The Use of a Biosolids Product as a Carbon Source for Biological Nutrient Removal

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Lystek Biosolids Treatment Process

- Low temperature thermal-chemical process
  - energy efficient
  - economical
- Process Conditions
  - combination of heat to 70-75°C (158 – 167°F),
  - pH 9.5-10.0 using alkali / KOH, and
  - high shear mixing treatment
- Cells disintegrate and hydrolysis of complex particulate organic molecules
  - Results in simpler and rapidly degradable compounds

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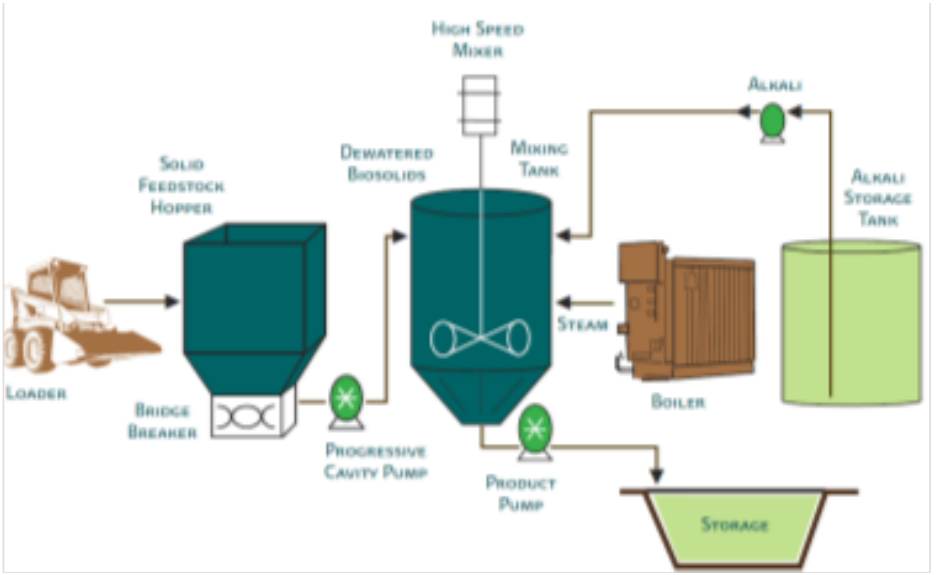
Lystek Biosolids Treatment Process

- Converts biosolids into
  - high solids (15% -17%),
  - homogeneous,
  - pathogen-free, and
  - nutrient rich Class A EQ liquid product.
- Potential
  - increase VS destruction in anaerobic digesters and
  - external carbon source for BNR



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Specific Denitrification Batch Tests

- Two series
  - protocol developed by the Water Environment Research Foundation (WERF)
  - provide endogenous denitrification rates as well as denitrification rates and yields with primary effluent or an external supplemental carbon source
- First series-Lystek produced from a Canadian treatment plant
- Second series-Lystek produced from sludge from the treatment plant in New York City

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Project Description

- First phase
  - determine the specific denitrification rate (SDNR) compared to typical carbon sources, glycerol and methanol.
- Second phase
  - determine various denitrification kinetics, optimum COD:N ratio, and cell yield using lab scale SBRs

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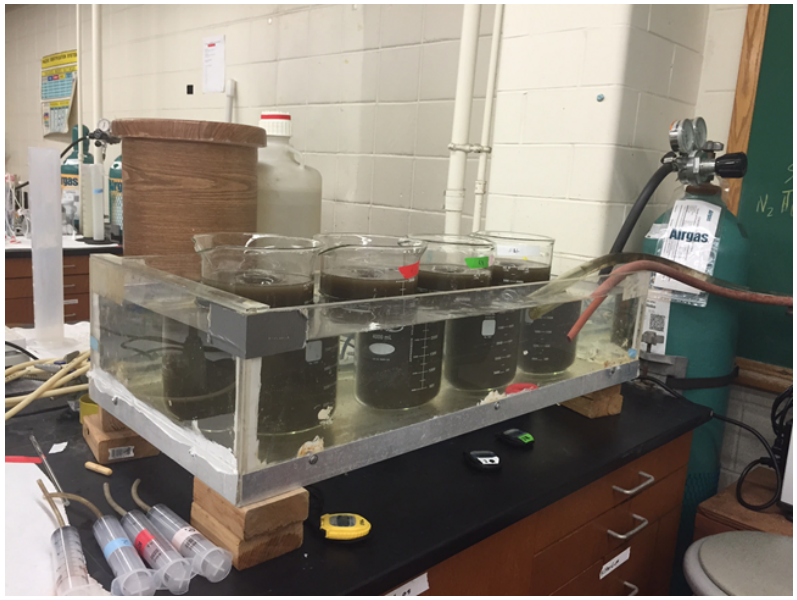
SNDR Batch Testing

