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  - **Ion Exchange**
- **Challenges for implementation of Ion Exchange**
  - **Field testing**
  - Regeneration
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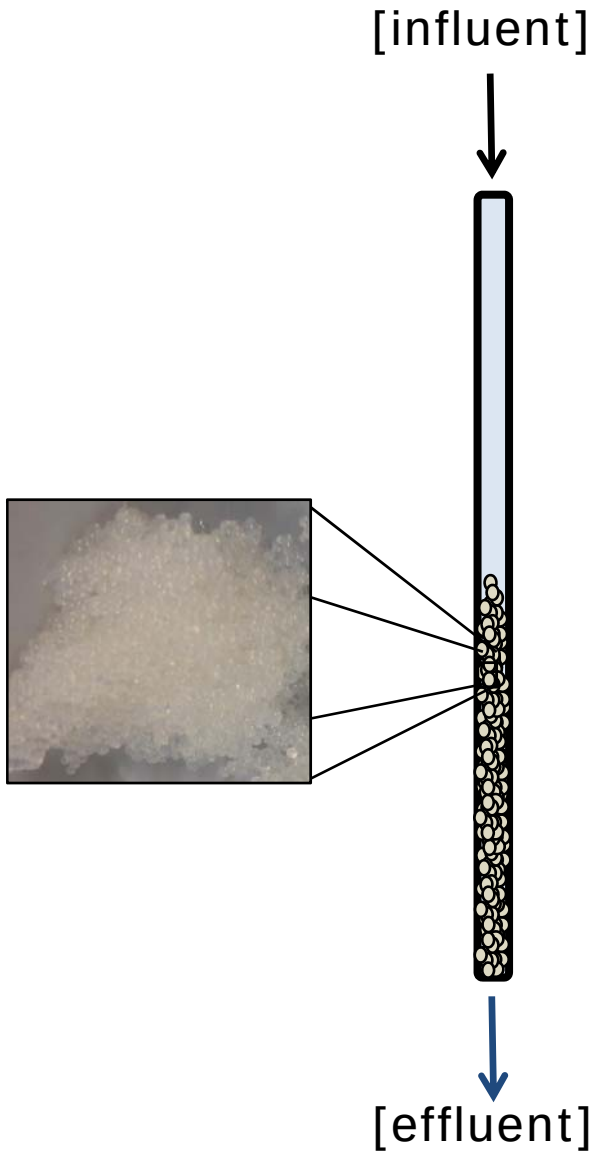
- **Performance**

Field testing

- **Column tests** (traditional approach)
  - Filter water through packed column to determine
    - **Removal, capacity**
  - Time and capital expensive



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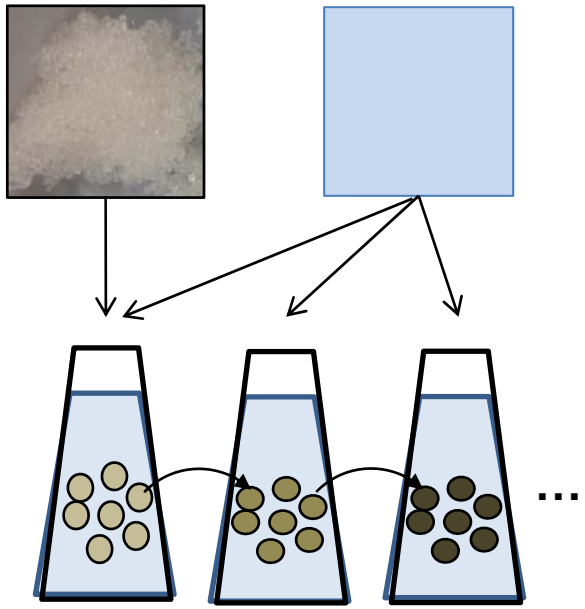
  - Accelerated test
    - **Volume rather than flow**
  - ‘Load’ re-applied to same resin multiple times
  - Completed in 1-2 days



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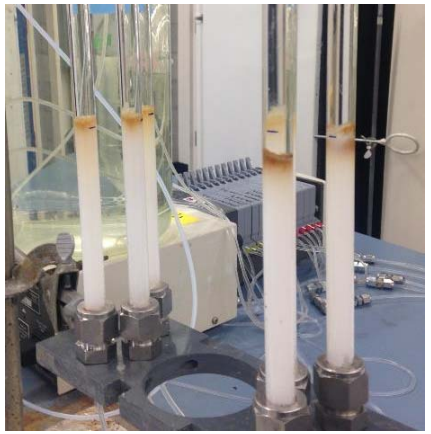
Side-By-Side Comparison

Parameter	Column Test	Multiple Loading Test
Ion Exchange Resin	Purolite®A860	
Resin volume (mL)	7.55	0.75
Model source waters	• **Jericho Pond water** (with and without 0.01% NaN_3 to inhibit biological growth) • **Suwannee River NOM water** (with and without 0.01% NaN_3)	
Source water DOC	5 mg/L	
Contact time	30 min EBCT	30 minute mixing time/cycle
Bed volumes	48/day	200 equivalent BV/ cycle (15 cycles)
Saturation point	C/C_o = 0.7	



