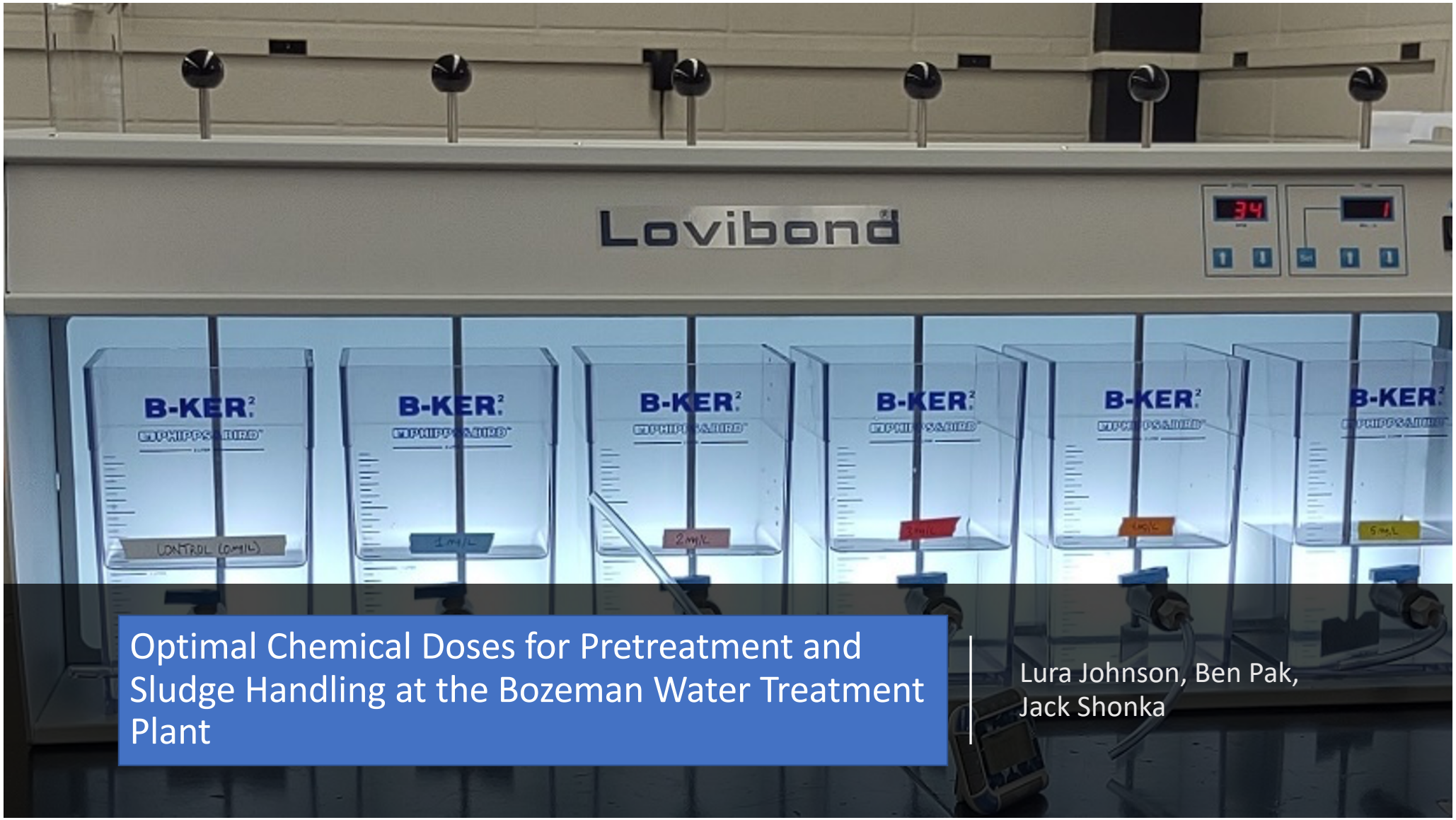
