

YIELD

renewable energy producers



Dr. Digester™

Introduction to contaminant removal for biogas facilities

Outline

1. Corporate Overview
2. Characterizing the Problem
3. Analyzing the Solutions
4. Financial Implications

1. Corporate Overview

- **Yield Energy was founded in 2007**
- **Turn-key design of urban anaerobic digestion (AD) plants utilizing contaminated/uncontaminated food waste**
 - Integration in balance of plant technologies such as waste water treatment etc.
 - Manufacture of key contaminant removal equipment
- **Dr. Digester™ Scientific Services**
 - Waste Audits/Feedstock Strategies
 - Feasibility Studies
 - Operational Support/Biological Stability

Characterizing the Problem

Food Waste – Contaminated Fuels



“Separated” Grocery



Non-separated Restaurant



Packaged Food

The Problem with Contaminants

Contaminants like bones, packaging, dishes, cutlery etc.



The Problem with Contaminants



The Problem with Contaminants

- CAPEX and OPEX on additional equipment
- Contaminant disposal costs
- In-tank mechanical problems
- Increase in energy production...maybe
 - depends on how much organics are removed with contaminants
- Production of clean digestate is mandatory

3. Analyzing the Solutions

Integration is critical

- Not a plug and play situation with pieces of equipment.
- Equipment manufacturers don't design or integrate solutions.
- Limited performance guarantee's on equipment.
- No matter what type of conditioning or pre-treatment equipment is chosen, it will create a dirty slurry.
- Contaminant removal technologies can dramatically affect the plants water consumption and energy balance

We advocate a multiple step cleaning process:

- No single piece of equipment can clean organic waste enough to prevent downstream mechanical problems
- Slurries contain significant amounts of heavy solids like bones, metals & eggshells
- Plastics will also make it through
- Heating during pre-treatment will improve solids separation

Without a multiple step cleaning process
your digester will accumulate a sinking
and a floating fraction



In-Tank Contaminant Removal System



Tank Skimmer System



What options are there and what should they accomplish?

- Perform multiple functions from package opening to particle size reduction to separation of organics and contaminants as well as moving of slurries in a plant
 - Horizontal & vertical shredders, press-type pumps
 - Separation mills
 - Hydro cyclones & hydro pulpers
 - In-situ tank cleaning equipment
 - Heating/pasteurizing systems

Increased water use...why?

- Looking to achieve a balance between water consumption & losing organics with solids
- More water could mean lower retention time or larger tanks
- Smaller screen sizes (1-10mm) results in more organics being separated along with the contaminants
- Larger screen sizes (15-40 mm) use less water: better for batch processing & package separation but will let more contaminants through

4. Financial Implications

Contaminants eroding profit margins

- Sinking Fraction:
 - 5000 tonnes/yr of organics @ 2% sinking contaminants (100 t/a)
 - Bulk density- 1.6 t/m³
 - **62.5 m³/a or 4.2%/a of 1500 m³**
- Floating Fraction:
 - 5000 tonnes/yr @ 1% floating contaminants (50t/a)
 - Bulk density- 0.6 t/m³
 - **83 m³/a or 5.5%/a of 1500 m³**

Water use eroding profit margins

- Input Total Solids of 1000 kg of Substrate- 20%
 - 1st Pre-treatment Step
- Hammer Mill Max Input TS-15%
 - +500 kg/500L/0.5 m³ additional water
- 2nd Pre-treatment Step
- Hydro Cyclone Max Input TS- 10%
- + 1000 kg/1000L/1 m³ additional water

Financial implications of contaminated feedstock

- Tipping fee revenue losses during downtime for cleaning
- Energy revenue losses during downtime
- Energy revenue losses during ramp up cycle
- Labour costs to remove the contaminants

Financial Implications for High Process Water Consumption

- Increase in energy use for purchasing & pumping extra water
- Potential decrease in retention time or requires larger digesters increasing capital costs
- Increased treatment and disposal costs of the extra process water

In summary

- Successful integration of components.
- Include buffer capacities in processing.
- Requires a proven systems approach.
- Long term financial and operational success.
- Know your fuel characteristics.
- Produce *clean* digestate.
- Minimize digester downtime.

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