REUSE WATER FOR POWER PLANT COOLING TOWERS

Presented By:
Jesse Neilson (Project Manager)

PHARMER ENGINEERING

Project Background

Canada Malting Company (CMC)

- The Calgary CMC facility was constructed in 1902 and has some of the oldest ground water rights in the Alberta Providence.
- CMC used lined aerated lagoons to pretreat the wastewater.
- CMC was informed that their pretreatment lagoons would not be re-permitted.

Project Background
Canada Malting Company (CMC)

- The City of Calgary has consistently raised their sewer rates over the last 12 years by 8% by year. Currently CMC is paying $1,239,000 in discharge fees annually.

- North American brewing customer perception of the use of reclaimed water in the malting process is far from positive.

Project Background
ENMAX (Local Power Utility)

- ENMAX is the primary provider of electricity, natural gas, renewable energy, thermal energy, high speed internet in Calgary.

- ENMAX plans on building a new 165MW cogeneration facility in the Calgary area.
- ENMAX will require large amounts of water for the cooling towers.

Project Background
ENMAX (Local Power Utility)

- Alberta Environmental (regulatory agency) now recognizes the connection between ground water and surface water. New water rights are not being issued out of the Bow River, thus new ground water rights are not available for the greater Calgary area.

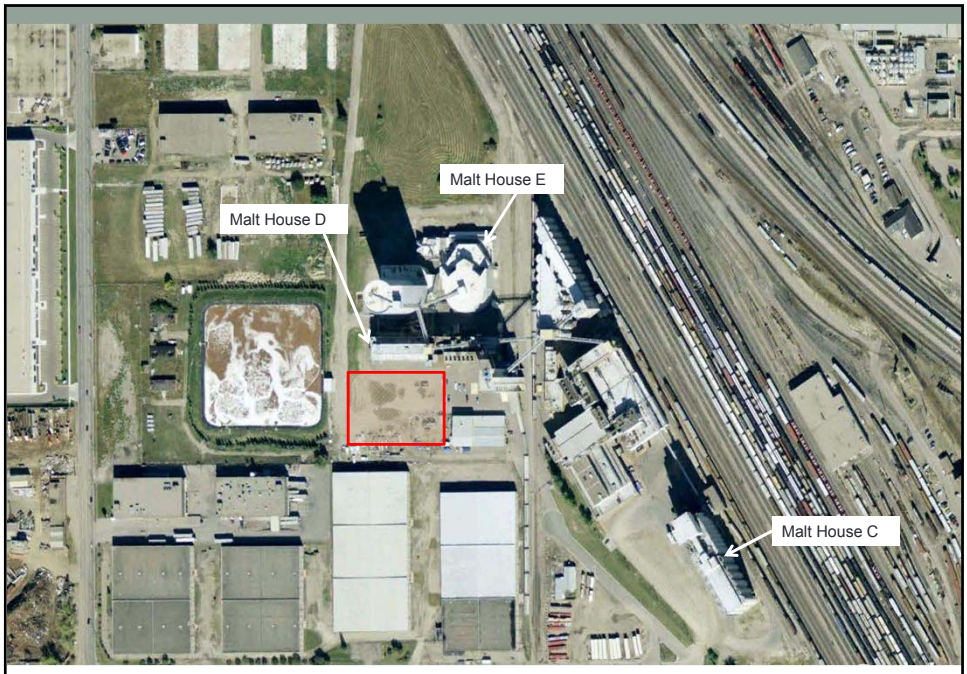
- Water cannot be purchased/sold by anyone other than the existing water authority.

CMC/ENMAX Agreement

- ENMAX will lease the 8 acre lagoon site for the new 165MW cogeneration facility.

- ENMAX is committed to pay for the construction of the MBR facility.

- CMC can discharge all treated effluent to the ENMAX cogeneration facility at no cost in effluent discharge fees to CMC.