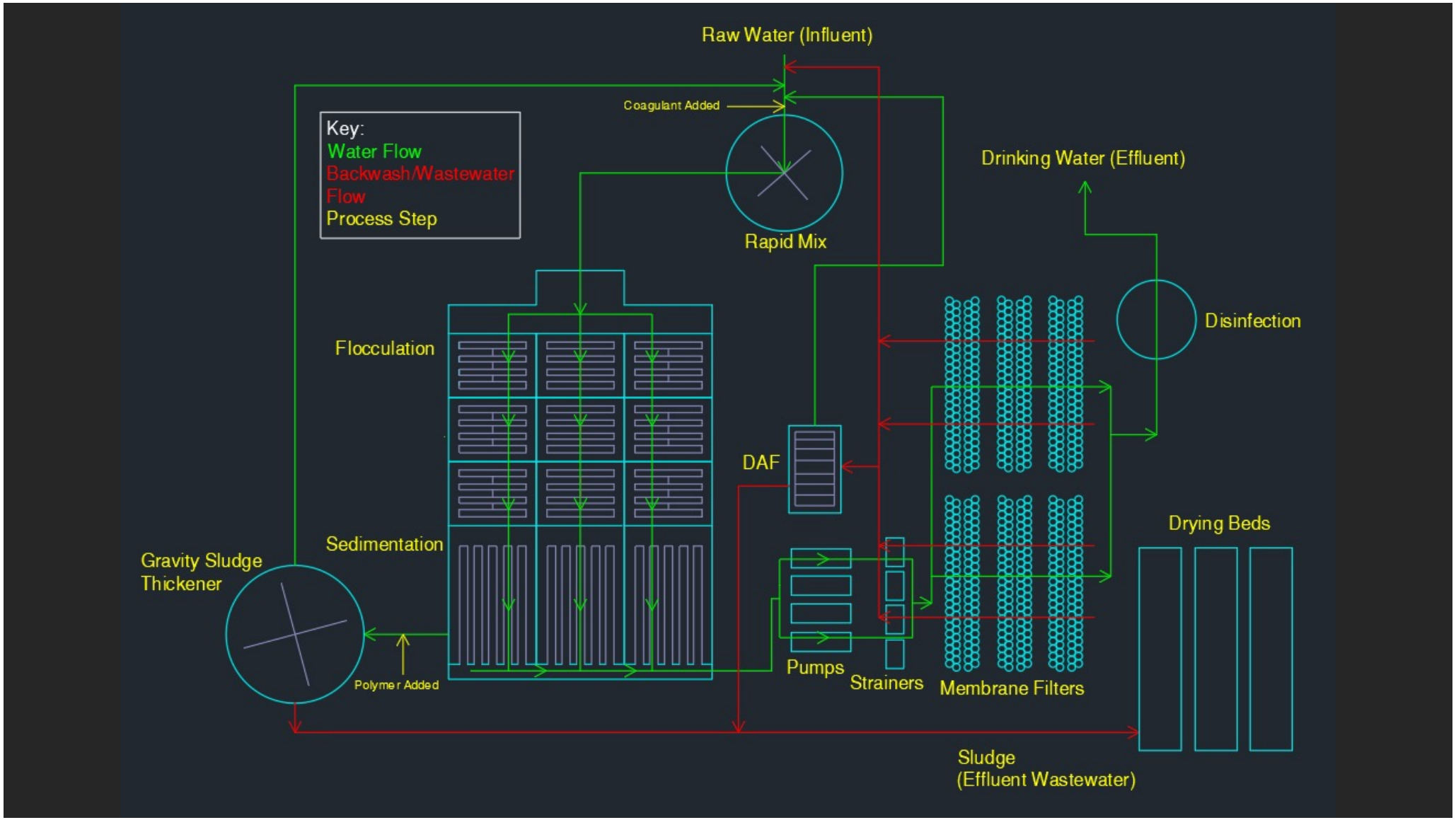