- Four Reactors
  - Reactor 1:
    - Control (endogenous) (RAS + Secondary Effluent)
  - Reactor 2:
    - Primary effluent as carbon source (RAS + Primary Effluent)
  - Reactor 3:
    - Methanol or glycerol (RAS + Secondary Effluent + Carbon Source)
  - Reactor 4:
    - Lystek (RAS + Secondary Effluent + Lystek)



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SNDR Batch Testing

- Primary effluent, secondary effluent and RAS
  - collected from treatment plants that were using as carbon sources
    - methanol
    - glycerol
    - Primary effluent
  - known concentration of sodium nitrate fed to each reactor and
  - loss of nitrate and NO_x with time (240 minutes)

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Batch Test-1

- Lystek produced in Canada
- Key product characteristics
  - COD 154000 mg/L
  - Alkalinity 20833 mg/L as $CaCO_3$
  - TS 16%; 46% volatile
- Lystek SDNR compared to other carbon sources

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Batch Test-1

- For each SDNR test
  - Early rate (first 30 minutes) and
  - Late rate (30 -240 min)
  - Calculated and reported as mg NO_x-N/mg VSS.d

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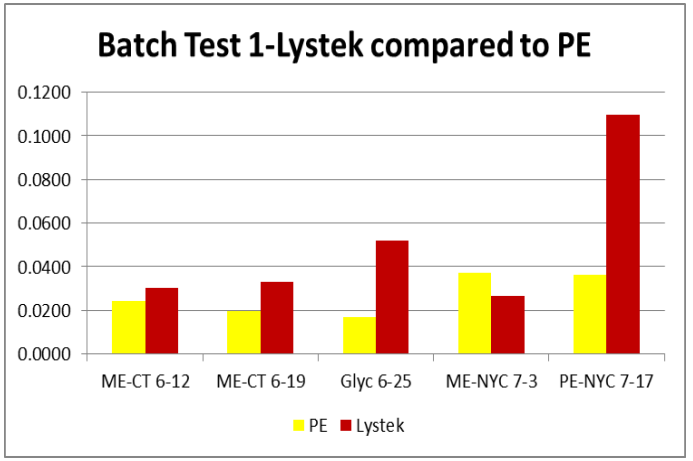
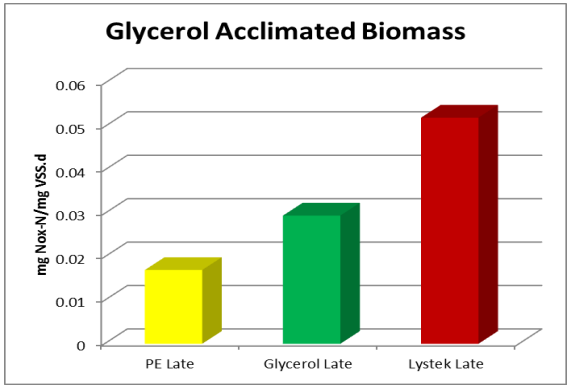
Batch Test 1-Results

- PE acclimated biomass
  - Lystek had higher late SDNRs than any other carbon source compared to PE except for NYC methanol acclimated plant
- Glycerol acclimated biomass
  - Lystek had higher late SNDRs that PE or Glycerol