Canada Malting Company, Calgary, AB

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Design Conditions

Parameter	Average Day	Maximum Month	Maximum Day	Minimum Anticipated Day
Flow (m3/day)	4,242	5,114	6,061	2,402
Flow (mgd)	1.12	1.35	1.60	0.63
BOD (kg/day)	5,515	8,438	11,212	1,753
BOD (lbs/day)	12,133	18,563	24,667	3,857
BOD (mg/l)	1,300	1,650	1,850	730
TSS (kg/day)	1,273	1,739	3,394	408
TSS (lbs/day)	2,800	3,825	7,467	898
TSS (mg/l)	300	340	560	170
TKN (kg/day)	170	245	364	55
TKN (lbs/day)	373	540	800	122
TKN (mg/l)	40	48	60	23
T-P (kg/day)	33.9	56.3	77.6	10.8
T-P (lbs/day)	75	124	171	24
T-P (mg/l)	8.0	11.0	12.8	4.5

Ambient Temperature range from -50°F to 95°F

Minimum Non-insulated Pipe Cover = 8.2 feet

Water Quality Requirements

Constituent	Limit (30 day rolling average)	Limit (composite daily sample)
Total Suspended Solids (mg/l)	< 15	150
BOD (mg/l)	< 15	150
TP (mg/l)	< 0.5	5.0
N-NH_3 (mg/l) (July 1 to Sept 30)	< 5	50
N-NH_3 (mg/l) (Oct 1 to June 30)	< 10	100
TN (mg/l)	< 15	150
E.Coli (CFU/100 ml)	< 200	2000
Total Coliform (CFU/100 ml)	< 200	2000

Calgary Bylaw 24M96

Process

Parameter	Value
Anoxic Tank	
Number and Volume	1 @ 946 m^3 (250,000 US gal)
MLSS	≈11,000 mg/L
Anoxic Recycle	4:1 (recycle from membrane tank to anoxic)
Aeration Tanks	
Number and Volume	2 @ 3,825 m^3 (1,010,000 US gal)
Total Volume	7,650 m^3 (2,020,000 US gal)
MLSS	≈11,000 mg/L
Total Process Tank Volume	8,596 m^3 (2,270,000 US gal)
SRT (Total Process Volume)	24 days
HRT	1.68 days
Oxygen Required	12,635 kg/d (27,850 lbs/d)
BOD removed	8,312 kg/d (18,325 lbs/d)
*WAS (with Ferric Precipitate)	2,400 kg/d (5,290 lbs/d)
$FeCl_3$ Dosage	924 kg/d (2,038 lbs/d)

MBR process sizing for max month flow conditions of 5,114 m^3/d (1.35 MGD).
*based on Ave. Day conditions

Process

Parameter	Value (Summer)	Value (Winter)
Active biomass concentration	6,535 mg/L	7,474mg/L
MLVSS contribution of influent	875 mg/L	876 mg/L
MLVSS due to nitrifiers	44 mg/L	37 mg/L
MLVSS total	7,454 mg/L	8,386 mg/L
MLISS due to influent	772 mg/L	773 mg/L
Biological ISS	1,634 mg/L	1,838 mg/L
Chemical Sludge Contribution (Fe)	1,043 mg/L	867 mg/L
Total Inert Solids	3,449 mg/L	3,509 mg/L
Total MLSS	10,903 mg/L	11,895 mg/L

-calculated mixed liquor concentrations assuming an F/M ratio of 0.16 for the summer (16°C) and 0.14 for the winter (10°C). The F/M ratios yielded a NSY of 0.274 in the summer, 0.313 in the winter and an SRT of 23 days.
-RAS is 4Q, pulled from membrane tank (RAS pump serves as WAS pump with modulating valves).

Oxygen Requirements

Parameter	Value (Summer)	Value (Winter)
O_2 required for BOD removal	12,140 kg/d (26,765 lb/d)	12,088 kg/d (25,650 lb/d)
O_2 required for N removal	492 kg/d (1,082 lb/d)	401 kg/d (885 lb/d)
AOR	12,634 kg/d (27,847 lb/d)	12,036 kg/d (26,535 lb/d)

The calculated O_2 requirement per unit of BOD_5 removed was 1.46 and 1.40 in the summer and winter, respectively. The calculated BOD_5 removed is 8,312 kg/d (18,325 lb/d). It was assumed that the nitrogenous oxygen demand (NOD) was 2.09 kg O_2 / kg NH_3 (4.6 lb O_2 / lb NH_3) and the calculated ammonia available for nitrification in the summer months is 106.6 kg N/d (235 lb N/d).

