Creating a Sustainable Economic Engine

Landfill Leachate and Septage Treatment
Waste-to-Energy
Matanuska-Susitna Borough Solid Waste Division

Turning Liabilities into Rewards

Dr. Kazem Oskoui
Vice President/Chief Technology Officer

Dr. Abi Assadi, PE
President/Chief Executive Officer

Vladimir Scheglowksi, PE
Chief Operations Officer/Executive Vice President

Creating a Sustainable Economic Engine
The Company

- Over 80 years experience
- Licensed in 48 states, including Alaska
- Completed projects all over U.S. and on all seven continents
Mat-Su Borough pursuing a combined septage and leachate treatment facility.

Location of facility is proposed at the Mat-Su Central Landfill.

Current funding $5M loan through DEC.

We are here to provide cost-effective options to achieve leachate and septage treatment.

Utilize septage as a part of waste-to-energy solution combined with MSW.
Phase 1: Landfill Leachate Treatment

- The Technology
- Experience
- Notable Contaminants Removed
- Results
- Economics
- Next Steps
Presentation Overview

Phase 2: Septage Treatment

- The Project
- Performance
- Results
- Economics
- Next Steps
Phase 3: Waste-to-Energy

- The Problem
- The Recommendation and The Solution
- MSW Sorting Diagram
- Clark-Evergreen Patented AD and LEACHBUSTER® System
- Commercial AD Plant Examples
- The Process and the Benefits
Phase 1

LANDFILL LEACHATE TREATMENT
Objective

➢ Design and construct a system for separate treatment of:

– Leachate generated by the Mat-Su Central Landfill.

– Septage generated by the majority of Mat-Su Borough population from residential, commercial, and public entities.
The Project

System Location
Mat-Su Borough Leachate treatment system will have the following design parameters:

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Landfill Leachate</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Capacity (Gallons per Year)</td>
<td>1,400,000</td>
</tr>
<tr>
<td>Expandable to (Gallons per Year)</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Treated Leachate Discharge</td>
<td>Subsurface Drain Field</td>
</tr>
<tr>
<td>Concentrated Leachate</td>
<td>Return to the open Landfill cell</td>
</tr>
<tr>
<td>Unit Dimensions</td>
<td>10ft x 14ft</td>
</tr>
<tr>
<td>Building Needs</td>
<td>25ft x 50ft</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>100 amp, 80kW, 3 phase 460 v</td>
</tr>
<tr>
<td>Operator Requirements</td>
<td>1 to 2 hours per day</td>
</tr>
</tbody>
</table>
The Technology – Comparison

Clark LEACHBUSTER® Leachate Treatment System

MBR Leachate Treatment System
The Technology and Experience

Clark LEACHBUSTER® Treatment System

- 70+ systems using this technology in operation treating:
  - Landfill Leachate
  - Septage
  - Municipal Wastewater
  - Industrial Wastewater
The Technology

- Clark has innovated and holds intellectual properties for various technologies
- Technologies provide a comprehensive solution for a wide range of water and wastewater treatment challenges
- The system offers up to 12+1 levels of treatment
The Technology

At the heart of these technologies is LEACHBUSTER®

- Innovative, state-of-the-art technology
- Treats a wide range of waste streams with high solids content of up to 25%
- No need for pre-filtration, pre-treatment, backwashing, or staging
The Performance

- Landfill leachate

- Septage and domestic wastewater
Notable Contaminants Removed

**Pathogens** without using disinfectants
- E-coli < 2 CFUs/100 ml
- Fecal Coliforms < 10 CFUs/100 ml
- No THMs or DBPs

**Volatile Organic** Contaminants
- VOCs - TCE, DCE, MEK...
- SVOCs
- PAHs

**Emerging contaminants** of concern
- PFCs,
- Boron,
- Chlorides...
Results

Physical indicators
- Organics BOD, TSS, and COD
- Inorganics TDS and TS
- Metals Cd, Cr, Cu, Pb, Se, Sb
- Conductivity

Common contaminants
- Phosphorus
- Nitrogen compounds, NO_x, NH_3
- Sulfates
- Bromides

Tomorrow’s contaminants
- Antibiotics
- Degradation byproducts
- Endocrine prohibitor
- Super bugs
## Results

### Raw Leachate and Treated Leachate Characterization

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Raw</th>
<th>Treated</th>
<th>% Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD (mg/l)</td>
<td>&gt;14000</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>&gt;30000</td>
<td>30</td>
<td>99.9</td>
</tr>
<tr>
<td>pH</td>
<td>7-8.5</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Temperature</td>
<td>65 to 75</td>
<td>80-90</td>
<td>-</td>
</tr>
<tr>
<td>Ammonia</td>
<td>&gt;400</td>
<td>&lt;10</td>
<td>99</td>
</tr>
<tr>
<td>TDS (mg/l)</td>
<td>&gt;5000</td>
<td>&lt;100</td>
<td>99.9</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>&gt;2000</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Total Coliforms</td>
<td>&gt;7 logs</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>E-Coli (CFUs/100ml)</td>
<td>&gt;5 logs</td>
<td>&lt;2</td>
<td>99.9</td>
</tr>
</tbody>
</table>
## Results

