Biological Nutrient Removal Implementation in West Otsego Wastewater Treatment Facility

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City of Otsego

- North-west of the Twin Cities
- 2 Municipal wastewater treatment facilities:
  - East (2000) and West (2004)

The West facility:

- Domestic collection
  - 2000 households
- Daily flow: 400,000 gallons
- Daily wasted sludge flow: 23,000 gallons

Location of Otsego (Google map, 2020)

The West Facility

1. 3 selector tanks (not aerated)
2. 2 oxidation ditches (parallel)
3. 2 secondary clarifiers (parallel)
4. UV disinfection
5. Gravity Belt Thickener (GBT)
6. Aerobic Digester

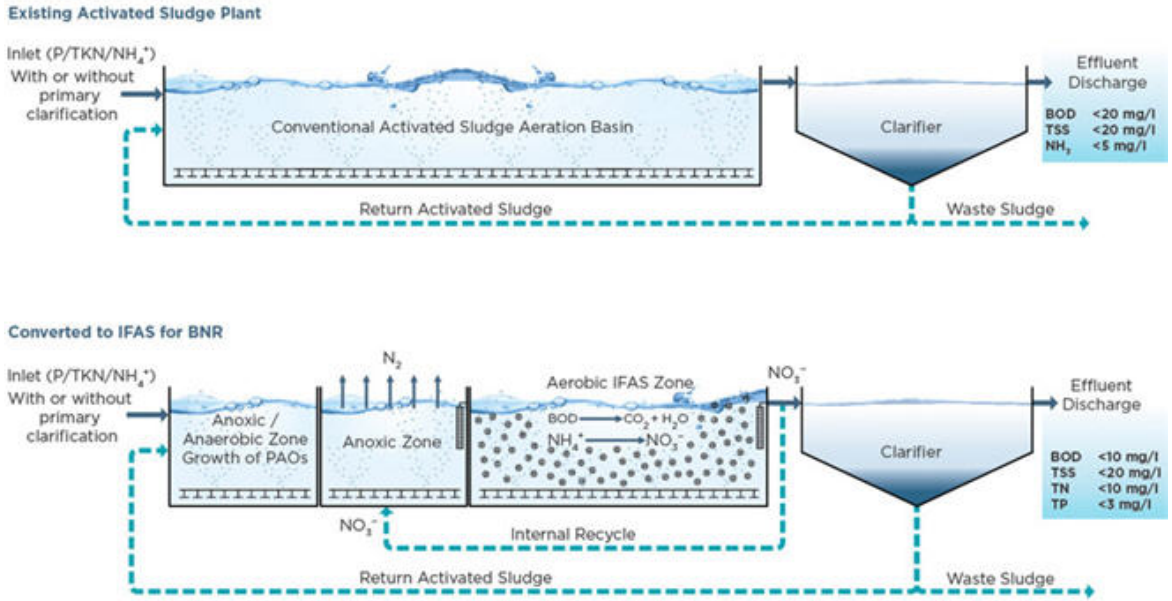
Aerial photo of the West Facility (Google map, 2020)

Objectives

Explore operational and energy efficiencies

- **Reduce potential impact of nutrient discharge**
  - Phosphorus and Nitrogen
  - Eutrophication, algal bloom
- **Save cost on chemical used for nutrient removal**
  - Ferric chloride application -- remove phosphorus
- **Save energy through operational changes**

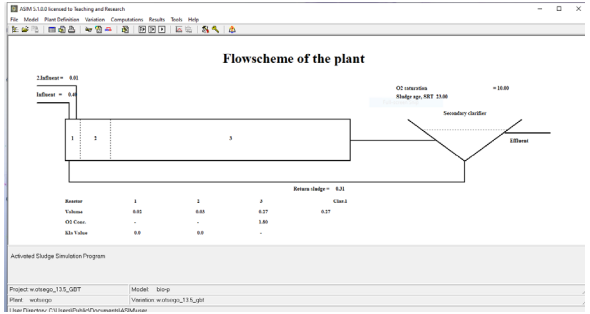
Biological Nutrient Removal (BNR)