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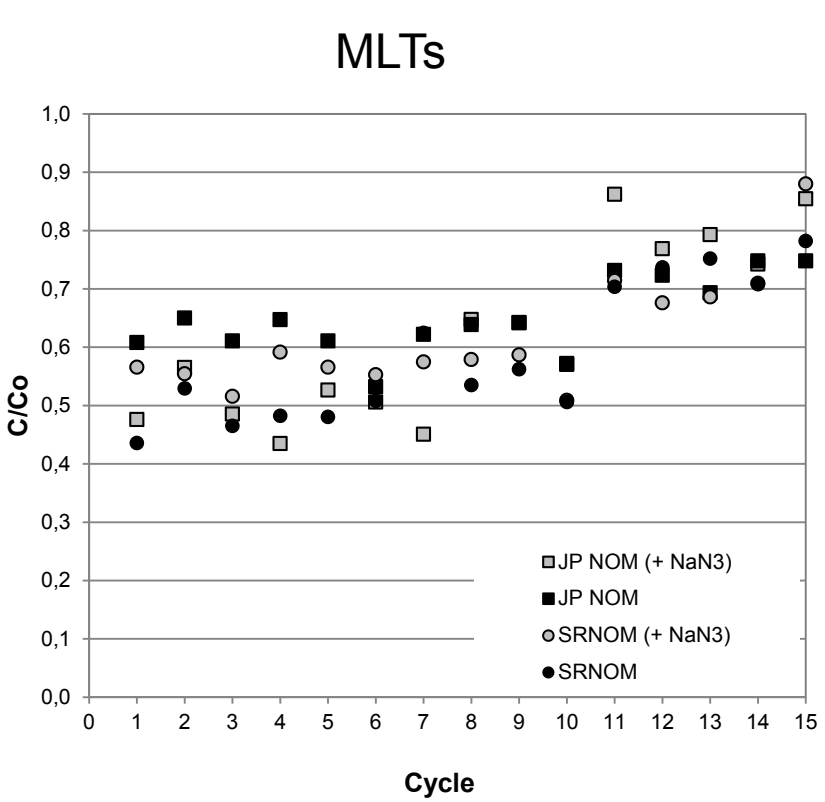

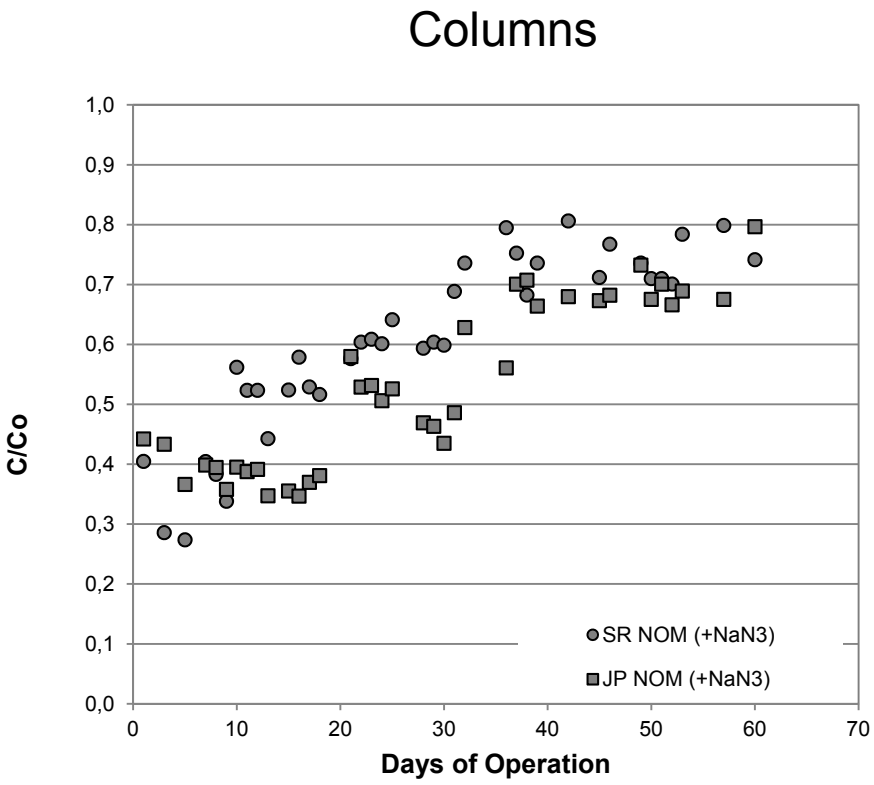

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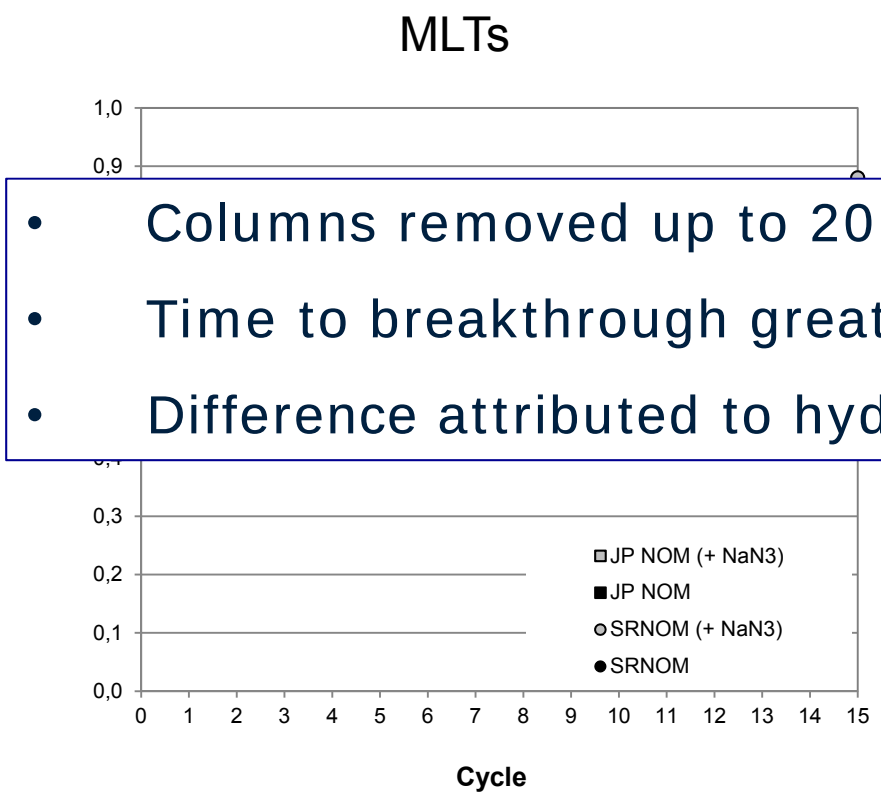

