Integrating Co-Generation for Renewable Fuel Production at the Catawba County, NC EcoComplex

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The Catawba County EcoComplex
Biodiesel Research, Testing, and Production Facility
Biodiesel Research, Testing, and Production Facility

- Partnership between Catawba County and Appalachian State University

- Funding for the facility:
  - Catawba County, ~$1.6mil for LEED Silver building
  - Appalachian State University, ~$1.6mil for equipment and staffing. Majority of this funding from the Golden LEAF Foundation, U.S. DOE, UNC General Administration, and the Biofuels Center of North Carolina.
Biodiesel Research, Testing, and Production Facility

• For Catawba County benefits include an economical renewable fuel source for landfill equipment and an onsite university partner for collaboration on EcoComplex development and optimization projects.

• For Appalachian State University benefits include a pilot scale facility for biodiesel production process research, laboratory facilities for feedstock and fuel quality analysis, chassis dynamometer for emissions analysis, and a “real-world” learning environment for student development.

Definitely a WIN-WIN
Biodiesel Research, Testing, and Production Facility
Combustion Emissions Analysis

Returns Emissions in g/km, g/kg fuel, g/s, or g/bhp-hr: CO$_2$, CO, SO$_x$, NO$_x$, THC, Particulate Matter
Heat Requirements per 500 gal Biodiesel (Btu)

- Distillation, 465,000
- Methanol Rectification, 340,000
- Acid Ester/settling, 215,000
- RXN, 281,000
- Glyc Refining, 110,000
- Wash & Hot water, 137,000
- Settling, 107,000
- Ion Xchange, Filter press, 117,000
Landfill Gas to Energy

Energy Output per Engine:
1MW e & 6.5 MMBtus/hr Waste Thermal Heat
RADIATOR SUPPLY
**GIVEN PARAMETERS (from Nixon):**

<table>
<thead>
<tr>
<th>PARAMETERS: Jenbacher HX</th>
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<tbody>
<tr>
<td>16 psi allowable pressure drop</td>
</tr>
<tr>
<td>270 gal/min coolant flow</td>
</tr>
<tr>
<td>15°C max temp drop</td>
</tr>
<tr>
<td>85°C coolant in temp</td>
</tr>
<tr>
<td>3.5 inch pipe supply</td>
</tr>
<tr>
<td>7 ft max length</td>
</tr>
<tr>
<td>200,000 BTU/hr needed</td>
</tr>
</tbody>
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**Heat Exchange Calculations**

<table>
<thead>
<tr>
<th>Area</th>
<th>20 ft²</th>
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<tbody>
<tr>
<td>U</td>
<td>144 Btu/(ft hr F)</td>
</tr>
<tr>
<td>Cp water</td>
<td>1 Btu/lb°F</td>
</tr>
<tr>
<td>Cp coolant</td>
<td>0.8 Btu/lb°F</td>
</tr>
<tr>
<td>mdot water</td>
<td>20,000 lb/hr</td>
</tr>
<tr>
<td>mdot coolant</td>
<td>134,000 lb/hr</td>
</tr>
<tr>
<td>Calculated Effectiveness</td>
<td>0.193</td>
</tr>
<tr>
<td>Q dot to cold side</td>
<td>232,000 Btu/hr</td>
</tr>
</tbody>
</table>
Used heat exchanger
Economic Analysis

• Heat Exchanger System
  – Installed Cost $21,663
  – Annual Avoided cost of $9,500 per year (based on 50,000 gal/yr and $1.19/therm nat. gas)
  – 3 year payback (based on 3.5% cost of capital and 1% inflation)
  – 39.7% IRR (based on savings)
Co-Gen Savings (Nat. Gas Comp)

Year

Cash Flow ($)
NPV

Dollars

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

$(40,000.00) $(20,000.00)
Thank you