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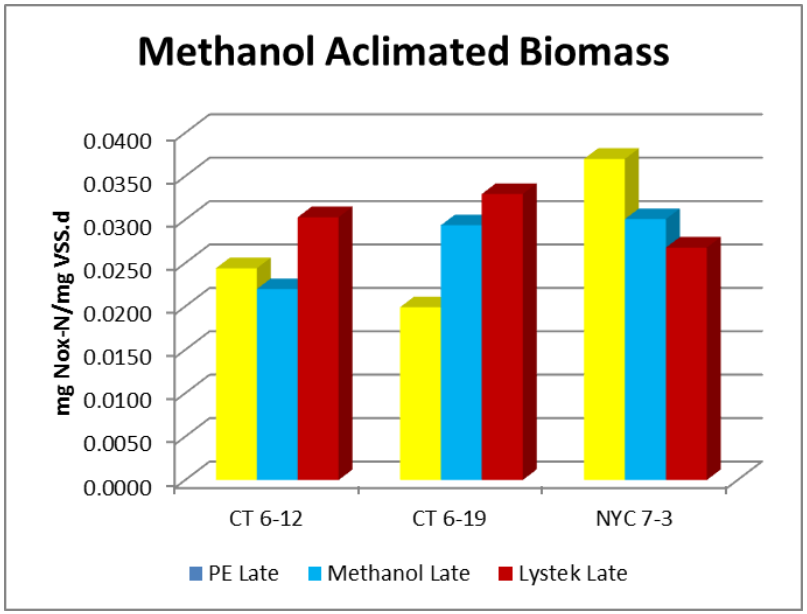
Batch Test 1-Results

- Methanol acclimated biomass
  - For CT plant
    - Lystek had higher SDNR than PE or methanol (6-12 and 6-19)
    - Plant has used methanol for 12 years (year round)
  - For NYC plant
    - Lystek had lower SDNR than PE and methanol
    - Relatively short term use of methanol



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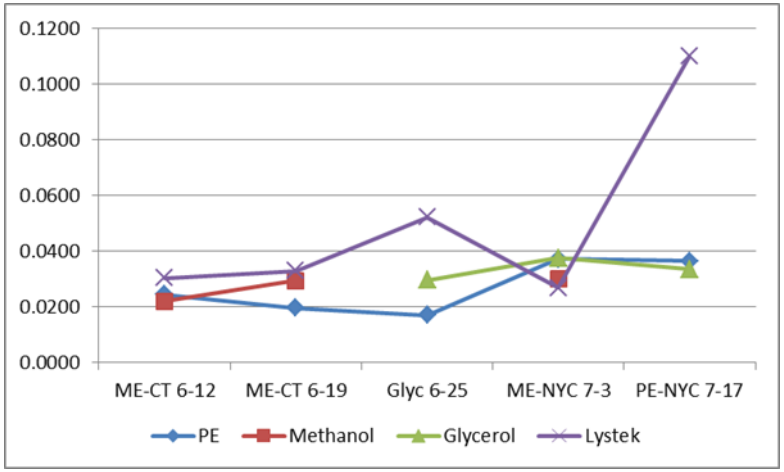
Batch Test-1 Conclusion

- Lystek SNDR higher in almost all cases as compared to PE, methanol, or glycerol



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Batch Test-2

- Lystek made from solids from a New York treatment plant
- Key product characteristics
  - COD 136,000 mg/L (154000 mg/L)
  - Alkalinity 9275 mg/L (20800 mg/L as $CaCO_3$)
  - TS 15%; 62% volatile (16%, 46%)
- Compare SDNR

