UNIQUE THICKENING AND DEWATERING OPERATIONS RELATED TO NUTRIENT REMOVAL

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St. Cloud NEW Recovery Facility
Overall Nutrient and Resource Recovery (NR2) Process Flow

- WAS THICKENING
- WAS P RELEASE (Tank 910)
- CO-THICKENING
- DIGESTERS
- DEWATERING
- CENTRATE
- EQUALIZATION
- CELL #6
- PROCESS DRAIN TO PLANT HEADWORKS
- OSTARA REACTOR
- PROCESS DRAIN TO PLANT HEADWORKS

Symbols:
- BSS - Biosolids
- BSC - Biosolids Centrifuge
- BSL - Biosolids Loadout
- CEN - Centrate
- FLT - Filtrate
- EQ - Equalization
- PFLT - Process Filtrate
- PSD – Primary Sludge
- TS - Thickened Sludge
- WPR - WAS P Release Sludge
- WW - Water Wash Drain
WASSTRIP Related Innovative Design and Process Opportunity

- Target: 24+ hours detention in WASSTRIP
- Thin WAS (<1% TS)
- WASSTRIP requiring 2% TS for 24 hours detention
  - Solution: Instead of introducing a new process to thicken – repurpose and utilize one of the existing GBT’s to thicken WAS to 2% and then send to the WASSTRIP tank
GBT WAS Thickening Pilot

- Piloted getting 2% WAS off of the GBT
  - Belt Speed (20 to 100%)
  - WAS flow (110 – 180 gpm)
  - Dam position
  - Chicane positions
  - Polymer dose
  - Discussed different weave size of the belt
2% WAS
WAS Filtrate
WAS and Co-thickening GBT Floc Hopper issues

• Low flows (100 gpm) to the large GBT’s causing solids settling in upfront hopper and flow distribution problems on the gravity deck
  – Solution: Reduce the hopper size
WAS Pre-Thickening

- Operates 24/7
- Bypass designed for blending to 2.0% solids, not typically used
WASSTRIP

**Key Target: Maintain level in 910 at 7 feet**
- Operator will set the GBT feed flow to the co-thickener to maintain 7 feet
- Pumps operate to maintain GBT feed flow setpoint

**Secondary Target: WASSTRIP HRT of 24 hrs at 2% Solids**
- Level is continuously monitored and HRT checked periodically
- GBT feed flow adjusted as needed to adjust HRT
- Mixers continuously run
GBT flow pattern – Co-thickening

WPR 2.0% TS ~100 mg/L PO4-P

PSD 2.0% TS ~0 mg/L PO4-P

WAS RELEASE PUMPS (2)

WPR FCV

GBT FCV

CO-THICKENING

TS 9.0% TS Particulate P (Bio and Chem) N in biomass

THICKENED SLUDGE CHUTE

THICKENED SLUDGE PUMPING

DIGESTERS

WPR

Raw Sludge Pumps (4)

PSD FCV

PSD FCV

Wash Water

TO BNR

TO FILTRATE PUMP STATION

Polymer

PFLT

~60 mg/L PO4-P Very little Nitrogen

Primary Scum

HSW

GBT Flow Pattern – Co-thickening

2.0% TS

~100 mg/L PO4-P

Very little Nitrogen

~0 mg/L PO4-P

~60 mg/L PO4-P
Co-thickening GBT

• **Key Target:** Maintain level in 910 at 7 feet
  - Operator will set the GBT feed flow to the co-thickener to maintain 7 feet in 910 (WASSTRIP)
  - Operators will basically match flow leaving and going to WASSTRIP (approximately 40 gpm)
  - Pumps operate to maintain GBT feed flow setpoint
  - Primary sludge flow typically 60 gpm
  - Cake is coming off at 8% to 9% TS

• **Secondary Target:** Filtrate TSS <500 ppm
  - Very important to have clean filtrate going to Ostara process
High Strength Waste

- HSW added to thickened sludge
- Receiving up to 10,000-17,000 gpd HSW including dairy, soda, brewery and food processing waste
- Design average TS flow 30,000 gpd
- Biological phosphorus converted to soluble phosphorus during digestion
- Some soluble phosphorus bound with Al, Ca and Mg in digestion
- Organic nitrogen converted to ammonia during digestion
- Storage digester to be converted to primary digester
Digester and Centrifuge Operation

- Operates 48 to 72 hours/week at 75 gpm
- Target TS concentration of 15%

Examples of throughput changes:
- 75 gallons per minute at 3.5% solids = 1314 lb/hr
- 75 gallons per minute at 4.0% solids = 1501 lb/hr
Centrifuge Dewatering
Centrifuge Operation

- In order to achieve 15% TS:
  - Adjustments to polymer dosage and make up water
  - Adjustments to centrifuge speed settings
Centrifuge Operation
### Centrifuge Operation