### PFCs

Amount of contaminants in raw leachate, treated effluent, and concentrate together with ILs and HRLs.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Raw Leachate</th>
<th>Treated Leachate</th>
<th>HRLs</th>
<th>Removal (%)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfluoropentanoic Acid</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td>ng/l</td>
</tr>
<tr>
<td>PFBS</td>
<td>680</td>
<td>ND</td>
<td>7000</td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluorohexanoic Acid</td>
<td>8300</td>
<td>ND</td>
<td></td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluoroheptanoic Acid</td>
<td>3200</td>
<td>ND</td>
<td></td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>PFHxS</td>
<td>2600</td>
<td>ND</td>
<td>7000</td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>PFOA</td>
<td>4500</td>
<td>ND</td>
<td>300</td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluorononanoic Acid</td>
<td>ND</td>
<td>ND</td>
<td>300</td>
<td>ND</td>
<td>ng/l</td>
</tr>
<tr>
<td>PFOS</td>
<td>1100</td>
<td>ND</td>
<td>300</td>
<td>100.00</td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluorodecanoic Acid</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td></td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluoroundecanoic Acid</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td></td>
<td>ng/l</td>
</tr>
<tr>
<td>Perfluorododecanoic Acid</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td></td>
<td>ng/l</td>
</tr>
</tbody>
</table>
Phase 2

SEPTAGE TREATMENT
# The Project

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Septage from Septic Tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Capacity (Gallons per Year)</td>
<td>14,000,000</td>
</tr>
<tr>
<td>Expandable to (Gallons per Year)</td>
<td>20,000,000+</td>
</tr>
<tr>
<td>Treated Leachate Discharge</td>
<td>Subsurface Drain Field</td>
</tr>
<tr>
<td>Concentrated Leachate</td>
<td>Dewatered and land applied</td>
</tr>
<tr>
<td>Unit Dimensions</td>
<td>2 @ 10ft x 14ft</td>
</tr>
<tr>
<td>Housing Dimensions (Building)</td>
<td>25ft x 60ft</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>250 Amp, 200kW, 3 phase 460 v</td>
</tr>
<tr>
<td>Operator Requirements</td>
<td>2 to 3 hours per day</td>
</tr>
<tr>
<td>Volume Reduction</td>
<td>95% to 98%</td>
</tr>
</tbody>
</table>
Performance

- **LEACHBUSTER®** was applied to treat municipal wastewater (sewage) and septage.
Results

Influent and Effluent Concentrations

<table>
<thead>
<tr>
<th>Contaminant Levels (ppm)</th>
<th>Influent</th>
<th>Level 1</th>
<th>Level 6</th>
<th>Level 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>545</td>
<td>0</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>TSS</td>
<td>840</td>
<td>105</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Influent and Effluent Treatment Levels
Results

Influent and Effluent Concentrations

Influent and Effluent Treatment Levels

Contaminant Levels (ppm)

- Influent: Ammonia 66.9, TKN 134
- Level 1: Ammonia 49.8, TKN 74.2
- Level 6: Ammonia 14.3, TKN 17.4
- Level 9: Ammonia 4.7, TKN 7.64
Results

Influent and Effluent Concentrations

Contaminat Levels (ppm)

Influent: 15.7
Level 1: 5.48
Level 6: 0.066
Level 9: 0.014

Influent and Effluent Treatment Levels

[Graph showing contaminant levels]
Results

E. coli Level (Colony Forming Units/100 ml)

Influent and Effluent Concentrations

Influent and Effluent Treatment Levels

Influent: 24,200
Level 1: 175
Level 6: 0
Level 9: 0
Economics

- Rough order of magnitude (ROM) pricing on a few options for consideration by Mat-Su Borough
- Revised pricing will be provided after completion of a directed engineering study
Economics

- Landfill leachate treatment
  - Landfill leachate treatment system is expandable to accommodate the inclusion of the septage treatment system

- Septage treatment system
The proposed system will treat only the landfill leachate without any provision to accommodate the treatment of septage.

- The system will be designed to treat initially 1,400,000 gallons of leachate per year during approximately 6 months.
- The system will be expandable to treat up to 2,000,000 gallons of leachate/year during that period.
- The system will consist of three modules, which can be brought into service to respond to varying demand.
- For example, one module can run during the winter, two in spring, and all three during the summer and fall when the rainfall is high.
Economics – Landfill Leachate Treatment

The ROM pricing for the system is:

- Treatment system skid, including:
  - Design, engineering, manufacturing, transportation, installation, commissioning, and training.
  - Building to accommodate the treatment system and site work related to the building’s leachate tanks’ internal and external piping and electric work.

$4,250,000
Economics – Septage Treatment

The proposed system will treat only the septage:

- The system will be designed to treat initially 14,000,000 gallons of septage per year during approximately 6 months.
- The system will be expandable to treat up to 20,000,000 gallons/year of septage during this period.
- The system can be designed for an additional cost to accommodate wastewater from the cities of Palmer and Wasilla also.
The ROM pricing for the system is:

- Treatment system skid including:
  - Design, engineering, manufacturing, transportation, installation, commissioning, and training.
  - Building to accommodate the treatment system and site work related to the building’s internal and external piping and electric work.

