Solids and Sludge Handling in Industrial Wastewater Treatment – Some Lessons Learned

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Industrial WWTPs

Pretreatment
- Screening, Grit Removal, etc.

Primary Treatment
- Chemical precipitation, Sedimentation

Secondary Treatment
- Aeration, Biological Treatment

Tertiary Treatment
- Metals, TSS polishing
Why Sludge?

Because the use of sludge treatment in industrial wastewater has expanded significantly in recent decades, sludge management has become a huge cost center for plant operators and we all need to do our best to minimize it and strategize for it.
Sludge Treatment

- **Thickening**
  - Necessary for Handling Sludge

- **Digestion**
  - Kill Bugs/Toxins
  - Cogeneration Opportunity?
  - Reduce the amount of sludge

- **Conditioning**
  - Enhanced Dewaterability

- **Dewatering**
  - Water recapture
  - Reduce disposed volume/weight
Thickening

• Handling it is easier because it’s more consistent in its % solids
• Reduce polymer consumption
• Better sludge pump performance and life
• Improved sludge quality to feed digesters
Sludge Thickening

Thickener

• Feed/Floc to influent
• Feed Well
• Compression Zone
• Rake
• Underflow
Evenflo Feed Well

WesTech Thickener

- Velocity transfer
- Better flocculation and maturation
- Enhanced settling
- Lower torque w/ no short-circuiting
Evenflo Case Study

Thickener Retrofit

- Overflow clarity improved by 50%
- Underflow wt% increased by 2% pts
- Polymer consumption reduced by 34%
Anaerobic Digestion

Sludge + Heat - $O_2$ = Decomposition of Organic Matter + $CH_4 + CO_2$

- Hydrolysis
- Acidogenesis
- Acetogenesis
- Methanogenesis
If you have or are going to have a CoGen plant, you think in terms of a healthy soup translating to Methane production. Fair enough, but fluctuations in the process of Methanogenesis effects sludge quality and quantity.
Digestion

Conventional Pancake Tank

Monitor:
Foaming
Temperature
% Solids Feed
% Solids Sludge
Digestion

Egg Design
• Better mixing & Less Foaming

Also Monitor:
pH (6.7-7.2)
Alkalinity (2,500 ppm)
TAN (NH$_4$/NH$_3$) (1000 ppm)
Metals
FA/Lipids:Protein/Carbs
Sludge Conditioning

Chemical Conditioning
• Neutralization of charge (double layer theory)
• Bridging of individual particles into a floc structure (polymer bridge formation)

➢ Polymer Addition (anionic, cationic, nonionic)

Thermal Conditioning
• Wet-Air Oxidation (500F/1000psi)
• Thermal Conditioning (300F/300psi)
Sludge Conditioning

Chemical
- Simple/Safe
- Well-known
- Lower CapEx, Higher OpEx
- 15-20% solids

Thermal
- Bit more complicated
- Higher CapEx, Lower OpEx
- Organics Release through fine solids
- 30-40% solids
Dewatering
Dewatering

- High-speed Centrifuge
- Decanting Separators
Dewatering

Traditional High-speed Centrifuge

AKA:

High-speed Stacked-Bowl Separator

3-Phase High Speed Separator

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Dewatering

3-Phase High Speed Separator

Often require temp conditioning

Best for lower solids waste streams and oily waste streams
Dewatering

Decanting Centrifuges

AKA: Solid-bowl centrifuges or separators
Dewatering

Decanting Centrifuges

Lower Energy

Cheaper separation on by weight basis

Higher solids tolerance – up to 65% w/w
Dewatering Case Study

Solid-Liquid Separation in Mining
Dewatering Case Study

Copper & Molybdenum Process

ROM → Crushing → Milling → Classification → Flotation → Cu Concentrate Thickener → Filtration, Laxox Filter → Copper Concentrate

Tailings Thickening & Tailings Dam → Mo Concentrate Thickener → Filtration & Leaching
Dewatering Case Study

Copper Tailings Dewatering

- 17 million tons of ore/year, # Medium size Plant
- 30 * P3-10070 (1000 mm)
- Solids Recovery above 95%
- Cake Dryness above 80 % w/w

www.alfalaval.com
Dewatering Case Study

Copper Recovery from filter wash water

- 17 million tons of ore/year, Medium size Plant
- 1 * P3- 8070 (720 mm)
- 30 m3/h, 4% w/w
- Solids Recovery above 98%#
- 7.000 tons Copper Concentrate recovered per year

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Dewatering Case Study

- 1 * P3-7070 (650 mm)
- 25 m³/h, 1.5% w/w
- 3,500 tons Molybdenum Concentrate recovered per year
So What Did We Learn?

• Thickening
  – Feed Well & Floc Quality REALLY matter

• Digestion
  – Reduce Sludge with careful monitoring

• Conditioning
  – Let experts pick your chemistry
  – Could Thermal be worth it?

• Dewatering
  – Decanting Separator?
World Heaviest Flying Bird?

Kori Bustard
Thank You & Questions

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