



Biogas Systems: Case Studies in Safe Design



Reception and Digester

November 17, 2020

Presentation Overview

- Part 1 – Reception and Digester
 - Feedstock handling – incoming quality
 - Feedstock reception area
 - Tank design concerns
- Part 2 – Biogas Handling
 - Aaron Parker, PE



Feedstock Handling

- Types of Feedstock
 - Food waste
 - Food processing waste
 - Retail food waste
 - Post-consumer food waste
 - Animal manure – dairy, pig, etc.
 - Dead stock
- Feedstock Reception Area must be designed carefully based on the types and quantities received





Food Waste as a Feedstock



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Reception Area Design

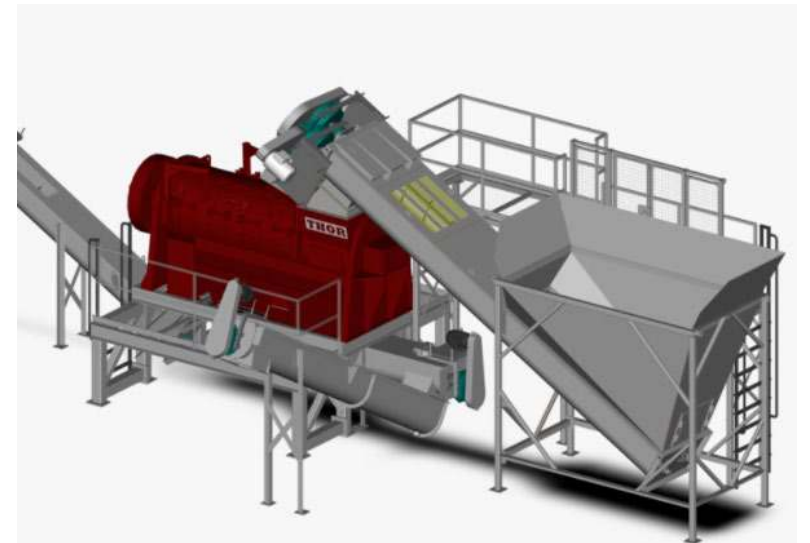
- Food waste requires treatment before entering the digester
- Equipment required depends on type
 - Uncontaminated – no packaging, no trash
 - Liquid waste – example: DAF, FOG
 - Can go directly into digester – screen for solids
 - Can be blended prior
 - Bulk food – produce, meat products
 - Grinding and blending to reduce solids
 - Slurry pit
 - Mixers, grinder pumps



