Nutrient Reduction at Hutchinson Wastewater Treatment Facility

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University of Minnesota

Facility Background

- Oxidation ditch treatment train 1988
- Membrane Bioreactor (MBR) upgrade 2008
 - Increased capacity from 2.45 to 3.67 MGD
- Effluent discharged to South Fork Crow River
- Scheduled Upgrades:
 - Preliminary treatment overhaul 3 to 4 years
 - Oxidation ditch aeration November to December





Project Overview

- Incentives
 - Nitrogen
 - Chemica
 - Exper
 - Handl
 - Increa





Source: Ellipkaingoigicabourvey

Project Overview

Current Situation:

- Phosphorus is removed chemically to ~0.6 mg/L
- Ammonia effluent concentration: ~0.2 mg/L
- Nitrate effluent concentration: ~20 mg/L

• Goals:

- Primary: Use ASIM to find operational/procedural changes to remove nitrogen and phosphorus biologically
- Secondary: Use ASIM to identify possible configuration changes to facilitate removal



M<u>n</u> TAP

Approach – Data Collection

- Influent Characterization:
 - Suspected low dissolved organic material in plant influent
 - Influent BOD is lower than normal, but not concerningly low
- Dissolved Oxygen Testing:
 - The MBR anoxic tanks have significant residual dissolved oxygen





Approach – Computer Modeling

- Gather Influent Data
- Run Model Initially
- Compare Modeled Effluent to Actual Effluent
- Calibrate Model
- Run Different Scenarios
 - Recirculation Rates
 - Sludge Ages
 - Dissolved Oxygen Levels
 - Tank Sizes
- Find Recommendations
- Test Implementation

Modeled Effluent:						
Fields (mg/L mostly)						
Flowrate/Volumes	2.65E+05	2.65E+05	2.65E+05	2.65E+05	2.65E+05	2.65E+05
Oxygen O2						
Inert COD	16.33	16.33	16.33	16.33	16.33	16.33
Substrate COD	0.266	0.26	0.257	0.25	0.296	0.393
Ammonium N	0.166	0.188	0.196	0.21	0.214	0.429
Dinitrogen N	11.935	24.309	26.33	28.023	10.688	7.94
Nitrate N	19.186	6.786	4.736	2.965	18.314	16.493
Alkalinity Mol	2.401	3.277	3.422	3.549	2.486	2.672
Phosphate P	7.412	7.419	7.416	7.405	7.025	6.214
Differences From Baseline:						
Flowrate/Volumes						
Oxygen O2						
Inert COD						
Substrate COD	0	0.006	0.009	0.016	-0.03	-0.127
Ammonium N	0	-0.022	-0.03	-0.044	-0.048	-0.263
Dinitrogen N						
Nitrate N	0	12.4	14.45	16.221	0.872	2.693
Alkalinity Mol						
Phosphate P	0	-0.007	-0.004	0.007	0.387	1.198
Percent Reductions:						
Flowrate/Volumes						
Oxygen O2						
Inert COD						
Substrate COD	0%	2%	3%	6%	-11%	-48%
Ammonium N	0%	-13%	-18%	-27%	-29%	-158%
Dinitrogen N						
Nitrate N	0%	65%	75%	85%	5%	14%
Alkalinity Mol						
Phosphate P	0%	0%	0%	0%	5%	16%





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 - High DO in anoxic zones
 - Denitrification is inhibited
 - No anaerobic zones
 - Biological phosphorus removal is impossible
- Recommendations:
 - Reduce DO in aeration basins from ~7 mg/L to 2 mg/L



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Recommended Configuration





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- Add recirculation from anoxic to anaerobic tanks



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Solutions

Nutrient Reduction Option	Waste Reduced (per year)	Implementation Cost	Annual Savings	Payback Period	Status
MBR Operational/Configuration Changes	 136,000 lbs of ferric chloride solution 1,800 lbs of phosphorus 40,600 lbs of nitrogen 626,000 kWh 	\$190,000	\$46,200	4.1 Years	Recommended
Oxidation Ditch Aeration Cycling	 135,000 lbs of ferric chloride solution 69,000 lbs of nitrogen 65,000 kWh 	\$7,700	\$33,800	<3 Months	Recommended



Personal Benefits

- Understood wastewater treatment from head-to-toe
- Learned about the cost and effort associated with testing
- Gained time management skills
- Learned about how a wastewater plant actually functions, not just the theory





Thank you for listening!