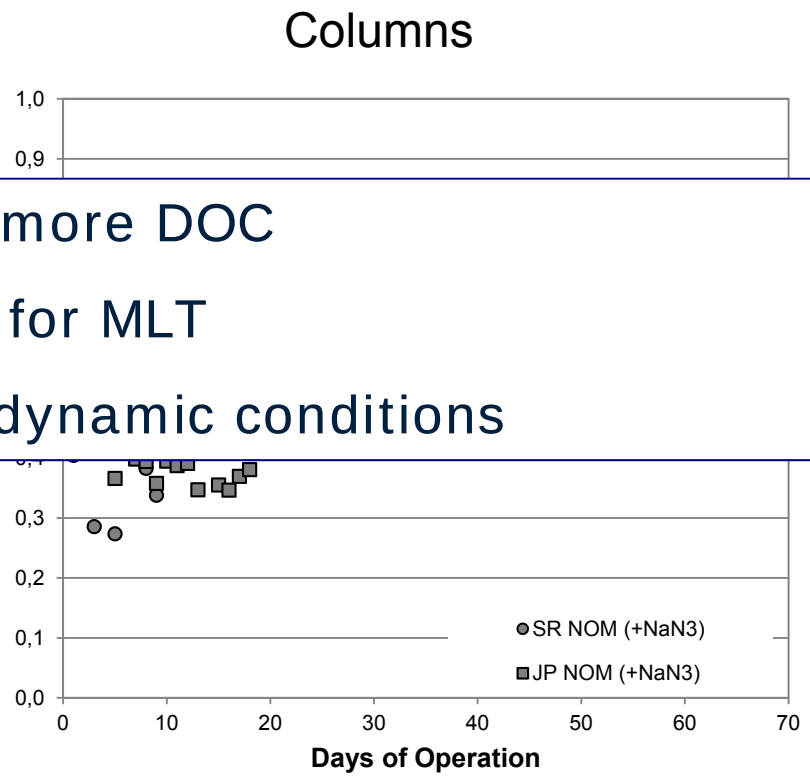

- Columns removed up to 20% more DOC
- Time to breakthrough greater for MLT
- Difference attributed to hydrodynamic conditions

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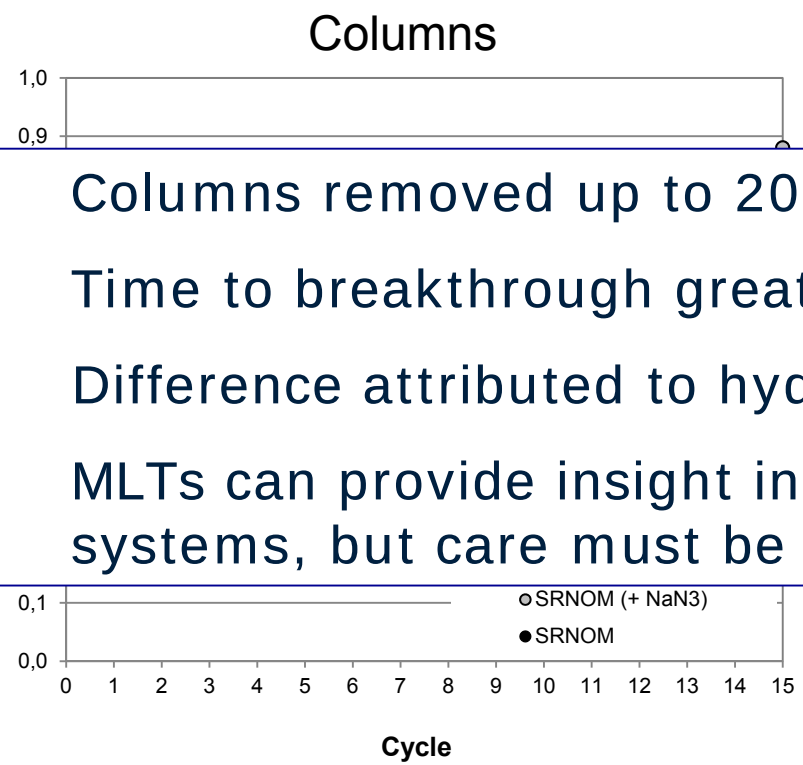

