

Operating a Digester Gas Cogeneration Facility

Workshop for
CHP and Bioenergy
for Landfills and Wastewater
Treatment Plants



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Presentation Outline

- Technology and related operational issues
- Recovering and utilizing heat
- Maintenance and digester gas cleanup
- Operating in parallel with utility
- Other tips

Cogeneration Technologies

- Reciprocating Engines (>250 kW)
- Micro turbines (30 to 250 kW)
- Gas Turbines (>3000 kW)
- Fuel Cells (demonstration only on DG)
- Stirling Engines (new technology, 55 kW with 250 kW in near future)



Reciprocating Engines

- Proven technology for using digester gas
- Strict air permit regulations
- Two manufacturer's can meet current regulations



Reciprocating Engines (Cont.)

- Siloxane is an issue, increases O&M significantly
- Requires <1 psi fuel pressure with low pressure fuel system
- Higher maintenance



Micro Turbines

- Easy to permit (low emissions)
- Only two manufacturer's with DG experience (limited)
- Lower efficiency than engines
- Requires > 50 psi fuel pressure



Gas Turbines

- Strict Air permit regulations
- Limited manufacturer's with experience on DG
- Siloxanes and H_2S are issues



Gas Turbines (Cont.)

- Competitive only for larger installations
- Low efficiency
- Requires > 200 psi fuel pressure



Fuel Cells

- Demonstration only on DG (Portland, OR, Renton, WA, and Yonkers, NY)
- Requires extreme fuel conditioning to remove all contaminants
- Higher capital cost and maintenance cost

Stirling Engines

- New technology
- Very promising on DG since external combustion
- Very tolerant to contaminants
- Very good emissions
- Requires < 1 psi fuel pressure



Digester Gas Quality and Its Impact on Maintenance

- 40% CO₂
- 60% CH₄
- Water vapor (saturated)
- Trace levels of contaminants including H₂S and siloxanes, grease, dirt, etc.
- Typically generated at 8-12 inches w.c.

Contaminants of Concern

- H₂S
- Siloxane
- Water

H₂S

- Typically present at levels of > 2000 ppmv if untreated
- Forms with water vapor (both in the gas and in the combustion products) to form H₂SO₄
- Most air districts regulate H₂S in some way, typically gas must have levels < 200 ppmv

H₂S Treatment Options

- Iron sponge (adsorption)
- Ferric or Ferrous Chloride into process

Iron Sponge

- Combustible
- Requires high degree of O&M (regeneration/replacement)



Ferric or Ferrous Chloride Addition

- Chemical storage/handling/delivery - very corrosive
- Process issues

Siloxane

- Several Silocon compounds
- Derived from several common household products (shampoos, etc.)
- Water soluble
- Causes hard abrasives “glass” like buildup on combustion equipment such as engine valves

Siloxane Treatment Options

- Adsorption (patented product)
- Remove water from gas (refrigerant gas drying)
- Sometimes both are required due to quantity in gas

