Industrial Anaerobic Digesters at Potato Processing Plants

2011 Idaho Water Reuse Conference

Wednesday, May 25, 2011 - Session A: Reuse Case Studies - Biogas

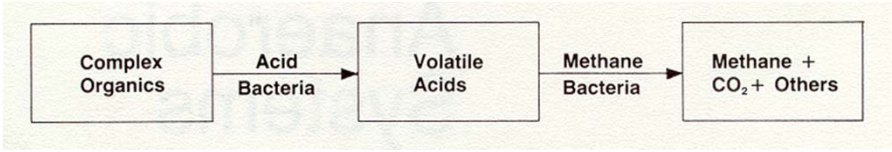
Anaerobic Digesters

- Low Rate (BVF) 8 day HRT
  - Heyburn, ID (given to the city of Burley)
  - Caldwell, ID
  - Portage la Prairie, Manitoba
  - Moses Lake, WA
  - Grand Forks, ND (under construction)
- Medium Rate (ACB) 2-3 day HRT
  - Hermiston, OR (facility closed)
- High Rate (Biothane) 8 hour HRT
  - Aberdeen, ID

Anaerobic Digesters

- Low rate (BVF) 90% COD removal, 50-70% TSS removal, 80% conversion of TKN to ammonia
- High rate(Biothane) 80% COD removal, net gain of TSS of 10%, 70% convernsion of TKN to ammonia

Anaerobic Digesters



Complex Carbohydrates (17%)
- Starches
- Sugars

Proteins (2%)
- Sources of nitrogen & sulfur

Fats (0.1%)
Fiber & Ash (1.4%)
Water (79.5%)

Add buffer to control pH, usually with magnesium hydroxide or sodium hydroxide

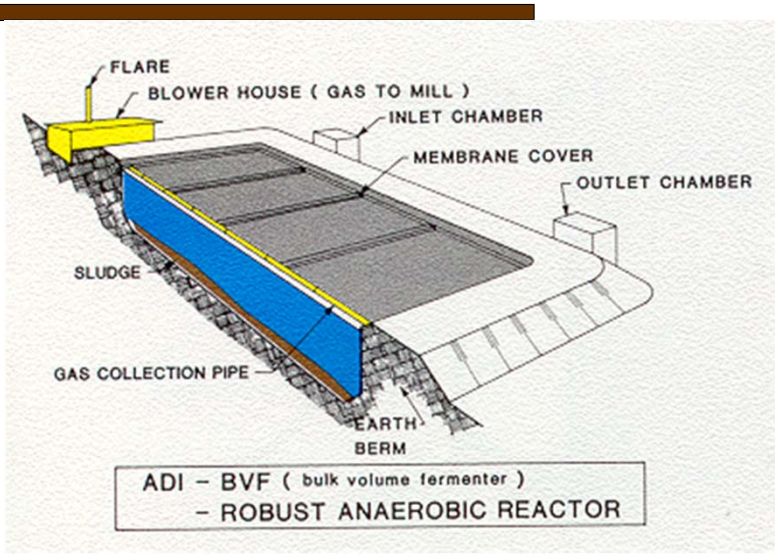
Impurities in gas include:
- Hydrogen sulfide at ~2500-4500 ppmv
- Air (oxygen & nitrogen)

Impurities in liquid include:
- Hydrogen sulfide & sulfide Ions, ammonia, phosphates and total dissolved salts

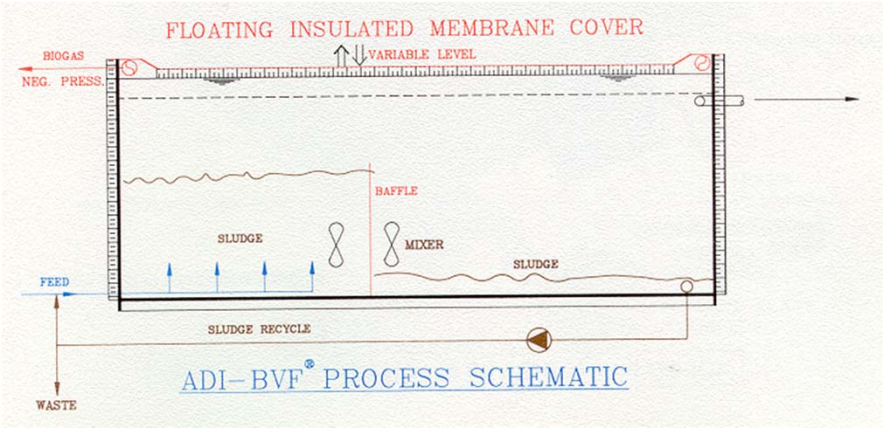
Anaerobic Digesters

- Operating conditions
  - 85-100 ºF, 6.8-7.1 pH
- Nutrients/impurities
  - TKN ~120 mg/l, influent NH_3-N ~25 mg/l, effluent NH_3-N ~100 mg/l
  - Total Phosphorus ~35 mg/l, effluent ortho-P (phosphate) ~30 mg/l, but suspect poly phosphates
  - Total Sulfur ~100 mg/l as sulfate, 30% additional sulfur from potato, about 50% to biogas – 50% in wastewater as sulfides & un-ionized hydrogen sulfide
  - Total Dissolved Salts - ~1100 mg/l, add MgOH