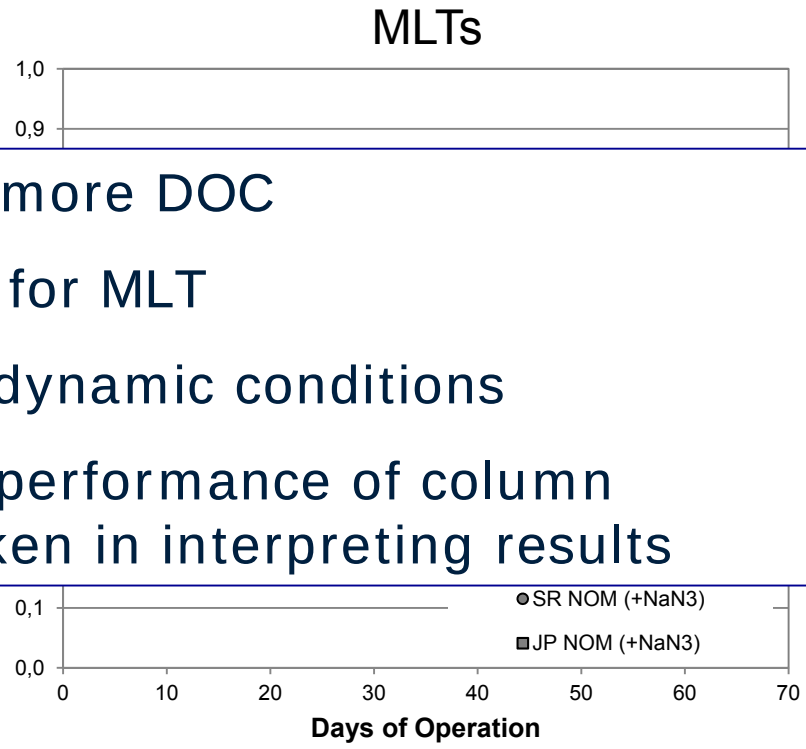

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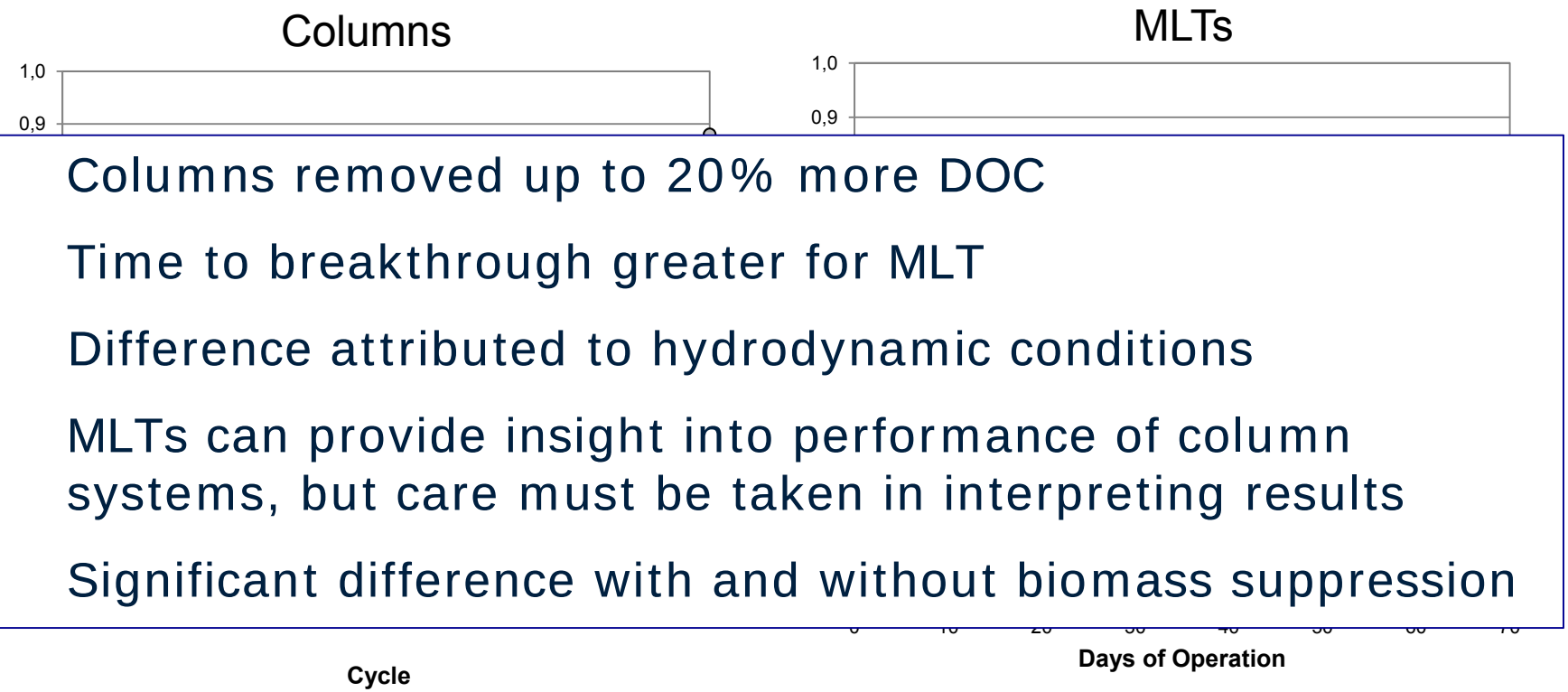