Siloxane Removal O&M Issues

- Costly media to replace
- Energy costs for drying



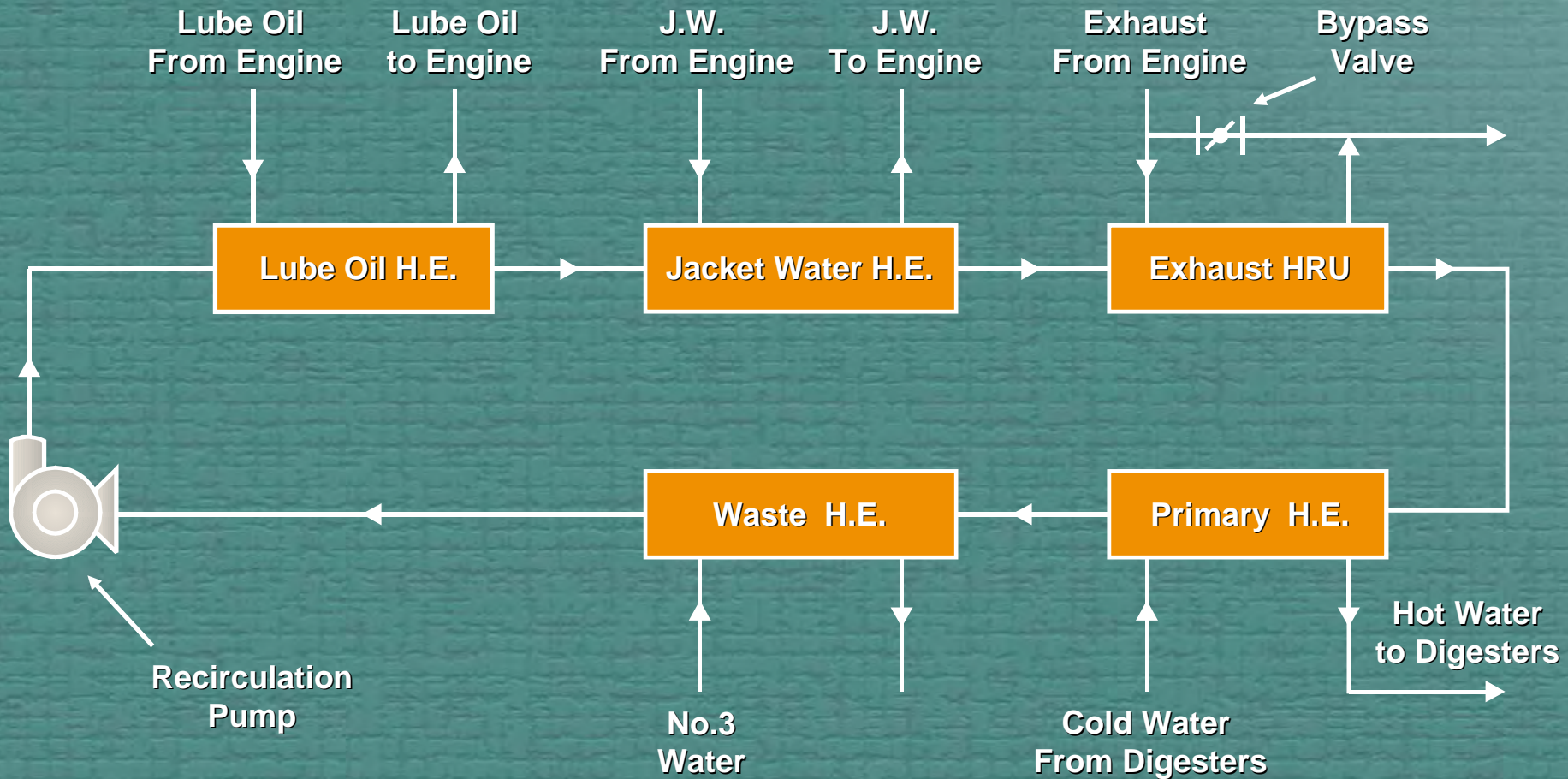
Recovering and Utilizing Heat

- Jacket, exhaust and lube oil heat recovery
 - Must cool lube oil and jacket water
 - Exhaust heat - recover only if needed
- Utilizing recovered heat
 - Heat digesters
 - Building heating and cooling
 - Sludge drying
 - Organic rankine cycle for additional power

Recovering and Utilizing Heat (Cont.)

- Type of heat exchangers to minimize plugging
- Chemical treatment of hot water to minimize corrosion

Engine Cooling and Heat Recovery System



Operating in Parallel with Utility

- Operate in parallel to increase utilization
- Import/export agreement with utility for ease of operation vs reverse power relay
- Standby power during utility outages to improve reliability
- Regular preventative maintenance

Other Tips for Improved Operation

- Regular periodic oil testing
- Avoid oversizing Cogen
- Check and maintain water chemistry
- Drain water from DG system
- Periodically check heat balance
- Preventative maintenance schedule
- Adequate staff training

Summary

- Design facility considering operation and maintenance issues
- Wastewater treatment plants are perfect fits for CHP
- Digester gas fuel needs special attention
- Need proper design for engine cooling/heat recovery system

Summary (Cont.)

- Pay attention to electrical and controls
- Preventative maintenance is a key element
- Good money making projects

Questions?