Reception Area Design

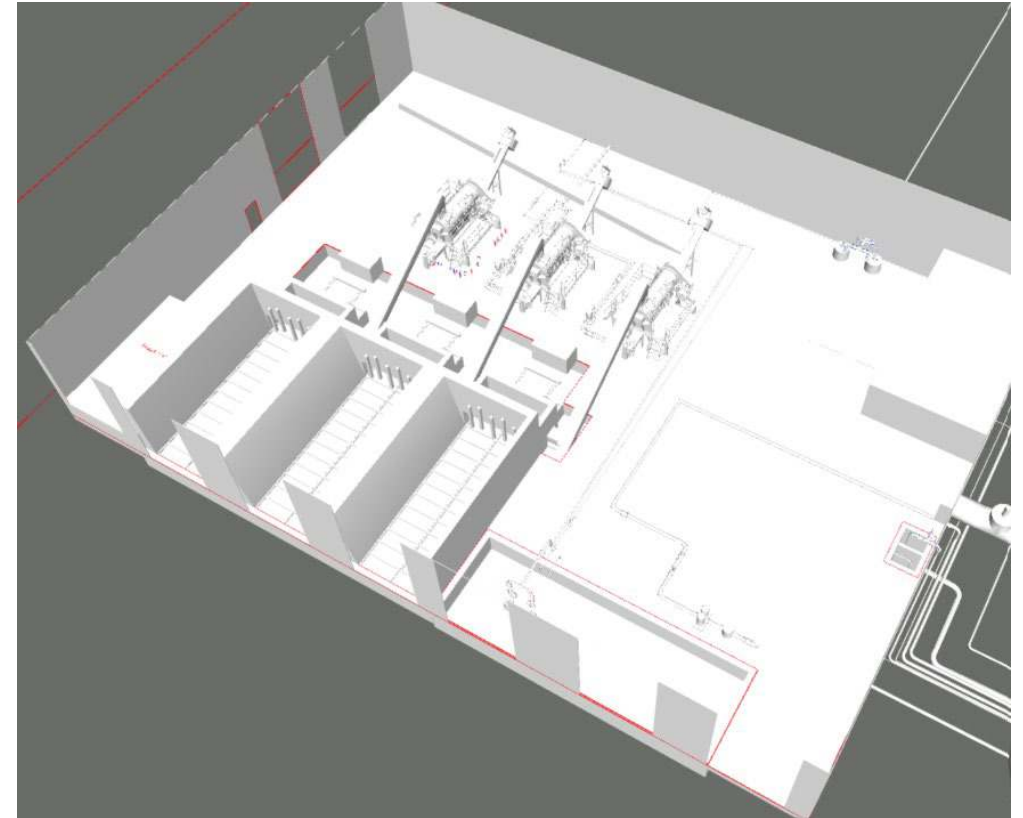
Contaminated Food Waste

- Packaging
 - Cans, bottles, plastic bags, boxes
 - Palletized
- Depacking
 - Vendor-supplied depacking equipment
 - Doda, Scott/Thors, etc
 - Manual – pallets, boxes



Feedstock Offloading

- Conveyance to get food waste into depacking units
 - Hoppers
 - Walking floors, conveyors
- Loading dock design to allow safe, easy access for trucks and personnel
 - Design for a variety of trucks and vehicles
 - Operators in constant attendance
 - Direct drivers to off-loading area
 - Inspect loads for unwanted items
- Direct dumping or discharging into slurry pit/tank
- Direct pumping of liquids to blend tank





Dairy Manure as a Feedstock



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Dairy Manure Quality

- Collection type
 - Scrape
 - Skid steer with tire scraper
 - Vacuum truck – direct dump to Reception
 - Alley scrapers – pump to Reception
 - Flush
 - Introduces a lot of water – lower solids concentration = larger digesters
 - Pump directly to Reception



Dairy Manure Reception

- Flush – pump to reception
 - Sump with mixers and pumps
 - Cover to prevent personnel falls and debris
 - Less effective biogas production due to larger tanks (cost) or use a lagoon (efficiency)



Source: US Farm Systems website



Source: confidential client



Dairy Manure Reception

- Scrape – trucks deposit directly into Reception Pit
 - Maximize solids concentration, decreases digester size
 - Design a safe, cost-effective, efficient means of depositing loads
 - Covered grate – no fall hazard but will clog and require cleaning periodically
 - Chain/cable fence – nonstandard but good balance between personnel safety and truck access



Source: Mensch Manufacturing LLC website



Source: Nuhn Industries website





Digester Design Considerations



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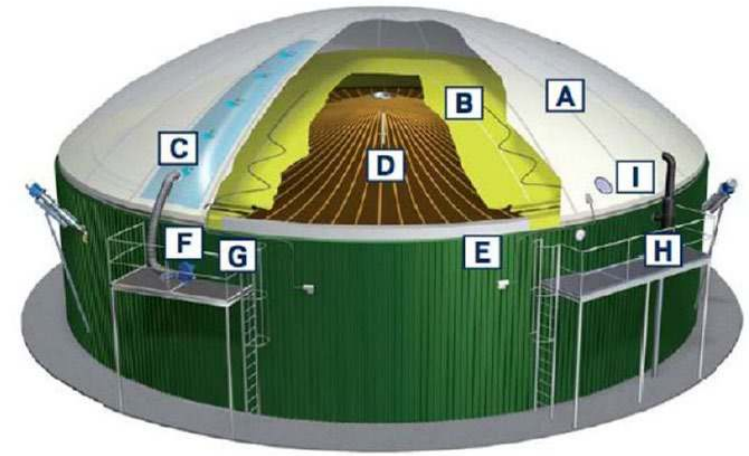
Digester Heating

- Internal heating loop
 - More efficient but more difficult to fix
 - Corrosion resistant tubes and supports
- External heat exchanger
 - Less efficient but easier to fix and maintain
 - Continuous recirculation aids mixing
 - Solids from feedstock handling could clog heat exchanger



Digester Roof

- Biogas flow and pressure fluctuations are inevitable – need to equilibrate
- Rigid roof with no flow/pressure buffering will leak over time
- Double membrane roof
 - All digesters, last digester (cold)
- Solid roof with external biogas storage



Reception and Digester Safety in Design

- Thank you for joining me today – to recap
 - Food waste Reception design
 - Dairy manure Reception design
 - Digester heating
 - Digester roof options
- Next step – biogas handling – Aaron Parker