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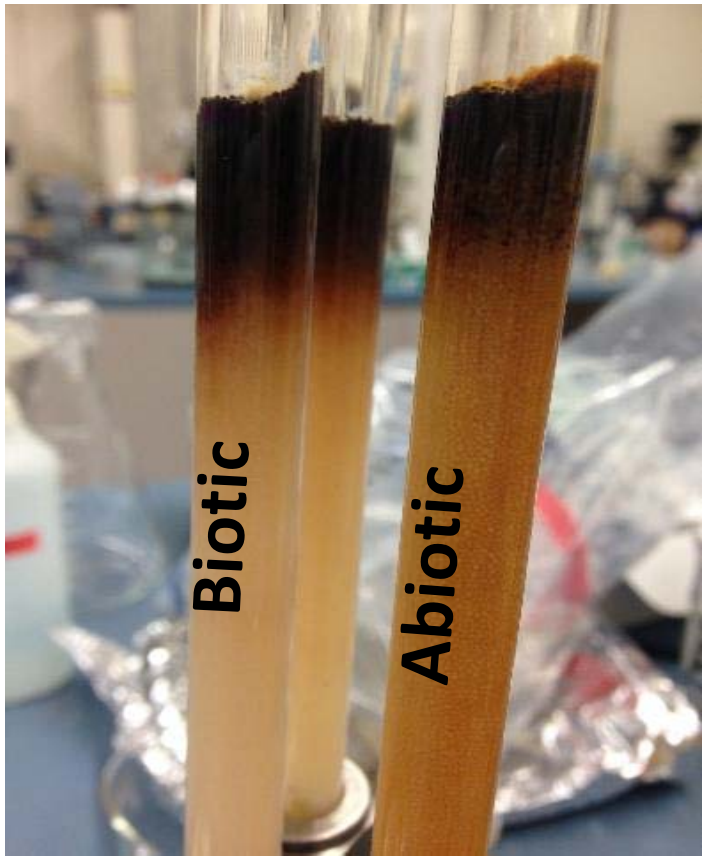
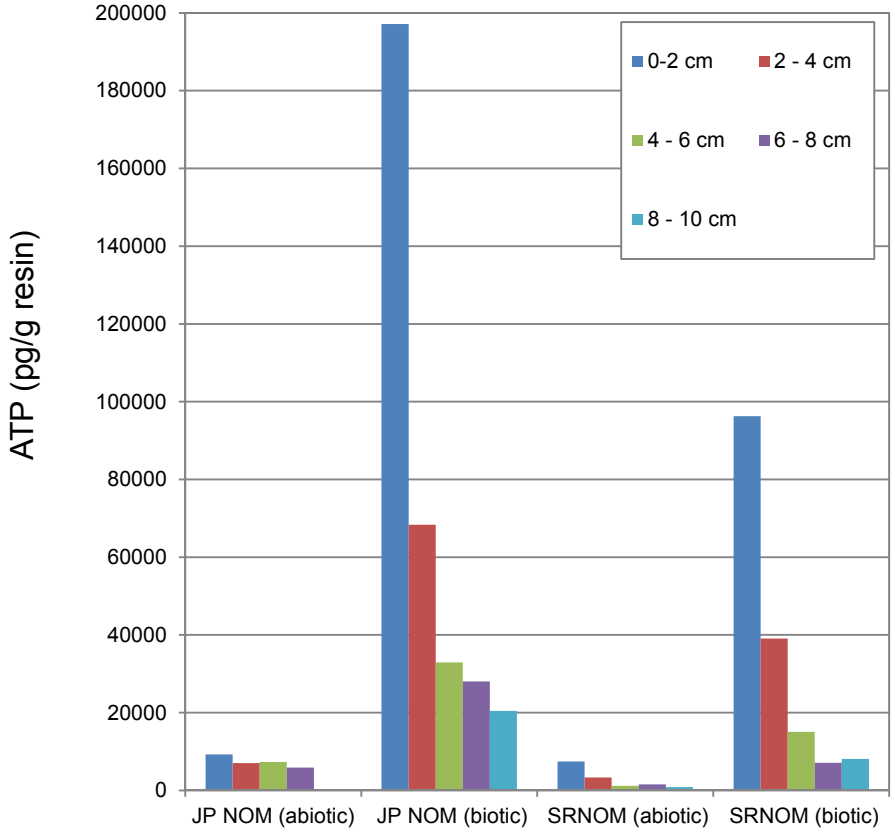
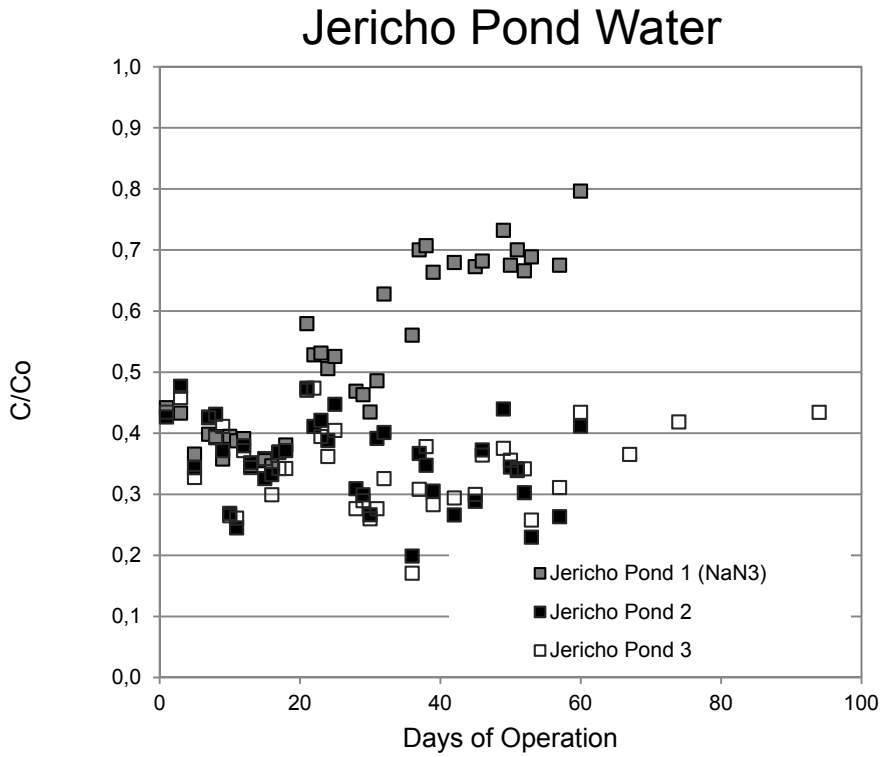
- Time to breakthrough greater for MLT
- Difference attributed to hydrodynamic conditions
- MLTs can provide insight into performance of column systems, but care must be taken in interpreting results
- Significant difference with and without biomass suppression

