Design of the SHAFDAN Digestion and Cogeneration Facility

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### SHAFDAN Wastewater Treatment Plant

#### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2008</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent Population</td>
<td>1.80 M</td>
<td>2.25 M</td>
</tr>
<tr>
<td>Average Annual Flow (m³/d)</td>
<td>340,000</td>
<td>427,000</td>
</tr>
<tr>
<td>Maximum Monthly Flow (m³/d)</td>
<td>410,000</td>
<td>515,000</td>
</tr>
<tr>
<td>Raw wastewater TSS conc. (mg/L)</td>
<td>&gt;400</td>
<td>&gt;400</td>
</tr>
</tbody>
</table>

100% Water Reuse for Agriculture
Background of Solids Stream Treatment

- Plant currently generates about 150 t/d (as dry solids) of WAS (waste activated sludge)
- WAS is gravity thickened to about 2.0 percent solids, and about 8,000 m³/d is discharged to the Mediterranean Sea under a “temporary” discharge permit issued in 1987
- New primary treatment will increase total sludge generated by approximately 15%. Cannot discharge undigested primary sludge to Mediterranean Sea
- In 2003, the Dan Region committed to developing a land-based biosolids management program. New thickening/dewatering facility completed in 2009
- Israel is a signatory to the Barcelona Accord, which bans the disposal of all wastewater solids to the Mediterranean Sea
Biosolids and Energy Resources Instead of Sludge in the Mediterranean Sea

Reclaimed Water for Agricultural Use

Mediterranean Sea

Sludge

Class A Biosolids for Beneficial Agricultural Use

Energy (Heat, Power)
Key Objectives

- Achieve high economic value – low life cycle cost, capital and operating cost conscious
- Environmentally sustainable – produce green power fueled by biogas, produce Class A biosolids to build healthy soils, protect the Mediterranean Sea
- Socially acceptable – be a good neighbor, have pleasing aesthetics, reduce vector attraction, control odors and acoustics
- Operator friendly – ease of operations and maintenance; provide reliable, flexible, accessible, and safe operations, protect against foam
Biosolids Processes Considered

- Thickening
- Anaerobic Digestion
- Dewatering
- Land Application
- Dewatering
- Drying
- Land Application
- Incineration
- Ash Disposal
SHAFDAN Wastewater Treatment Plant
Site Overview

New Digestion and Cogen Facility

New Primary Treatment and Headworks

Bioreactors

Secondary Clarifiers

Thickening and Dewatering Building

Visitor Center

New Truck Loading Facility

Existing Headworks

Administration Maintenance
Anaerobic Digester Facility Overview

- Sludge Screens
- Electrical and Control Bldg
- Energy Building
- Boiler Building
- Main Building
- Anaerobic Digesters
- Transformers
# Sludge Design Loadings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sludge Flow (m³/d)</th>
<th>TSS (kg/d)</th>
<th>VSS (kg/d)</th>
<th>Concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup Average Annual</td>
<td>4,150</td>
<td>199,000</td>
<td>156,000</td>
<td>4.8</td>
</tr>
<tr>
<td>2030 Average Annual</td>
<td>4,800</td>
<td>230,000</td>
<td>180,000</td>
<td>4.8</td>
</tr>
<tr>
<td>2030 Maximum Month</td>
<td>5,900</td>
<td>283,000</td>
<td>222,000</td>
<td>4.8</td>
</tr>
<tr>
<td>2030 Maximum Week</td>
<td>7,630</td>
<td>362,000</td>
<td>281,000</td>
<td>4.7</td>
</tr>
<tr>
<td>2030 Maximum Day</td>
<td>9,110</td>
<td>431,000</td>
<td>332,000</td>
<td>4.7</td>
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</tbody>
</table>
Solids Processing System

Primary Sludge
Thickened WAS

Sludge Blend
Tanks

Sludge Screens

Digester Feed
 Tanks

Heat Recovery

To
 Digesters

To
Dewatering

Anaerobic Digesters

Digested
Sludge
Storage
Tank
Biogas Treatment System

- Biological H₂S Removal
- Biogas Holder
- Biogas Flares
- Moisture Removal
- H₂O Removal
- Siloxane Removal
- H₂S Iron Sponge Scrubbers
- Booster Blower
- Digester Feed Tanks
- Digested Sludge Storage Tanks
- Sludge Blend Tanks
- Anaerobic Digesters
- Cogeneration Units
- Hot Water Boilers
Thickened Primary and Waste Activated Sludge Screening

- Eight Screens
- Hydraulic capacity: 45-68 m$^3$/hr each
- Solids concentration: 4 - 6%
- Screen Size: 5 mm

Photo courtesy of Huber
Anaerobic Digesters with Submerged Fixed Covers

- Eight Anaerobic Digesters
- Volume: 13,200 m³
- Inner diameter: 34 m
- Side water depth: 14.4 m
- Gas dome diameter: 4.5 m
- Gas dome height: 3 m

Architectural features were inspired from anaerobic digesters at the Metro Biosolids Center, San Diego, CA
Biogas System

- Treatment for protection of internal combustion engines and boilers
- Average gas production: 89,000 – 100,000 m³/day from start up to 2030
- Max day gas production: 149,000 m³/day
- 4.0 Peaking factor for gas piping

Biological treatment extends the life of iron sponge that extends the life of activated carbon.
Seven Internal Combustion Engine Cogeneration Units

- 1.4 MW electrical capacity each
- 1.4 MW thermal capacity each
  - 90 degrees C
  - 60 m³/hr

Cogeneration Units: Highmark Renewables Facility, Vegreville, Alberta & Columbia Boulevard WWTP, Portland, OR
Overall Environmental Benefits of the Digestion and Cogeneration Facility

Environmental Protection of Mediterranean Sea

Production of Class A Biosolids for Beneficial Agricultural Use

Production of Renewable Energy from Biogas
Questions?