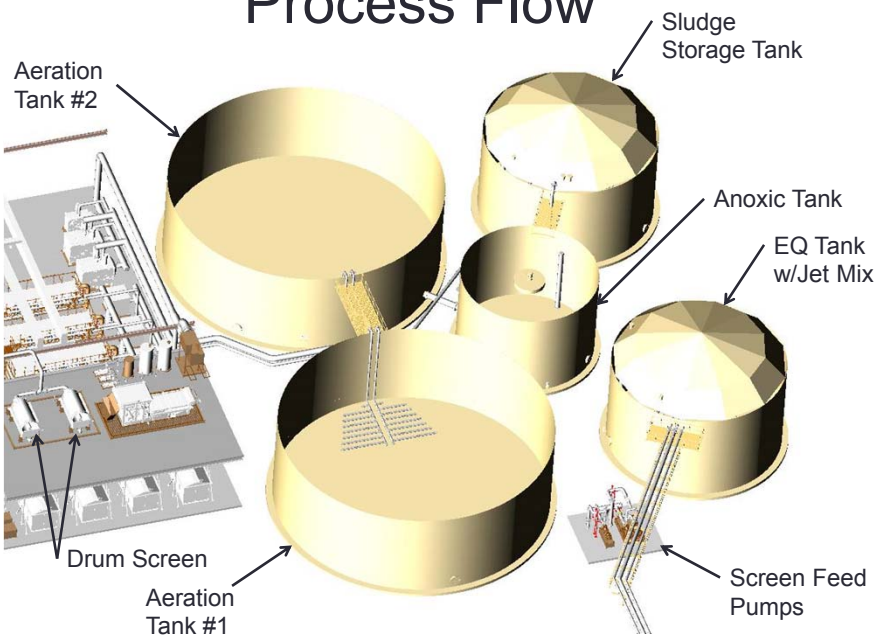
Oxygen Requirements

	Units	Ave Day Summer	Ave Day Winter	Max Day Summer	Max Day winter
No. Trains in Operation	2	2	2	2	2
No. Grids in Operation	4	4	4	4	4
No. Operating Diffusers	4,000	4,000	4,000	4,000	4,000
SOR	lbs/d	63,100	57,300	105,200	99,740
SOTE	%	45.4	45.9	43.2	43.5
Total Air Rate	scfm	5,543	4,987	9,708	9,157
Diffuser Air Rate	scfm/diff	1.39	1.25	2.43	2.29
Static Pressure	psig	10.59	10.59	10.59	10.59
Max H_L Heat Exchanger, system, diffuser, filter, F.S.	psig	3.57	3.57	3.57	3.57
Max Discharge Pressure	psig	14.16	14.16	14.16	14.16