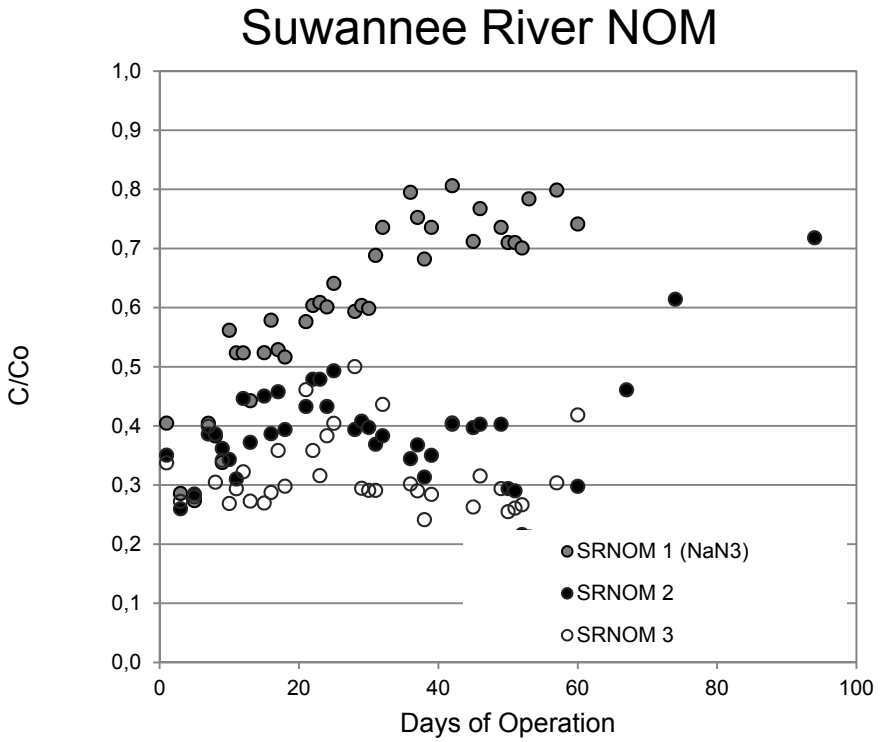
With / Without Biomass Suppression





Performance: BIEX vs IEX





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