**Polymer make up water**

- Changed make up water to warmer REC EFF

**Sludge temperature**

- Sludge type: Anaerobic digested biosolids at 55% VS
- Dewatering equipment: Centrysis CS18-4
- Polymer Used: Polydyne C-6275 (liquid emulsion)
- Polymer % Active: 45
- Polmer Makeup Water Temp ºF: 49
- Typical Sludge pH: 7.5
- Typical Sludge Temperature deg ºF: 95

**Sludge feed % solids**

<table>
<thead>
<tr>
<th>Sludge Feed (%TS):</th>
<th>3.8</th>
<th>3.8</th>
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<th>3.2</th>
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**Sludge Flow Rate (gpm):**

| 76 | 76 | 76 | 75 | 77 |

**Sludge Throughput (lbs/hr):**

| 1445 | 1445 | 1445 | 1426 | 1233 |

**Polymer Pump Capacity (gph):**

| 10.36 | 10.36 | 10.36 | 10.36 | 10.36 |

**Stroke Length (%):**

| 100 | 100 | 100 | 100 | 100 |

**Polymer Pump Speed (%):**

| 62 | 53 | 50 | 39 | 42 |

**Polymer Flow Rate (gpm):**

| 0.11 | 0.09 | 0.09 | 0.07 | 0.07 |

**Neat Polymer Flow Rate (gph):**

| 0.42 | 5.49 | 5.18 | 4.04 | 4.35 |

| 74.14 | 63.37 | 59.79 | 47.26 | 58.86 |

**Active Polymer Dosage (lb/ton):**

| 33.36 | 28.52 | 26.90 | 21.27 | 15.26 |

**Polymer Sol. (%)**

| 1.07 | 1.02 | 1.02 | 1.12 | 1.04 |

| 10.00 | 9.00 | 8.50 | 6.00 | 7.00 |

**Polymer Sol. Flow Rate/dilution H2O flow (gpm):**

| 74.14 | 63.37 | 59.79 | 47.26 | 58.86 |

**Centrate TSS (mg/l):**

| 50 | 80 | 100 | 200 | 50 |

**Thickened/Cake Solids (%TS):**

| 22 | 14 | 13.8 | 13.5 | 13 |

**Capture (%):**

| 99.9 | 99.8 | 99.8 | 99.6 | 99.9 |

**99.812**

**Polymer Dosage Calculation**

| Date: | 08/16/18 | 08/17/18 | 08/17/18 | 09/12/18 | 12/14/18 |
| Time: | 5:00 PM | 2:30 PM | 5:00 PM | 2:30 PM | 5:00 PM |
| Centrifuge Δn : | 1 | 1 | 2.5 | 2.5 | 1.750 |
| Centrifuge p1 : | 20 | 20 | 25 | 25 | 19.250 |
| Centrifuge α : | 4.5 | 4.5 | 2.5 | 1.7 | 3.300 |
| Sludge temp: | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| Sludge pH: | 3.8 | 3.8 | 3.8 | 3.8 | 3.2 |
| Sludge Feed (%TS): | 3.8 | 3.8 | 3.8 | 3.8 | 3.2 |
| Sludge Feed (%TVS): | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
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| Stroke Length (%): | 100 | 100 | 100 | 100 | 100 |
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| Polymer Dosage (lbs/ton): | 74.14 | 63.37 | 59.79 | 47.26 | 58.86 |
| Active Polymer Dosage (lb/ton): | 33.36 | 28.52 | 26.90 | 21.27 | 15.26 |
| Polymer Sol. (%) | 1.07 | 1.02 | 1.02 | 1.12 | 1.04 |
| Polymer Sol. Flow Rate/dilution H2O flow (gpm): | 10.00 | 9.00 | 8.50 | 6.00 | 7.00 |
| Polymer Dosage (lbs/ton): | 74.14 | 63.37 | 59.79 | 47.26 | 58.86 |
| Centrate TSS (mg/l): | 50 | 80 | 100 | 200 | 50 |
| Thickened/Cake Solids (%TS): | 22 | 14 | 13.8 | 13.5 | 13 |
| Capture (%): | 99.9 | 99.8 | 99.8 | 99.6 | 99.9 |

**99.812**
Centrifuge Dewatering

- Dirty centrate diverted to process drain pump station
- Clean centrate to equalization tank
- Cake biosolids processed in thermal hydrolysis process
NR2 Biosolids

- Biosolids Product Enhancement: Lystek
  - Class A
    - Enhance land application logistics
  - 12% Flowable/Pumpable Liquid
    - Decrease liquid storage needs (increase storage capacity)
    - Decrease hauling time and costs
Sludge Storage Conversion

Centrate EQ and Lystek Biosolids Storage

- **Lystek Biosolids Storage**
  - 198 days of storage at future average flow

- **Digested Sludge Storage**
  - 39 days of storage at future average flow

- **Sidestream EQ/Treatment**
  - 21 days of storage at future max month flow
Nutrient Recovery Process

- PO4-P and NH4-N converted to struvite
NR2 Project in the Biosolids Building

- Boiler
- Centrifuge
- Lystek
- Biosolids Loadout
- Nutrient Harvesting
- Chemical Storage
- Polymer Storage
NR2 Project in the Biosolids Building
The Team
Thank You

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