Legacy BioSolids Options

- Biological Treatment
- Digester
- Fuel
- Dewatering
- Drying Bed
- Composting
- Landfill
- Land Application
Why Dry Biosolids

- Reduce Disposal Costs
- Obtain Class A Biosolids
- Reduce Lawsuit Risks
- Lower operating costs (ERS)
- Pre Dry for Combustion
- Create BioFuel
- Digester gas utilization
- Environmentally Friendly
BioEnergy and Biosolids Options

- **Digester**
- **Biosolids Heat Exchanger**
- **BioGas**
- **BioCon Dryer**
- **Solia**
- **Class A Biosolids**
- **ERS Furnace**
- **Incineration**
- **Gasifier**
- **Reciprocating Engine**
- **Fuel Cell**
- **Microturbine**
- **Heat Exchanger**
- **Electricity**
Types of Drying

- **Heat Transfer**
  - Conduction
  - Radiation
  - Convection

- **Types of Dryers (Condensed)**
  - Belt (Conveyor)
  - Rotary
  - Paddle/Disc
  - Tray

- **Heat Delivery Options**
  - Direct Fired
  - Indirect Fired
## Drying & Combustion Mass and Volume Reduction

<table>
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<tr>
<th>Input Data</th>
<th>Units</th>
<th>Data</th>
<th>Notes</th>
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<td>Solids Loading to Dryer</td>
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<tr>
<td>Density of Wet Cake</td>
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<td><strong>ERS (Combustion)</strong></td>
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## Dewatering and Thermal Drying

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13.5% Savings
BioCon Process Flow

1. **Dewatering**
   - Wet sludge
   - Solids: 10-30%

2. **Buffer Tank**

3. **PC Pump**

4. **BioCon Dryer**
   - Air out take/recirculation

5. **Biofuel**

6. **Fuel**

7. **Heat**

8. **ERS Furnace**

9. **Class A Biosolids**
BioCon Dryer System

Wet sludge
Solids: 10-30%

Dried and Treated Class A sludge.
Solids: >90%

Air input/recirculation

Air out take/recirculation

Air Condenser

Air Heater
BioCon Dryer Cabinet
Dewatered solids (10-30%)
- Primary, Secondary, and/or Digested

Buffer tank
- Typically 24-hr holding time

Variable speed PC pumps to sludge depositors
Biosolids Depositors

- Deposit the biosolids onto the belt with oscillating motion.
Depositors – Top View
Depositors – Inside Dryer
Stainless Steel Belts

- No sticking
- Good support
- Gentle handling
- Allows even air flow
- Variable Speed
Dryer Cabinet

- Reinforced steel construction
- Thick insulation (4”)
- Plastisol Cladding
- Multiple Inspection Doors and Windows

*Inspection Doors and Windows*
Condenser

- Closed loop drying air
- Additional heat recovery
- Minimal off-gas from dryer
- No supplemental odor control system
Dry End Product

- EPA 503 Class A quality.
- Mulch like consistency
- Easily transported and spread with normal equipment.
- Size distribution provides variable nitrogen release for agricultural use.
- Spreads with typical agricultural spreaders with standard dust control provisions.
- Easily burned for fuel.
BioCon Controls

- Kruger’s renowned controls expertise and SCADA
- KrugerLink – Remote monitoring and guidance system
Biosolids Thermal Dryer 20 Year Life Costs
10 MGD facility

Equipment Costs 14%
Installation Costs 13%
Fuel Costs 60%
Electrical Costs 6%
Spare Parts Costs 4%
Labor Costs 3%
Chemical Costs 0%
# 10 Dry Tons/Day Costs

<table>
<thead>
<tr>
<th></th>
<th>Disposal</th>
<th>BioCon Only</th>
<th>BioCon and ERS</th>
<th>BioCon and Bees</th>
<th>BioCon and Gas Engine</th>
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<tbody>
<tr>
<td><strong>Capex Cost ($US)</strong></td>
<td>$ -</td>
<td>$ 3,600,000</td>
<td>$ 7,500,000</td>
<td>$ 4,000,000</td>
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<tr>
<td><strong>20 Year NPV Opex (2009 $US)</strong></td>
<td>$ 23,557,071</td>
<td>$ 9,832,180</td>
<td>$ 4,205,395</td>
<td>$ 1,455,754</td>
<td>$ 3,916,258</td>
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<td><strong>Total 20 year NPV (2009 $US)</strong></td>
<td>$ 23,557,071</td>
<td>$ 13,432,180</td>
<td>$ 11,705,395</td>
<td>$ 5,455,754</td>
<td>$ 10,016,258</td>
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<td><strong>Cost $/wet ton year 1</strong></td>
<td>$ 40.48</td>
<td>$ 27.55</td>
<td>$ 10.27</td>
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<tr>
<td><strong>20 Year NPV Cost/wet ton of sludge for 20 years ($/wet tons)</strong></td>
<td>$ 64.54</td>
<td>$ 36.80</td>
<td>$ 32.07</td>
<td>$ 14.95</td>
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Cumulative Opex and Capex Cost
(10 dry tons/day)

Cumulative Capex and Opex Costs for Biosolids Options

- $5,000,000
- $10,000,000
- $15,000,000
- $20,000,000
- $25,000,000
- $30,000,000
- $35,000,000
- $40,000,000

Year

$ BioCon and ERS
$ BioCon and BEES
$ BioCon Fueled by Natural Gas
$ Disposal

KRÜGER
Energy Sources

Low temperature allows for multiple heat sources

• Boiler (gas or biogas)
• Gas engine
• Steam
• Biosolids furnace
• Other waste energy sources
BioCon BEES Process

- **Digester**
- Sludge/condensate air exch.
- Condenser
- Dryer
- Dried sludge (90% DS)
- biogas
- dewatering
- Boiler
BioCon Biosolids Energy Recovery

- Remaining ash ~ 5% of the original biosolids quantity
- Operates as an extension of the BioCon biosolids drying plant
- Energy (heat) required for dryer is from furnace off-gas
- Compact furnace design
- Post-combustion of the flue gas before treatment and emission through stack
- Includes dry flue gas cleaning system
- Designed for intermittent as well as continuous operation
- Low operating and maintenance cost
BioCon Furnace (Section View)

- Reciprocating Grate
- Ash Removal Screws
- Heated Air to Heat Exchanger
- Insulated Cabinet
- Combustion chamber
Biosolids Furnace
Questions