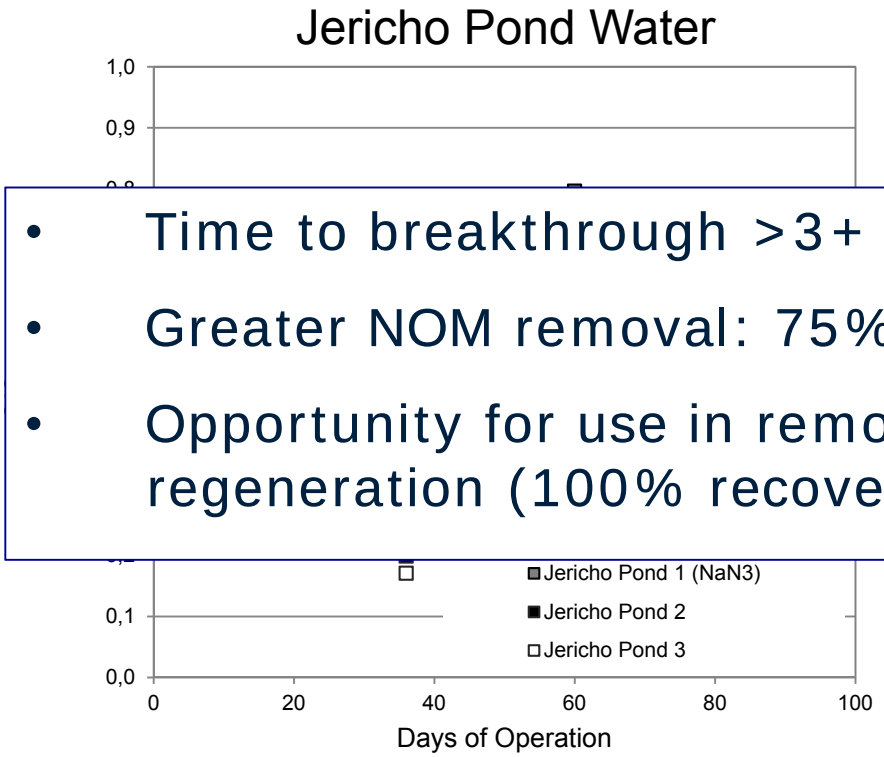
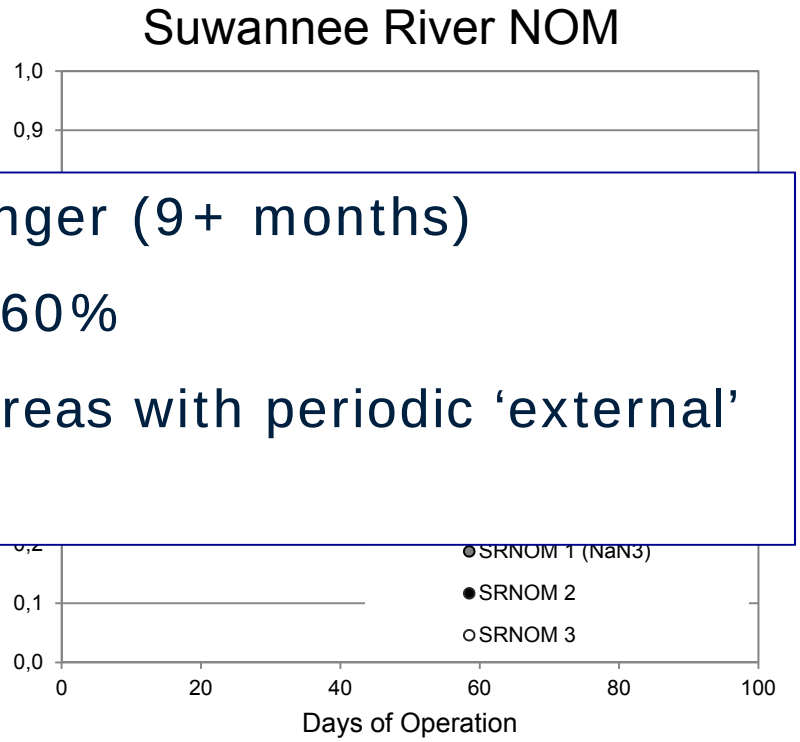
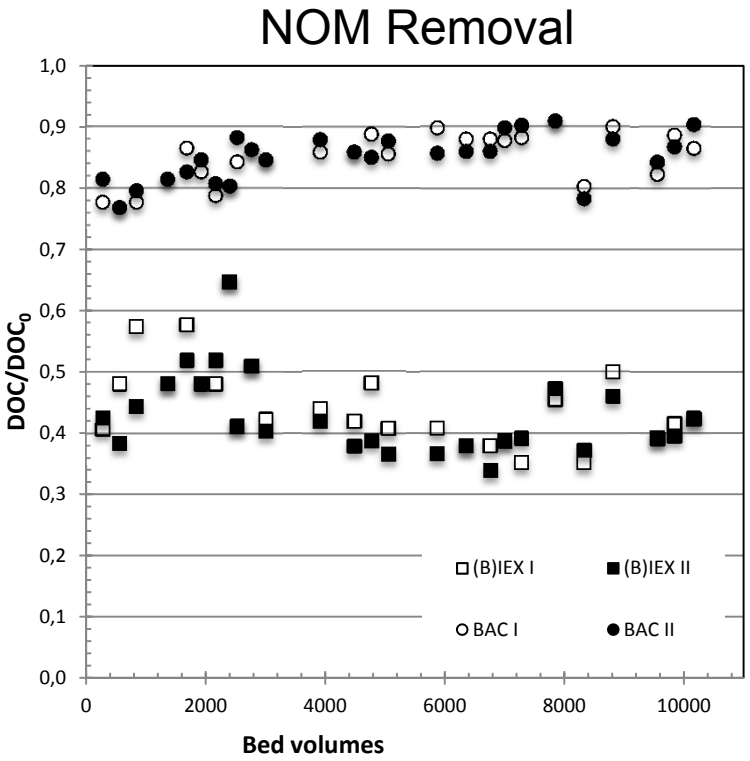
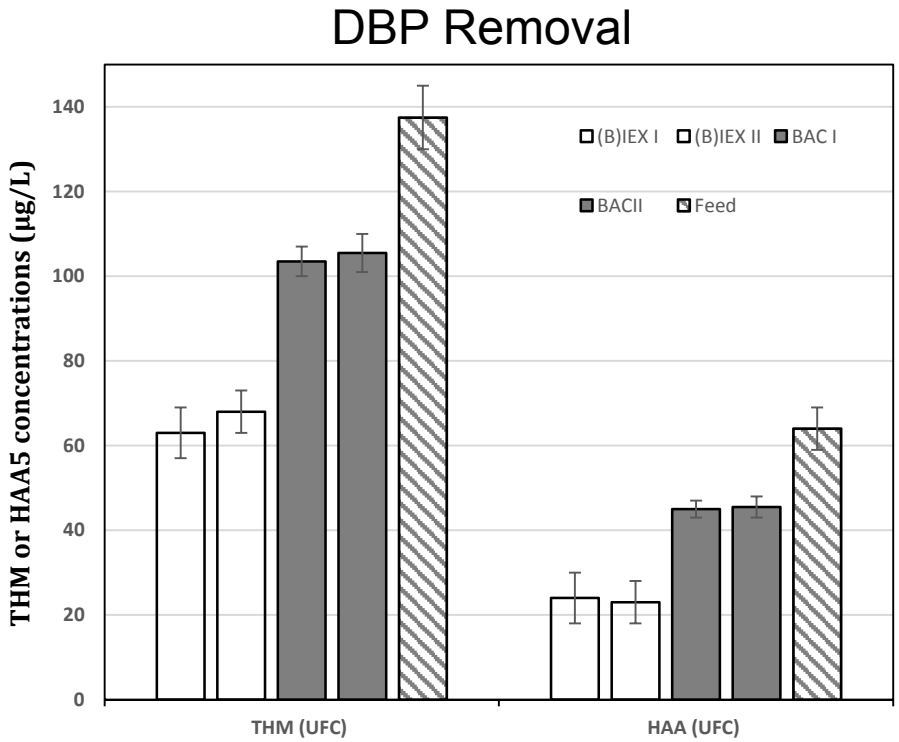




