AV Group Atholville: Wastewater Treatment Plant Upgrade

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UNB EST. 1785 UNIVERSITY OF NEW BRUNSWICK
Engineering Design Symposium
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Introduction

Background

- Effluent treatment plant discharging 43,000 m^3/day
- Pulp and paper effluent regulations (PPER) under fisheries act
- Limit various parameters:

COD: Chemical Oxygen Demand
BOD: Biological Oxygen Demand
TSS: Total Suspended Solids

Parameter		Current Output	Current Regulations	New Regulations
	Units	Kg/ T RPR	Kg/ T RPR	Kg/ T RPR
COD	Daily	119	N/A	75
	Monthly Avg.	N/A	N/A	45
BOD	Daily	8	12.5	4.25
	Monthly Avg.	N/A	7.5	2.6
TSS	Daily	11	18.75	6.25
	Monthly Avg.	N/A	11.25	3.75
	Units	mg/L	mg/L	mg/L
Phosphorous	Weekly Avg.	0.36	N/A	2
	Monthly Avg.	N/A	N/A	1.5
Nitrogen	Weekly Avg.	0.43	N/A	20
	Monthly Avg.	N/A	N/A	15

Objective

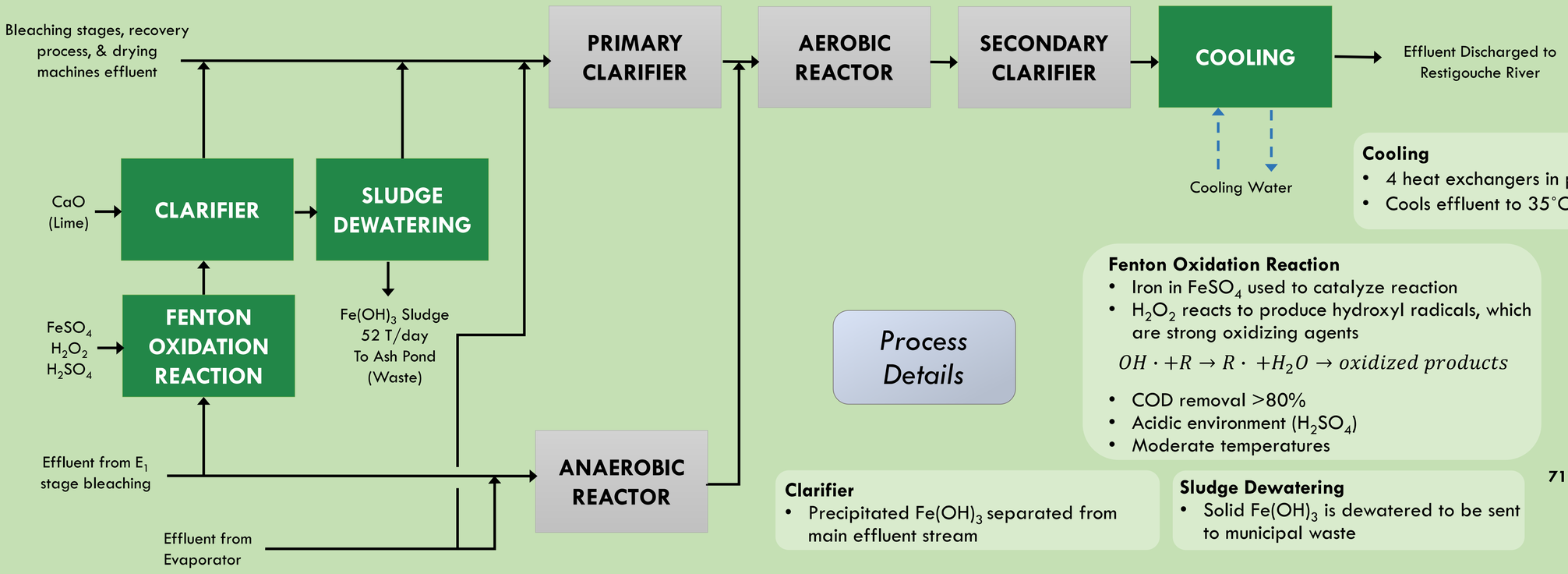
- PPER Proposed to change for 2021
- Current treatment plant does not meet proposed PPER
- Design for discharge rate of 62,000 m^3/day

How is this accomplished?

- Target high refractory COD stream (E_1 stream) with advanced oxidation techniques - biological processes can't be used
- Fenton oxidation reaction pre-treatment
- Additional clarifier to reduce TSS
- Cooling post-treatment using heat exchangers to reduce discharge temperature

Upgraded Process

CURRENT PROCESS **UPGRADED PROCESS**



Process Details

Cooling
- 4 heat exchangers in parallel
- Cools effluent to 35°C before discharge

Fenton Oxidation Reaction
- Iron in $FeSO_4$ used to catalyze reaction
- H_2O_2 reacts to produce hydroxyl radicals, which are strong oxidizing agents