$7,640,000
Next Steps – Directed Engineering and Parametric Design Study

Identify design characteristics for the full-scale system

Obtain engineering and design parameters for full-scale system

Define layout, configurations, elements and operating parameters for final system
Phase 3

WASTE-TO-ENERGY

A NEW VISION: INTEGRATED WASTE MANAGEMENT, RESOURCE RECOVERY, AND RENEWABLE ENERGY SYSTEM (A THRIVEABLE SOLUTION)
Large and Inefficient
Large and Inefficient
The Problem

We need a paradigm shift.

There is a better way to treat solid and liquid waste.
The Recommendation

Employ robust technologies.

Clark-Evergreen integrated waste management and waste-to-energy conversion system.
The Recommendation

- Clark-Evergreen integrated waste management and waste-to-energy conversion system
  - An efficient means of reducing the volume of MSW and sewage
  - Convert waste into valuable products and by-products: biogas or green electric power, organic fertilizer, clean water
The Recommendation

- Clark-Evergreen integrated waste management and waste-to-energy conversion system
  - Significantly reduce waste storage issues and associated air and water pollution
  - Significantly reduce capital and operating costs
The Recommendation

- Clark-Evergreen integrated waste management and waste-to-energy conversion system

**Convert liabilities into assets:** create an income stream in addition to tipping and treatment fees.
The Solution


Integrated waste-to-energy conversion system is the gift that keeps on giving, thanks to the valuable products and by-products it produces.
The Solution


Integrated waste management and waste-to-energy conversion system is the gift that keeps on giving. Diesel fuel:

- Plastics and tires recovered from the MSW are converted into No. 2 diesel fuel
- This fuel can be used to run most diesel engines
MSW Sorting Diagram

- **MSW Municipal Solid Waste**
  - **Recycling/Sorting**
    - **Hazardous Waste**
      - Hazardous Waste Landfill
    - **Plastic**
      - End User
    - **Metal**
      - **Aluminum**
        - End User
      - **Ferrous**
        - End User
    - **Glass**
      - Clear Glass
      - Colored Glass
      - Other Glass
      - **End User**
    - **Non-Recyclable Material**
      - To Landfill
    - **Solid Organic Waste**
      - **Paper**
        - Wood
        - Food Waste
        - Other
      - To Landfill

- **CWTI-Evergreen System**
### The Benefits

#### Sample MSW for Rochester, MN

<table>
<thead>
<tr>
<th>MSW Discards (After Curbside Recycling) by weight</th>
<th>% of Total</th>
<th>Weight (in tons)</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food, Yard Wastes and Organics</td>
<td>32.20%</td>
<td>64,400</td>
<td>32.2</td>
</tr>
<tr>
<td>Textiles, Rubber, Leather, Wood</td>
<td>21.30%</td>
<td>42,600</td>
<td>21.3</td>
</tr>
<tr>
<td>Plastics</td>
<td>17.60%</td>
<td>35,200</td>
<td>17.6</td>
</tr>
<tr>
<td>Paper and Cardboard</td>
<td>14.80%</td>
<td>29,600</td>
<td>14.8</td>
</tr>
<tr>
<td>Metals</td>
<td>9.00%</td>
<td>18,000</td>
<td>9.0</td>
</tr>
<tr>
<td>Glass</td>
<td>5.10%</td>
<td>10,200</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>200,000</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

- **Total Organic (Organic + Paper + Cardboard)**: 47.00% of 94,000 tons = 47 tons
- **Plastics, Rubber, Oil (Pyrolysis)**: 38.90% of 72,200 tons = 36.1 tons
Clark-Evergreen Patented Anaerobic Digestion and LEACHBUSTER® System
By converting much of that biogas into green electricity with a co-gen electric power facility, green power can be provided to many more thousands of homes and businesses than by utilizing other waste-to-electricity conversion methodologies.
The Clark-Evergreen process

- Recovers 80% or more of the NPK-rich bio-solids as organic fertilizer
- Sequesters and removes macro and micro nutrients from the water column
Examples of Commercial AD Plants
Single process

– Significantly reduces the need for landfills and wastewater treatment facilities
– Combines these facilities into one all-encompassing system
The Benefits

➤ Scalable

  – Lack of space to install and full-scale water or sewage treatment plant is no problem
  – Each Clark-Evergreen system is custom-designed and can be scaled to meet the capacity needs of each user
  – Capacity can be added as needed
The Benefits

Self-sustaining

- Energy produced by the system can provide gas or electricity to a business/community
- Excess energy may be sold back to the existing utilities that provide gas and electrical service to the community
- This completes the full circle of the sustainable treatment cycle
The Benefits

Cost effective

- The Clark-Evergreen system can process virtually any organic source material without costly treatment steps and chemicals
- Maintaining and powering the system is the only cost associated with it after installation
- These costs can be offset by a small portion of the energy produced and income from energy, water, and fertilizer
Next Steps

Questions?