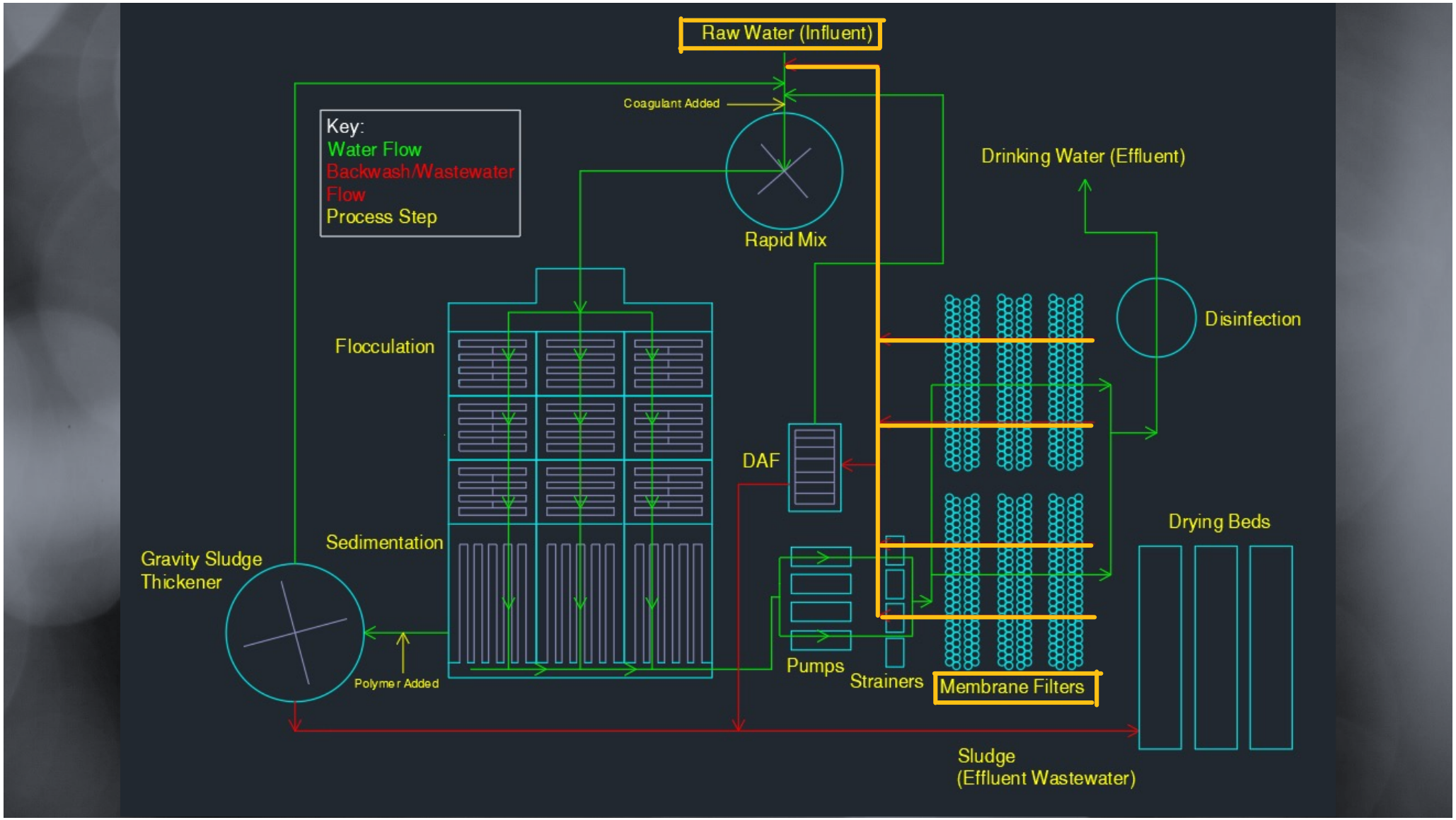