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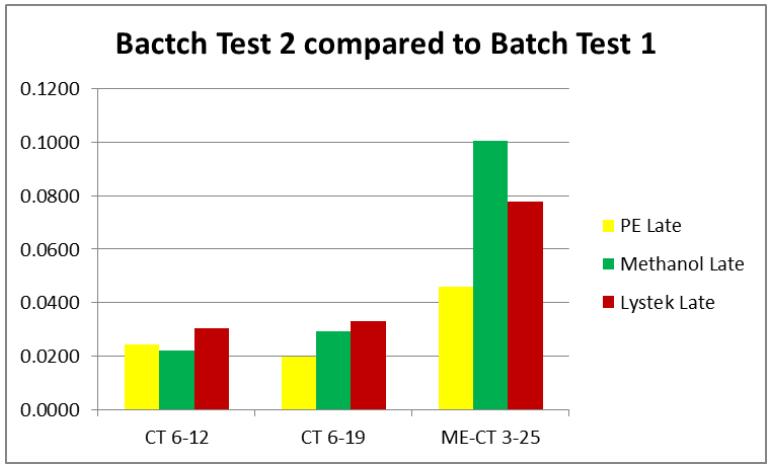
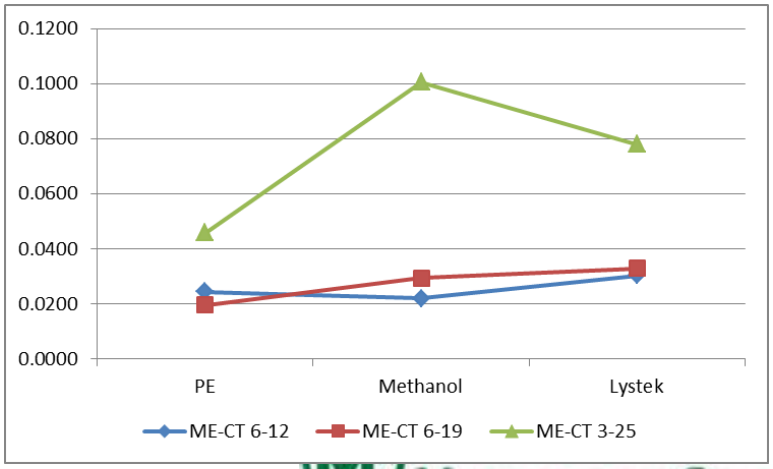
Batch Test-2 Results

- PE acclimated biomass
- Methanol acclimated biomass
- Rates much higher for methanol and PE than Batch Test-1
- Lystek rate higher compared to PE, lower compared to methanol





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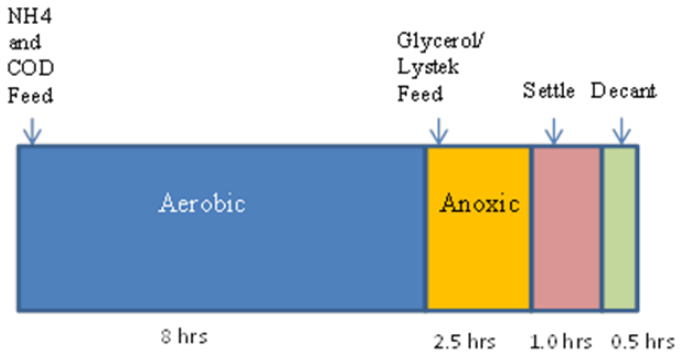
SBR Testing

- Two, 6-liter Sequencing Batch Reactors
- Timers and syringe pumps
  - carbon source and
  - ammonia
- Aerobic conditions using diffuser connected to an air supply
- Anoxic conditions maintained by stopping air flow and adding N_2 gas
  - maintain a D.O. < 0.01 mg/l.



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SBR Testing

- Control reactor fed glycerol
- Originally used with "as received" Lystek
  - Too high a solids content
  - Would not be done in a treatment plant
- In a typical WRRF
  - Lystek would be dewatered
  - Centrate/filtrate returned to treatment process

SBR Testing

- Some problems with operation of SBR not attributed to Lystek
- Changed operation on 9/23
- Current procedure
  - Lystek centrifuged
  - Centrate used as carbon source
  - Three 8 hours cycles per day
  - Increased decant volume

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Conclusion

- Lystek has potential as carbon source based on SDNR batch testing
  - Rates better than PE
  - Most cases better
    - Methanol
    - Glycerol
- Results from SBR will give better understanding of potential

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