Factors that Influence Biosolids Process Upgrades: Comparison of Different Drivers at Two San Francisco Treatment Plants

Presented By:
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Carolyn Chiu, P.E./SFPUC
May 12, 2015
Agenda

- Overview of the Sewer System Improvement Program (SSIP)
- Oceanside Plant – Sequencing Batch Reactor (SBR) Temperature Phased Anaerobic Digestion (TPAD)
- Southeast Plant – Thermal Hydrolysis (THP) + Mesophilic Anaerobic Digestion (MAD)
- Conclusions
  - Priority Evaluation Criteria for Biosolids Planning
- Q&A
SFPUC’s Combined Sewer System

100-year-old system: 1,000+ miles of pipes, 3 treatment plants and 27 pump stations
Sewer System Improvement Program (SSIP)
$6.9B

Grey

Green

Clean

SYSTEM & SEISMIC RELIABILITY & REDUNDANCY

INNOVATIVE STORMWATER MANAGEMENT SOLUTIONS

PROTECTING PUBLIC HEALTH & THE ENVIRONMENT

### SSIP Projects ($millions)

<table>
<thead>
<tr>
<th></th>
<th>PHASE I</th>
<th>PHASE II</th>
<th>PHASE III</th>
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<tr>
<td><strong>Treatment Plants</strong></td>
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<td>• Oceanside Plant Improvements</td>
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<td>• Northpoint Facility Improvements</td>
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<td>• Central Bayside Syst. Improvements</td>
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<td>$2,712</td>
<td>$3,295</td>
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SSIP Level of Service Goals

- Meet present and future regulatory requirements
- Produce Class A biosolids
- Beneficially use 100% of the biosolids and biogas
- Meet the needs of internal and external stakeholders, including ratepayers, WWE staff and nearby residents
- Enhance the surrounding community
- Ensure minimal odors, noise, traffic
SFPUC OCEANSIDE PLANT: SEQUENCING BATCH REACTOR TEMPERATURE PHASED ANAEROBIC DIGESTION (SBR TPAD)
Oceanside Treatment Plant

- Originally Constructed in the early 1990’s
- ADWF 21 mgd
- PWWF 65 mgd
- Adjacent to SF Zoo, Ocean Beach, and other recreation areas
- Buried facility
Oceanside Plant Biosolids Upgrades
Project Drivers and Goals

- Can implement quickly
  - Address Solano County Land Application Ruling
    - “having a portion of their biosolids produced as Class A Exceptional Quality biosolids”
- Does not trigger EIR – upgrades accommodated within the existing footprint
- Maximize value of existing digestion process
  - Minimize impact to ongoing operations and maintenance
- Maintain reliability/redundancy of existing OSP facilities
- Manage odors, grit, and foaming events
Oceanside Plant System Planning Parameters

- Design year 2035 - limited population growth on west side
- ADWF 21 mgd and PWWF 65 mgd
- Current solids loadings: 100,000 gpd (50,000 lb/day)

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<tr>
<th>Oceanside Plant 2035 Solids Projections (lb/day)</th>
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<tr>
<td>Annual Average</td>
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<tr>
<td>Combined solids (primary sludge, WAS, and FOG)</td>
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Oceanside Plant
Biosolids Alternatives Considered

1. Thermophilic Anaerobic Digestion
2. Thermal Hydrolysis Process with Mesophilic Anaerobic Digestion (THP+MAD)
3. Sequencing Batch Reactor Temperature-phased Anaerobic Digestion (SBR TPAD)

*TPAD Project was determined to be the most promising solution.*
Conversion from Current Operation to SBR TPAD

- **Current Operation**
  - 4 mesophilic digesters operating in parallel

- **Future Operation – SBR TPAD**
  - 3 Thermophilic Phase Reactors (digesters) operating in parallel
  - 1 Mesophilic Phase Reactor (digester) operating in series
Time/Temperature to Meet Class A

- What is SBR? - Sequencing multiple reactors simultaneously in fill, hold, and draw phases to ensure a minimum of 24 hours hold phase to meet Class A biosolids
- Alternative 1 – Time and Temperature.
- Digester feed will be held for a minimum of 24 hours at a minimum of 131°F
SBR TPAD Process Flow Diagram

TPAD Heat Recovery System

Thickened sludge is preheated by heat recovered from thermophilic phase

Heat is recovered from hot digested sludge prior to mesophilic phase
Oceanside Biosolids Solution
SBR TPAD

- Conversion can be completed with existing digester tankage
  - Much tighter connection between liquids and solids process
- Conversion can be completed relatively quickly
- Project can be performed economically
  - Construction cost: $4 Million
- Thermophilic batch process provides Class A
- Mesophilic step mitigates thermophilic odors
- Startup:
  - Convert/upgrade one digester at a time
  - Steel tank corrosion issues being addressed
  - Transition to TPAD operation expected in August 2015
SFPUC SOUTHEAST PLANT: THERMAL HYDROLYSIS PROCESS WITH MESOPHILIC ANAEROBIC DIGESTION (THP+MAD)
Southeast Treatment Plant

- Constructed in 1952 with significant upgrades in 1980’s
- ADWF 85 mgd
- PWWF 250 mgd

- Constrained site
- Nearby residential neighbors
Southeast Plant
Project Drivers and Goals

- Produce Class A Exceptional Quality product
- Accommodate future regulatory requirements
- Maximize energy recovery/minimize greenhouse gas
- Address aging/outdated infrastructure
  - Significant Condition Issues
    - 1950’s digesters, seismic issues, failing roofs
    - Limited CoGen capacity
    - Significant odors
- Neighbors: Residents, public produce market, future train station, light industrial
Southeast Plant
System Planning Parameters