- Establish anaerobic and anoxic zones
- Nutrient removal by biological processes
- Target nutrient output
  - Nitrate N : < 10 mg/l
  - Phosphate P: < 1 mg/l

Source: Water Online, Headworks Intl Inc.
https://www.wateronline.com/doc/biological-nutrient-0001

Approach



Wastewater Data Analysis

- MPCA Discharge Monitoring Reports (DMR) data
- Compare data within 5 years

Activated Sludge Simulation Program (ASIM)

- Baseline model construction
- Tank sizes variation, operational changes, cycling, COD addition
  - COD: Chemical Oxygen Demand
    - Amount of organic matter presented
    - Indicator of wastewater quality and treatment efficiency
    - Food source for microorganism in the treatment processes

Literature Research

External Carbon Source Addition

- Low biological activity due to limited COD input
- Boosts microbial activity
- Enhance nutrient removal
  - Nitrate N < 10 mg/l
  - Phosphate P < 1 mg/l
- Unnecessary ferric chloride addition

Source: Aries chemical

1. Industrial Wastestream

Collaboration with St. Cloud Wastewater Facility

- Waste sources are transported from factories by tanker trucks
- Mixed wastestream sample: 158,000 mg COD/l
- Require approximately 1500 gallon-per-day

Recommendation	Annual Reduction	Cost Savings	Total Cost	Payback period	Status
St. Cloud Wastestream	40,000 lbs Ferric chloride 10,000 lbs Phosphate P 7,800 lbs Nitrate N (from baseline model)	$13,000 from ferric chloride application	TBD (transport, storage)	TBD	Recommended, required further discussion

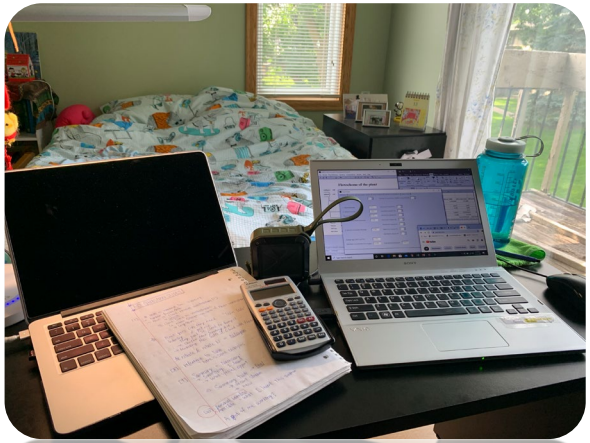
2. Commercial Products

- **Consistent COD values**
- **Concerns on safety, price, availability, handling**

Product	20% Acetate Acid	Ethanol	Methanol	MicroC 2000 (glycerin-based)
COD mg/l	216,000	1,650,000	1,200,000	1,100,000
$/lb	4.90	5.72	1.40	0.56

Simulation Result/ Recommendation		Annual reduction	Cost savings	Total costs	Status
1a	**External Carbon Source addition**	40,000 lbs Ferric chloride 10,000 lbs Phosphate P 7,800 lbs Nitrate N (from baseline model)	$13,000 from ferric chloride application	TBD (storage, transport…)	Recommended
1b	**Construction of a New Anoxic Tank**	Similar result to option 1a		$$$	-
2	**More frequent operation of the Gravity Belt Thickener**	700 lbs Phosphate P 1,500 lbs Nitrate N	-	-	Implemented

Anecdote



Thank you very much for the opportunity given during the pandemic. It is a special experience. I am amazed by all the possibilities that we found and have acquired new knowledge about wastewater treatment.

I highly appreciate everyone's help and support in this internship. The accomplishment we made is a motivation for my future.

Source: NY times