Anaerobic Digesters



Anaerobic Digesters



Anaerobic Digesters

Potato, alcohol – Idaho, USA

Sustainable Simplot
Bringing Earth's Resources to Life

Anaerobic Digesters

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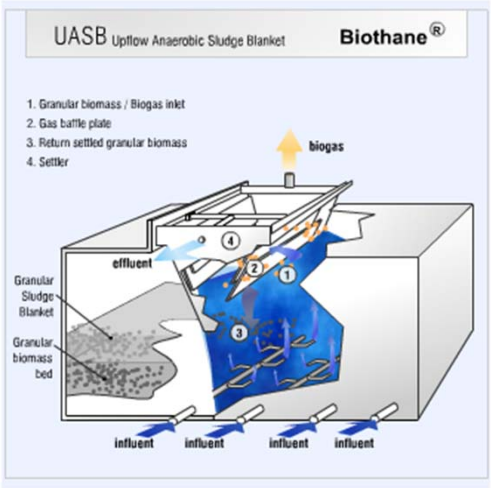
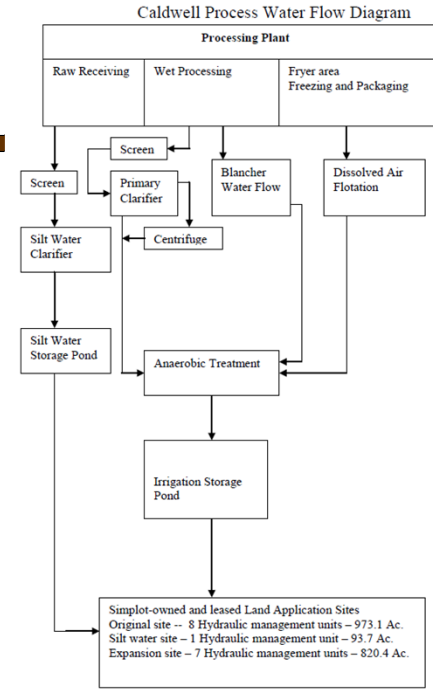


Anaerobic Digesters



Anaerobic Digesters

$(C_6 H_{12} O_6)_n \rightarrow 3n\ CH_4 + 3n\ CO_2$

Starch — Methane — Carbon Dioxide

1 lb = ~5 scf

Anaerobic Digester Biogas Production - Design

Facility	Wastewater							Biogas Production from Digester				
	Flow	COD digester efficiency	COD digester influent		COD digester effluent		COD digester reduction	Methane		Biogas	Production days per year	Biogas
	mgd	%	mg/l	lbs/day	mg/l	lbs/day	lbs/day	cu.ft./day	% of biogas	cu.ft./day		cu.ft./yr
Caldwell, ID	2.00	86	3000	50,040	420	7,006	43,034	215,172	60	358,620	300	107,586,000
Aberdeen, ID	0.70	84	3000	17,514	480	2,802	14,712	73,559	65	113,167	300	33,950,215
Moses Lake, WA	2.05	86	2727	46,624	382	6,527	40,096	200,481	60	334,135	300	100,240,566
Portage la Prairie, MB	1.29	86	5461	58,753	765	8,225	50,527	252,637	60	421,061	300	126,318,336

Biogas Production

- For Caldwell, 100 MM Btu/hr boiler for steam requirements, 70% average utilization = 70 MM Btu/hr average use
- Caldwell biogas production, at design, is 215,172 cu.ft./day methane, or 8,965 cu.ft./hr methane
- Methane contains about 1000 Btu/cu.ft.
- Heat content of methane from biogas is 8.966 MM Btu/hr
- Biogas can make up to 12.8% of typical boiler fuel use for a potato plant

Greenhouse Gas Reporting

- 40 CFR 98.350 Subpart II, Industrial Wastewater Treatment
- Meet the 40 CFR 98.2(a)(2) threshold of 25,000 metric ton CO2 equivalent for all combustion sources
- Anaerobic Process within a facility includes:
  - An anaerobic reactor
  - An anaerobic lagoon, either covered or uncovered
- Reporting requirements – Methane generation/emissions/recovered for each reactor or lagoon, Wastewater COD & flow, methane calculations

Greenhouse Gas Reporting

- Measurements
  - Flow rate of wastewater to anaerobic treatment process - weekly
  - COD of wastewater to anaerobic treatment process – weekly
  - Biogas flow continuously, STP compensated, moisture content
  - Biogas methane content, weekly

Greenhouse Gas Reporting

- Reporting
  - Monitoring must begin January 1, 2011
  - First reports to EPA are due on March 31, 2012 and annually thereafter
- Read 40 CFR 98.350 very carefully
  - Calibration requirements
  - Method requirements

Carbon Credits - Voluntary Carbon Standard

- Eliminate methane emissions from uncovered anaerobic ponds
  - Convert methane into biogenic CO2 resulting in direction emission reduction – Methane = 21 times CO2e
- Directed methane to boiler to displace natural gas usage
- Emission reductions calculated in accordance with UNFCCC Clean Development Mechanism (CDM) methodology number ACM0014, “Mitigation of greenhouse gas emissions from treatment of industrial wastewater”

Carbon Credits - Voluntary Carbon Standard

- Not subject to any federal, state or local laws or regulations – project was voluntary
- Must Validate and Verify project through third party, includes enhanced monitoring
- Results
  - 18,000 tonnes CO2e reduction per year
  - Blue Source marketing Carbon Credits for Simplot
  - Large portion of revenue from 2008 to 2012 sold – gross revenue to date $320,000

Carbon Credits - Voluntary Carbon Standard

- Lessons Learned
  - Methodology has specific requirements that must be met even instances that do not make sense
  - Additionality must be addressed early on – mention credits early in project development
  - Monitoring and recordkeeping requirements are above what a facility traditionally monitors

Other Regulatory Issues

- Toxic Release Inventory
  - Usually requires reporting for ammonia
  - Hydrogen sulfide expected to be taken off the "stayed chemicals" list
- Air Regulations – NAAQS 1-hour standard
  - NO_x – NO_2
  - SO_2