Optimal Chemical Doses for Pretreatment and Sludge Handling at the Bozeman Water Treatment Plant

Lura Johnson, Ben Pak, Jack Shonka


Raw Water (Influent)
Coagulant Added
Key:
Water Flow
Backwash/Wastewater Flow
Process Step
Rapid Mix
Drinking Water (Effluent)
Disinfection
Flocculation
DAF
Sedimentation
Gravity Sludge Thickener
Drying Beds
Pumps
Strainers
Membrane Filters
Polymer Added
Sludge (Effluent Wastewater)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Sludge (Effluent Wastewater)

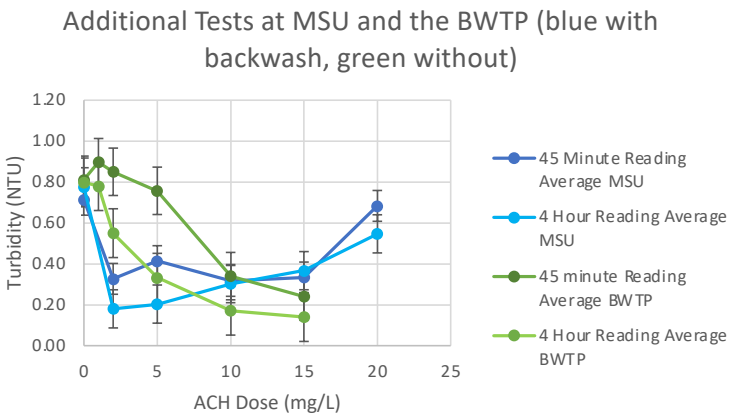
Methods of testing

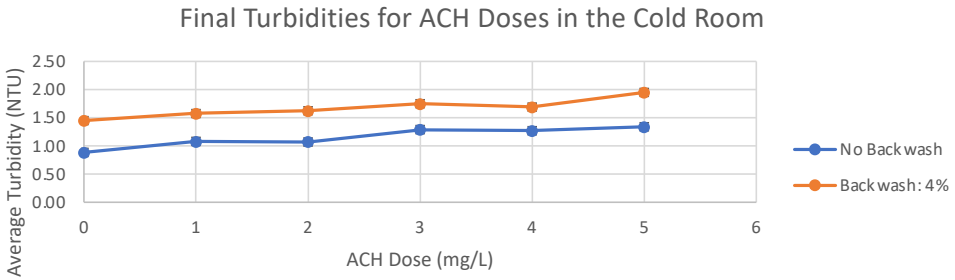
ACH Dosing Optimization

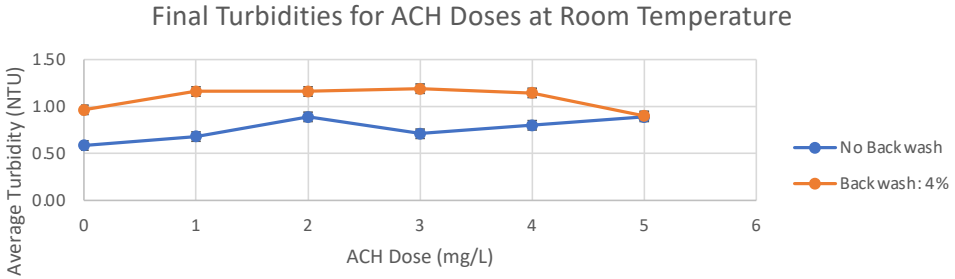
- Jar testing scale (1L total volume).
- Cold room temperature (5°C) vs. Room temperature (20°C).
- No Backwash vs. 4% Backwash (960mL water and 40mL backwash water).
- Differential mixing speed and settling period.
- Differing ACH dosages.

Sludge Settling

- Jar testing scale (1L total volume).
- Pass/Fail settling condition (at least 500mL in 4 minutes).
- Trial 1 aimed to find optimal polymer concentration that produced the most compact sludge cake settling.
- Trial 2 increased the resolution from Trial 1 on a smaller range of optimized polymer concentrations based on the results of trial 1.