Nutrient Requirements

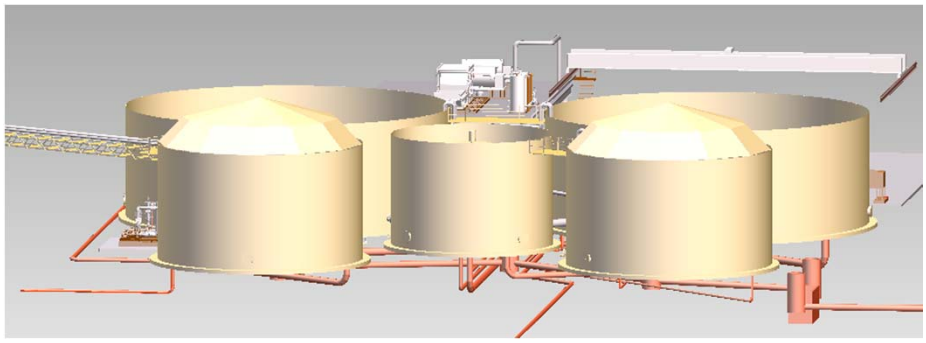
Parameter	Value (Summer)	Value (Winter)
Influent ammonia available	246 kg N/d (542 lb N/d)	246 kg N/d (542 lb N/d)
Biological nitrogen requirement	137 kg N/d (301 lb N/d)	156 kg N/d (344 lb N/d)
Effluent residual ammonia	2.56 kg N/d (5.64 lb N/d)	2.56 kg N/d (5.64 lb N/d)
Required nitrogen addition	0 kg N/d (0 lb N/d)	0 kg N/d (0 lb N/d)
Influent phosphorus available	56 kg N/d (124 lb N/d)	56 kg N/d (124 lb N/d)
Biological phosphorus requirement	29 kg N/d (65 lb N/d)	34 kg N/d (74 lb N/d)
Effluent residual phosphorus	5 kg N/d (11 lb N/d)	5 kg N/d (11 lb N/d)
Required phosphorus addition	0 kg N/d (0 lb N/d)	0 kg N/d (0 lb N/d)

Process Flow



CMC Site Layout
Contributing Wastewater Flows

Mechanical



Turbo Blowers

- Recent Installation for Heinz
- Existing 500 hp Centrifugal
  - 8,000 SCFM
- New 300 hp turbo
  - 6,500 SCFM – 6,800 SCFM

Canada Malting
Rotary Lobe vs. Turbo

Rotary Lobe

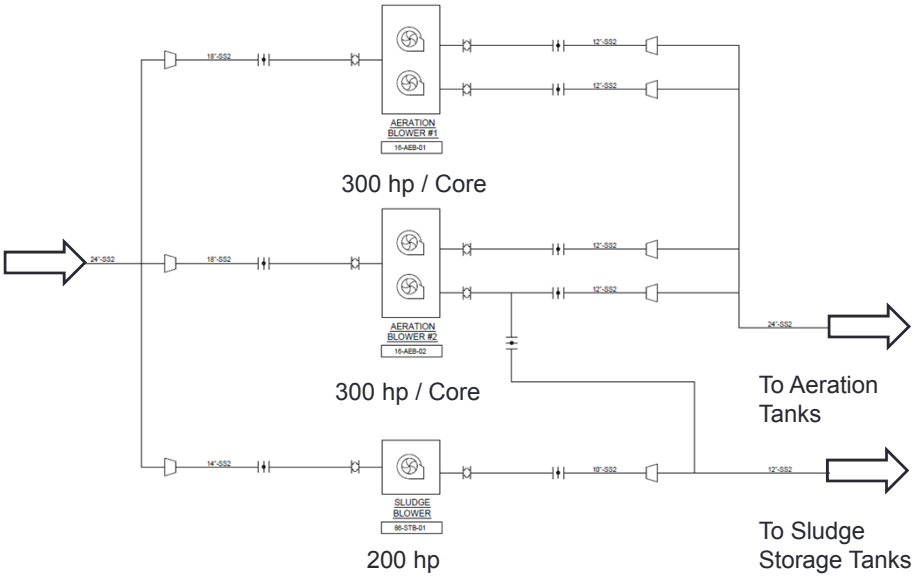
Blower	Quantity	hp/Blower	Total hp
Aeration	5	250	1,250
Sludge	1	250	250
Standby	1	250	250
		Total Connected Load	1,750

Turbo

Blower	Quantity	hp/Core	Total hp
Aeration	3	300	900
Sludge	1	200	200
Standby	1	300	300
		Total Connected Load	1,400

*Max Discharge Temp. = 300 °F (Rotary Lobe) vs. 250 °F (Turbo)

Aeration / Sludge Turbo Blowers



Heat Reclaim (Loop #1)

- Heat exchanger on aeration tank blowers discharge
  - Ave. Energy Production = 700,000 Btu/hr (275 hp/hr)
  - $\Delta T = 120°F$
  - Adiabatic Heat of Compression = 12°F/psi
  - Energy used to supplement building heat
  - Excess energy diverted to CMC kiln
  - Rate of Return < 2-3 yrs