- Design year 2045
- ADWF 85 mgd and PWWF 250 mgd
- Current solids loadings: 168,000 ppd

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<th>SEP 2045 Solids Projections (lb/day)</th>
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Southeast Plant
Biosolids Alternatives Considered

1. Conventional high rate mesophilic anaerobic digestion followed by thermal drying (MAD+TD)
2. Conventional high rate mesophilic anaerobic digestion with aerated static pile composting (MAD+COMP) and CHP
3. Temperature-phased anaerobic digestion (TPAD) and CHP
4. Thermal hydrolysis process with mesophilic anaerobic digestion (THP+MAD) and CHP
   - 4C: THP+MAD with GBTs and Gas Turbines
Costs are comparative costs for alternatives analysis (2% design phase) and are not to be used for project budgeting.

Financial Summary – O&M Costs

Costs are comparative costs for alternatives analysis (2% design phase) and are not to be used for project budgeting.
Critical Non-Financial Evaluation Criteria

- Adaptable to future regulatory changes
- Allows SFPUC to create a community asset
- Net Renewable Energy
- System maturity and reliability
- GHG offsets
- Diversity of Biosolids End Uses
- Future expandability
- Easily maintained and operated

Criteria are weighted by the Utility staff

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<th>Criteria</th>
<th>Weight</th>
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<td>Adaptability to Future Regulatory Changes</td>
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<td>System Maturity and Reliability</td>
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<td>Load Variation Adaptability</td>
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<td>Vehicle Traffic</td>
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## Non-financial Analysis

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<th>1. MAD+TD</th>
<th>2. MAD+COMP</th>
<th>3. TPAD</th>
<th>4. THP+MAD</th>
<th>4C. THP+MAD (GBTs &amp; Turbines)</th>
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Benefit-Cost Analysis Using O&M Costs

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<thead>
<tr>
<th>1. MAD+TD</th>
<th>2. MAD+COMP</th>
<th>3. TPAD</th>
<th>4. THP+MAD</th>
<th>4C. THP+MAD (GBTs &amp; Turbines)</th>
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<tr>
<td>Benefit-OPEX Cost</td>
<td>51</td>
<td>69</td>
<td>99</td>
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(Non-financial Score/O&M Cost)

1. MAD+TD
2. MAD+COMP
3. TPAD
4. THP+MAD
4C. THP+MAD (GBTs & Turbines)
## Alt 3 (TPAD) vs Alt 4 (THP+MAD)

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<th>Criteria</th>
<th>Alt 3 TPAD</th>
<th>Alt 4 THP+MAD</th>
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<td>Process robustness &amp; Industry trends</td>
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<td>Operability/Maintainability</td>
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<tr>
<td>End Product Quality</td>
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<tr>
<td>Biogas Use</td>
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<td>+</td>
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<tr>
<td>Regulatory change</td>
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<td>Pathogen Regrowth</td>
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<td>+</td>
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<tr>
<td>Construction schedule</td>
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<td>Sole Source</td>
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<tr>
<td>Digester volume</td>
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Alt 3 (TPAD) vs Alt 4 (THP)  

Conclusions

• Capital costs for all Alternatives are essentially equal
• O&M for Alts 3 & 4 are comparable
• Decision between Alt 3 & 4 is based on non-cost factors
  • Alt 4 outranks Alt 3 on key non-financial factors
Southeast Biosolids Solution
THP+MAD

CONCLUSIONS
Different Drivers Results in Different Decisions

Common Drivers
• Class A product, ease of operation, sensitive neighbors

Oceanside TPAD Drivers
• Regulatory driver
• Implement quickly
• Construct within existing footprint
  • No EIR impacts
• Minimize cost, maximize use of existing infrastructure

Southeast THP Drivers
• Resilient to regulatory change
• Product quality and diversity
• Robust process
• Available adjacent space
Biosolids Planning
Changing Drivers for Wastewater Agencies

Critical project drivers for long term biosolids planning:

- Operational costs (esp. labor)
- Net energy
- Safety and health of workforce
- Capital costs
- Product marketability/diversity
- Good neighbor issues – truck traffic, odors, noise
- Greenhouse gases
Drivers and Criteria for Long Range Biosolids Planning are Evolving

- Long range plans need to look toward a 20-30 year planning period
- Capital costs and especially operating costs are still important!
- Thinking in terms of a Class A ‘product’ changes the ‘end point’ for biosolids planning
- Expected regulatory changes and public perception drive the need for more diverse and more sustainable solutions
- New technologies are available to help move us forward

Facility Plans should reflect the long range values of the Organization and your Ratepayers
QUESTIONS?

Acknowledgements

**SFPUC**: Carolyn Chiu, Rosanna Tse, Humphrey Ho, Alex Miot, Jignesh Desai, Brian Carlomagno, Bonnie Jones, George Engel, Jeff Yee, Dale Posey, and the staff at OSP and SEP

**Oceanside Consulting Design Team**: Dave Green, Dru Whitlock, Tim Bauer, and the rest of the CH2M HILL design and startup team.

**Southeast Biosolids Consulting Team**: Tracy Stigers/BC, Dave Green/CH2M, Perry Schafer/BC, Jonathan Keaney/BC, Dru Whitlock/CH2M, Peter Burrowes/CH2M, Summer Bundy/CH2M, and the rest of the SEP Biosolids design team.
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