Anaerobic Digestion for Energetic Utilization of Organic Wastes & Residues from Food and Beverage Industry

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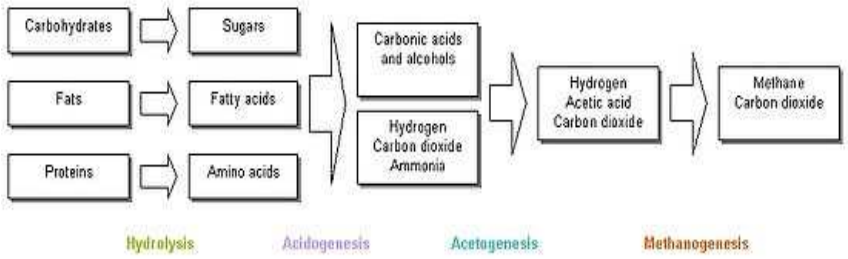
Outline

- Introduction – basics of AD
- AD in food processing industry overview
- Examples: Breweries, Abattoirs...
- Advantages & Disadvantages
- Conclusions

Anaerobic Digestion Process

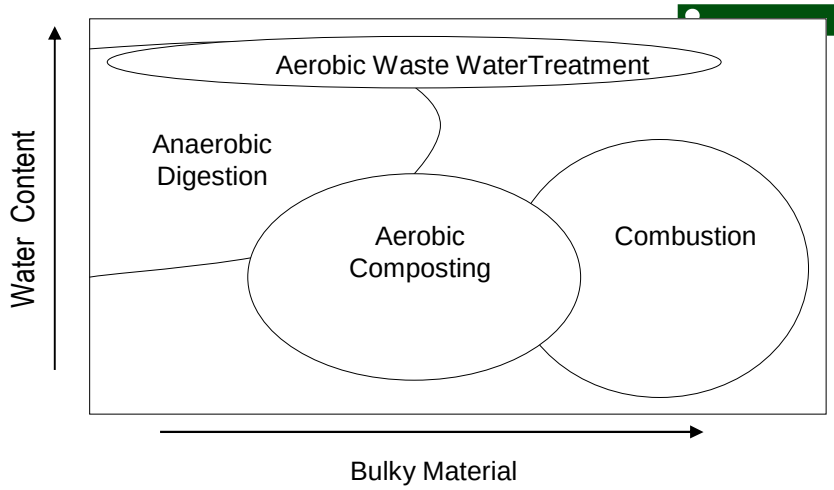


Mesophilic (30-40℃) or Thermophilic (45-55℃)

Typical composition of biogas =>

Matter	%
Methane, CH_4	50–75
Carbon dioxide, CO_2	25–50
Nitrogen, N_2	0–10
Hydrogen, H_2	0–1
Hydrogen sulfide, H_2S	0–3
Oxygen, O_2	0–2

How does my organic waste look like?



Potential substrates for AD – food and bewerage industry residues in Austria (Braun 2007)

Waste	t / Year[1)]	Suitable for AD	Available
Wastes from Food- and Luxury Food Products	538.180	538.180	240.000
Wastes from Vegetable and Animal Fat Products	146.072	146.072	73.000
Wastes from Animal Breeding and Slaughtering	670.000	445.000	225.000
Skin and Leather wastes	127.225	40.000	20.000
Waste Wood	4.021.625	0	-
Cellulose-, Paper- and Cardboard Wastes	1.412.238	0	-
Other Wastes from Processing / Conditioning of Animal and vegetable Products	75.377	75.377	35.000

Potential in the food processing industry

- Dairies
- Beverage industry
- Distillery
- Sugar industry
- Starch industry
- Brewery
- Abattoir
- ….