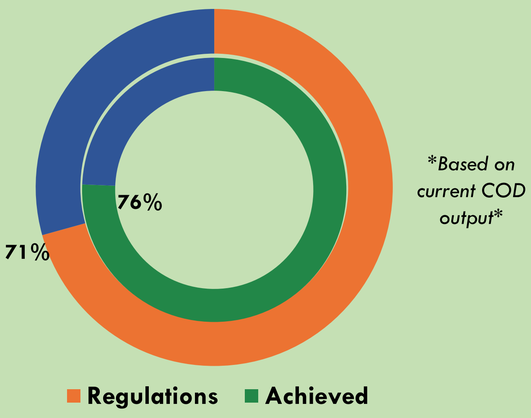
$$OH \cdot + R \rightarrow R \cdot + H_2O \rightarrow oxidized\ products$$

- COD removal >80%
- Acidic environment (H_2SO_4)
- Moderate temperatures

Clarifier
- Precipitated $Fe(OH)_3$ separated from main effluent stream

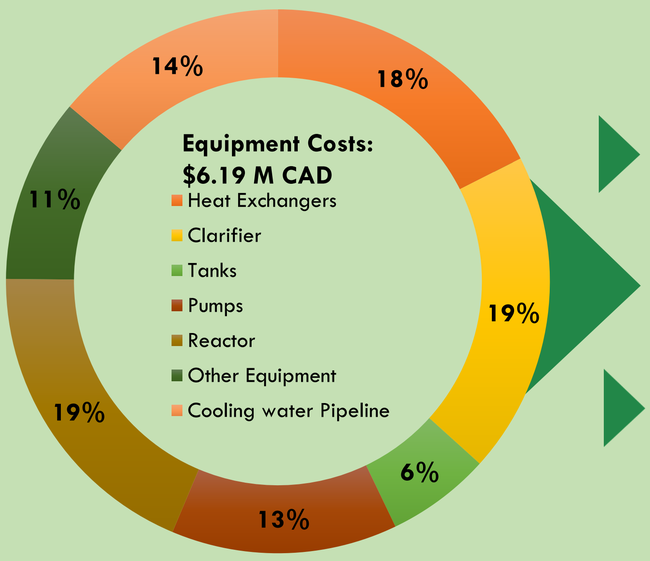
Sludge Dewatering
- Solid $Fe(OH)_3$ is dewatered to be sent to municipal waste

COD Removal Improvement



Economic Analysis

Capital Cost



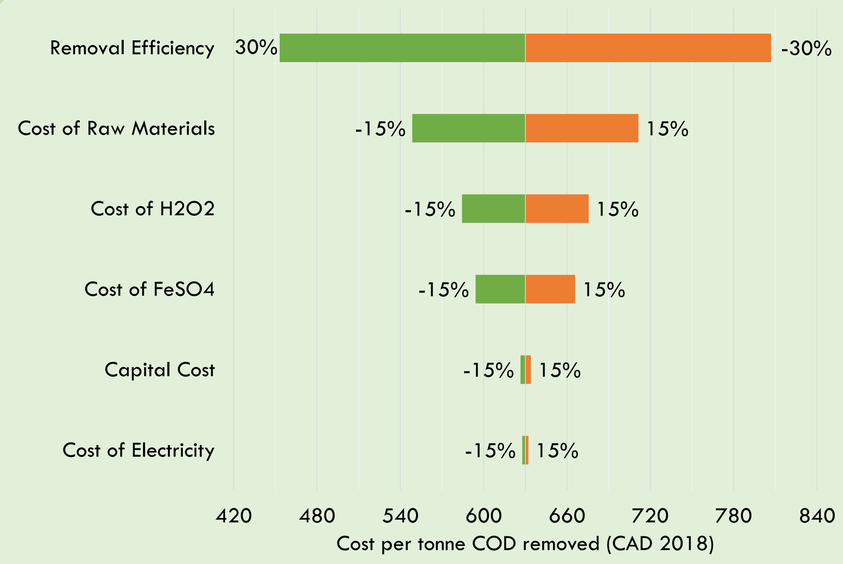
$7.4 M CAD

Working Capital: $40,000 CAD

Fixed Capital: $7.2 M CAD

Start Up Expenses: $120,000 CAD

Sensitivity Analysis



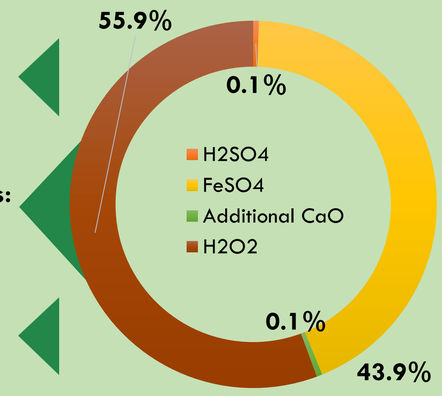
Operating Cost

$12.1 M CAD

Utilities: $280,000 CAD

Total Raw Materials: $10.9 M CAD

Waste Disposal: $940,000 CAD



Conclusions & Recommendations

- Upgraded design will meet proposed PPER
- Additional clarifier and enhanced clarification in primary clarifier will reduce TSS
- Post-treatment cooling will meet 35°C discharge limit
- Conduct treatability testing on effluent for Fenton Oxidation

- Conduct market research on selling $Fe(OH)_3$
- Investigate feasibility of using 68,000 m^3 of river water for cooling – may need an additional river intake system
- Investigate potential improved Fenton Oxidation Technologies – could reduce sludge production and chemical dosage

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