- Time to breakthrough >3+ x longer (9+ months)
- Greater NOM removal: 75% vs 60%
- Opportunity for use in remote areas with periodic ‘external’ regeneration (100% recovery)

Performance: BIEX vs BAC





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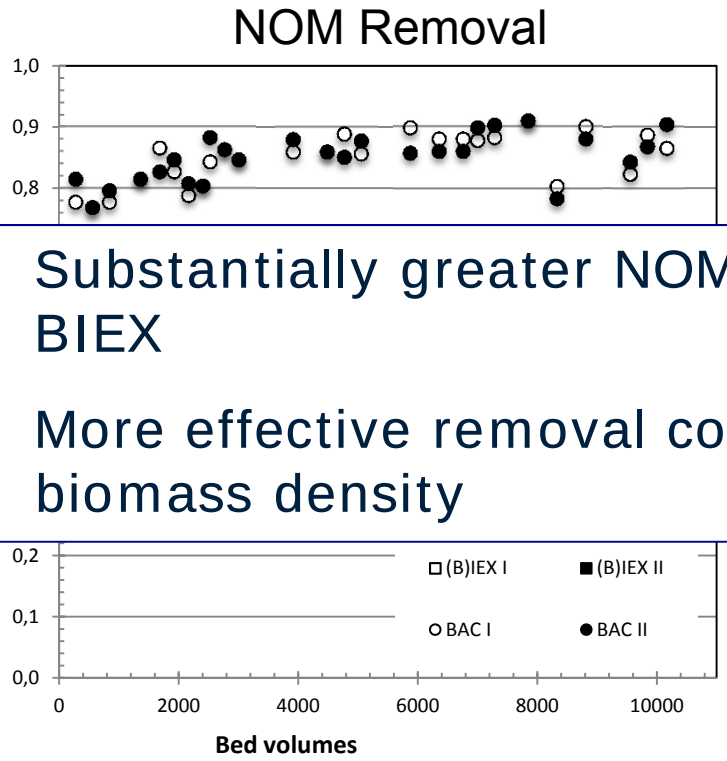

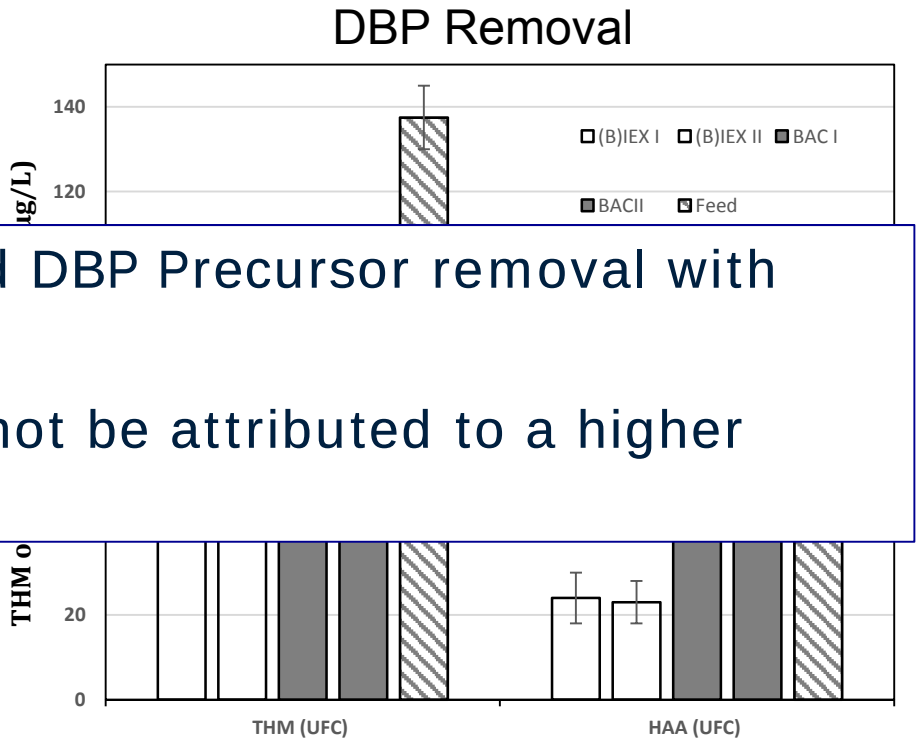

- Substantially greater NOM and DBP Precursor removal with BIEX
- More effective removal could not be attributed to a higher biomass density

Summary

- **MLTs can provide an initial estimate of capacity of resins**
  - Testing under relevant conditions essential to obtain an accurate estimate of resin capacity
    - Column or fluidized bed
- **Biological operation improves NOM removal and extends time to breakthrough**
  - Regeneration every 9+ months
  - Opportunity to introduce ‘external’ regeneration approach
- **BIEX more effective than BAC at NOM removal**

Acknowledgements

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