@1: Energy potential of several residues at a 100.000 hl/a brewery

Substrate	Gas yield [m³ CH_4/t FM]	Gas potential [m³ CH_4/a]
Brewers spent grains	80	160.000
Malt powder	400	6.000
Yeast	60	13.800
Wastewater	0,35 m³ CH_4/kg CSB	28.000

~210.000 m³ CH_4 or 2,1 Mio. kWh

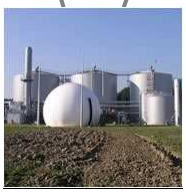
Substitution of energy demand in breweries

26,8 kWh/hl SB

~~~~80%

9,9 kWh/hl SB

~80%



21,0 kWh/hl SB
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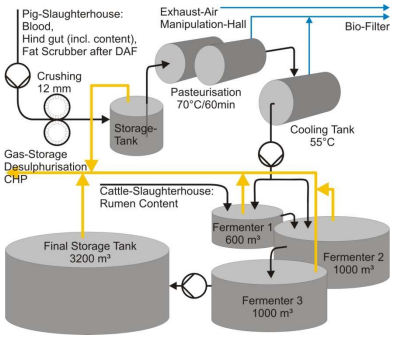
@2: Pig Abattoir, Austria

- Slaughterhouse Grossfurtner (biggest abattoir in Austria)
- 10.000 pigs/week
- Disposal material ~ 150 - 200m³/week (cost factor 50-70€/t)
- Implementation Biogas plant (2003)
  - First worldwide using slaughterhouse waste only
- Beside AD: geothermal power plant



Energetic Self sufficiency Abattoir

	2006	2007	2008	2009*	*Maximum potential*
Energy Demand	MWh	MWh	MWh	MWh	*MWh*
Electricity	5,101	5,556	5,828	6,120	*6,120*
Natural gas	3,051	2,972	2,873	2,079	*2,079*
Thermal Power (AD-plant)	1,091	871	1,241	1,900	*3,802*
Thermal power (geothermal)	921	1,092	1,143	1,562	*0*
Annual Demand	10,164	10,491	11,085	11,661	*12,001*
Green energy production	MWh	MWh	MWh	MWh	*MWh*
Electricity (AD-Plant)	1,389	1,401	*1,257*	*2,166*	*5,069*
Thermal Power (AD-plant)	1,091	871	*1,241*	*1,900*	*3,802*
Thermal power (geothermal)	921	1,092	*1,143*	*1,562*	*0*
Annual production	3,401	3,364	3,641	5,628	*8,871*
Degree of self sufficiency	33%	32%	33%	48%	*74%*

@3: Biogas plant Kaposvár – Hungary, Magyar Cukor

- Substrate: Residues from sugar production
- Capacity: 860 t/d
- Biogas production: 160.000 m³/d
- Energy production: ca.60% of energy demand

→ 2012 extention up to 95-100% of process energy demand

© Planungsbüro - BPE Dr. Prendl

Source: Agrana eröffnet einzigartige Biogasanlage in Kaposvár [http://www.alsa.at/chemiereport/stories/6913/]

@4: Biogas plant Wels – Dairy Landfrisch

- Substrates: whey and wastewater
- Capacity:

  180 t/d whey, 180 t/d wash water
- Biogas production: ca. 6.000 m³/d
- Energy production:

→ 40% of heat demand covered by CHP waste heat (580 kW)

→ Electricity (500 kW)

© AAT / Landfrisch

Source: www.klimaaktiv.at/filemanager/download/18743/

Anaerobic digestion in FBI

- Advantages
  - Utilization of mostly all organic residues
  - Covering of energy demand by own wastes
  - Optimal use of waste heat from CHP unit
- Disadvantages
  - Possible longer retention time needed (holocellulose content)
  - Possible competition (e.g. animal feedstock)
  - Effluent / digestate utilization/treatment
- Mostly necessary
  - Pre-treatment of substrates (+ e.g. nitrogen removal, additives)
  - Adaptation of process engineering, monitoring
  - Buffer tank system and recuperation network

Do you know the answers?

- How much do you pay for energies?
- What are your real needs?
- What are your waste, residues and by-products streams?
- How much do you pay for your organic waste disposal / treatment?
- Do you want to be more energy independent?
- Do you want efficient utilize your available resources?
- What alternatives do you have?

Conclusions

- AD in the food industry is an alternative pathway
- Industry specific process engineering for AD
- Covering of process heat and electricity demand up to 100%
- Substitution of fossil fuels / reducing of carbon footprint
- Reduction of energy and waste disposal costs
- Higher energetic independency
- **The aim should be an efficient utilization of own organic residues and available resources => looking for smart combinations and clever solutions**

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Other useful links:
www.codigestion.com
www.bioenergy2020.eu
www.iea-biogas.net

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