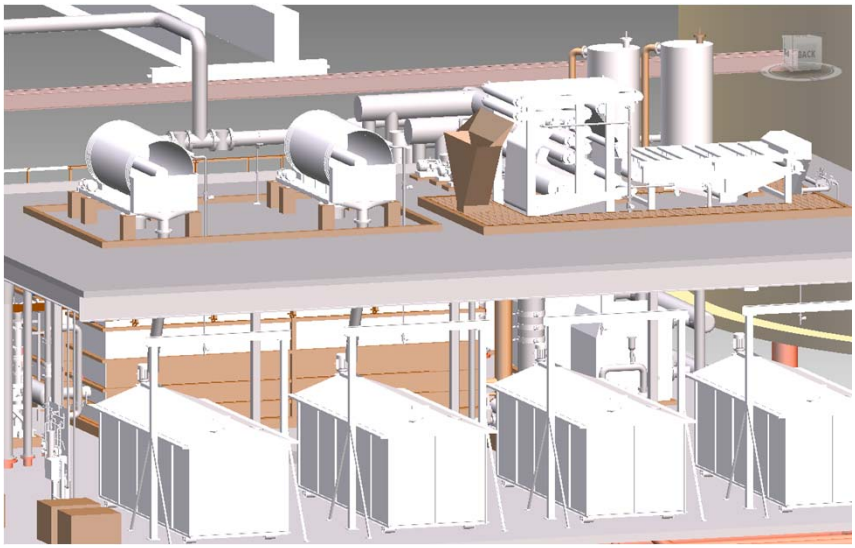
Heat Reclaim (Loop #2)

- Heat exchanger on hot water loop from ENMAX cooling towers
  - Ave. Energy Production = 1,300,000 Btu/hr (511 hp/hr)
  - Water loop is 104°F
  - ΔT = 30°F
  - Energy used to supplement building heat
  - Excess energy diverted to CMC kiln
  - Rate of Return < 2-3 yrs

Heat Reclaim

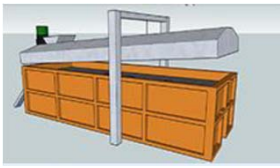
- Maximum Energy Requirement for Building Heat = 2,000,000 Btu/h
- Backup heat reclaim system direct fired natural gas burners in the two make-up air units

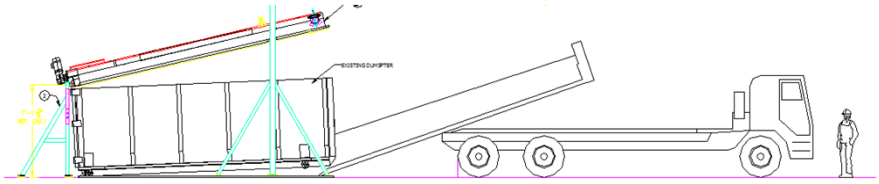
WAS/Solids



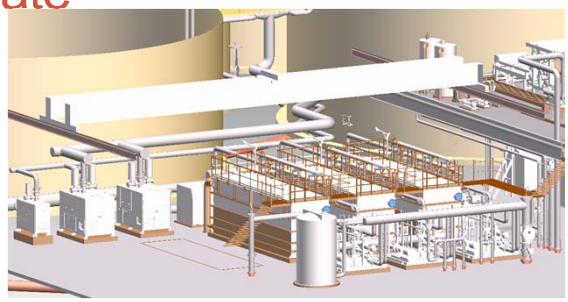
WAS/Solids

- WAS sent to Sludge Storage Tank w/ RAS Pumps
  - Bypass to City Sewer
  - Bypass to 2m Belt Press
- 4 Roll-off Bins
  - 2 bins for screens (1 / screen)
  - 2 bins for belt press (alternate w/conveyor)





Permeate



- CMC must provide ENMAX an uninterrupted flow of 440 gpm at water quality standards.
- Permeate bypass to City Sewer
- Permeate can be supplemented with well water
- NaClO disinfection until UVT values can be obtained

Foam

Questions

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