DIGESTER CONFIGURATION, SIZING, HEATING

S. A. Weeks
HORIZONTAL VS. VERTICAL

- No clear difference in biogas production
- Unmixed vertical is “vertical plug flow”
- Mixing does occur naturally within digesters
- Mixing with pumps, props, or recycled Biogas consumes considerable energy
- Design may depend on land “footprint” available
HORIZONTAL VS. VERTICAL (CONT.)

- Loop horizontal to reduce length
- Looped design has inlet and outlet at same end
- Looped design makes future influent-effluent heat exchange easier
- Vertical allows gravity flow of effluent to storage, and gravity emptying
DIGESTER INTERNAL HEATING SYSTEM

- Crusting may occur on internal pipes
- Electrolysis may occur on internal pipes
- Digester has to be emptied to fix exposed internal pipes
- Not allowed for Municipal systems
- Pipes poured within floor or walls = easy cleaning, but poor heat transfer
**EXTERIOR HEAT EXCHANGERS**

- Municipal systems use spiral heat exchangers---they are expensive
- Shell & tube exchangers will plug with large manure solids
- Shell & tube exchangers work with separated manure liquids (with back flush system)
- Shell & tube with ground manure?
EFFLUENT-INFLUENT HEAT EXCHANGE

- Will yield lots of excess heat from system
- May be necessary for manure from uninsulated barns in Northeast
- Will tend to plug with large manure solids
- Easy to accomplish with separated liquid
- Possible with ground manure?
STEAM HEAT

- Direct injection of steam into manure
- Initial, successful test at Foster Brothers Farm
- 1,000 Btu available per pound of water converted to steam
- 167 Pounds of manure (one cow) @ 40 degrees to 100 degrees requires 10 pounds of water converted to steam
BIOGAS BOILER ISSUES

- Operate boiler continuously (heat dump)
- Adjust gas valve pressure to match Biogas production
- Nozzle openings larger than natural gas
- Avoid pilots
- Keep water temperature hot to reduce heat exchanger build up
DIGESTER CLEANING

- The “unmentioned” issue
- Depends on “grit” in influent
- Calcium carbonate (calcite) an issue at NYC Watershed project
- Periodic cleaning needs to be scheduled for warm weather
- Conical bottoms greatly assist cleaning