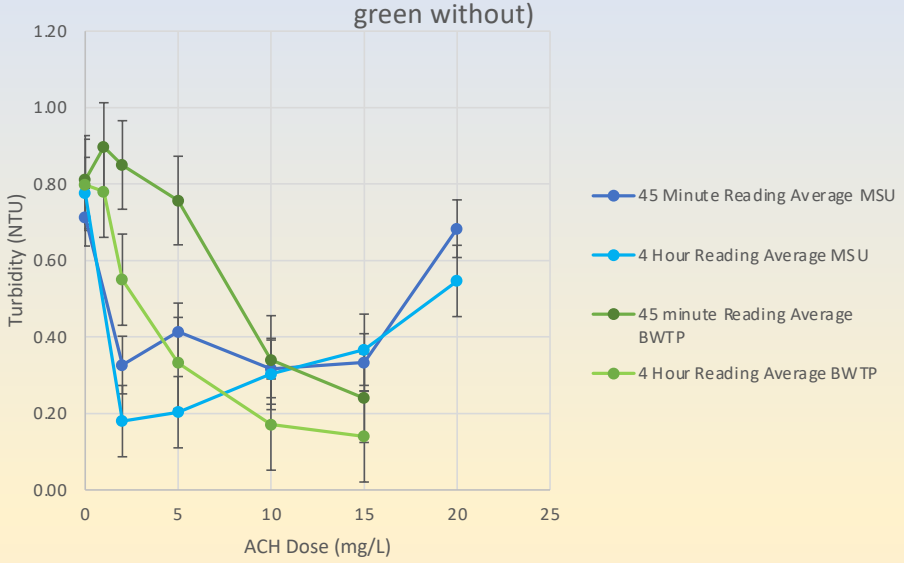


Initial Turbidities	Turbidity (NTU)
Cold Room	1.33
	1.33
	1.81
	1.18
Cold Room Avg.	1.41
Cold Room St. Dev.	0.27
Cold Room High Dose	4.06
	7.07
	7.63
	5.61
Cold Room High Dose Avg.	6.09
Cold Room High Dose St. Dev.	1.60
Room Temperature	1.35
	1.36
	1.36
	1.09
Room Temperature Avg.	1.29
Room Temperaure St. Dev.	0.13

How does backwash impact pretreatment?

- Effect on ACH Dose
- Effect on Effluent Turbidity
- Cost/ Energy Effect
- Conservation

Additional Tests at MSU and the BWTP (blue with backwash, green without)



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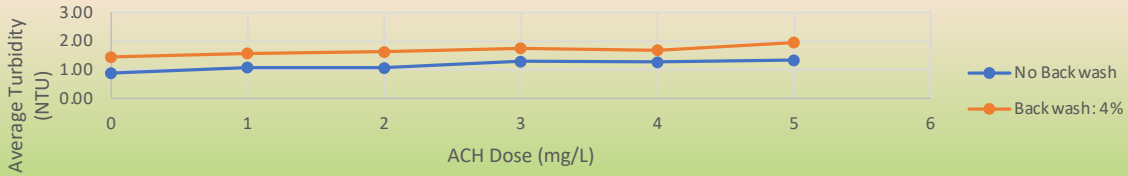
Final Turbidities for ACH Doses in the Cold Room



Sludge Settling

- Why do we need to dewater sludge?
- How does polymer concentration impact compactness of the sludge cake?
- What is the cost of polymer?

Sludge Settling Results

Polymer Concentration (mg/L)	Pass/ Fail (average)	Frequency of Pass	Pass Fail Based on Average	Average 4 minute Settling (mg/L)	Average 60 minute Settling (mg/L)	Most Compact Sludge Cake
0	Fail	0.00%	Fail	923.3333333	303.75	
1	Fail	0.00%	Fail	730	280	
2	Fail	40.00%	Pass	382		
3	None	50.00%	Pass	500	265	XX
4	None	50.00%	Fail	440	265	
5	Pass	100.00%	Pass	336.25	229.375	XXXX
6	Pass	100.00%	Pass	372.50	257.50	XXX
7	Pass	100.00%	Pass	320.00	290.00	
8	Pass	100.00%	Pass	225	282.5	
9	Pass	100.00%	Pass	345	305	
10	Pass	100.00%	Pass	252.5	238.3333333	
15	Pass	100.00%	Pass	250	275	
20	Pass	100.00%	Pass	270	287.5	

Recommendations

ACH Dose

- 2 mg/L for low turbidities
- Further Testing is highly recommended
  - Use a uniform sampling location for all tests.

Sludge Settling

- 5 mg/L of polymer for compact sludge cakes.

Backwash Recycling

- Further testing to determine how the backwash addition changes optimal ACH.
- Flocculation Type
- Overall, there seemed to be only a small impact on effluent turbidity, so recycling backwash is tentatively recommended with more testing.

Questions