Anaerobic Digestion
-
Pathogens and Pasteurisation of Digestate

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BIOENERGY ASSOCIATION

BIOENERGY AUSTRALIA
FUEL | GAS | HEAT | POWER

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AGENDA

Who we are

Reference in Victoria

Pathogens & Pasteurisation of Digestate

Technology

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Who we are

- Established 1970
- Queensland based company with offices in Ipswich, Melbourne and Sydney
- Water and waste water industry
- Turn key projects
- First project in New Zealand in 1989

Alexander Vogelsang

- Ma. Sc. Process Engineer
  Focus on Energy from biomass and waste
- Working in the biogas industry since 2014
- Technical Design of Anaerobic Digestion plants
- Technical Consultancy for project development
- Operations assistance for Aurora Waste to Energy Facility, Melbourne

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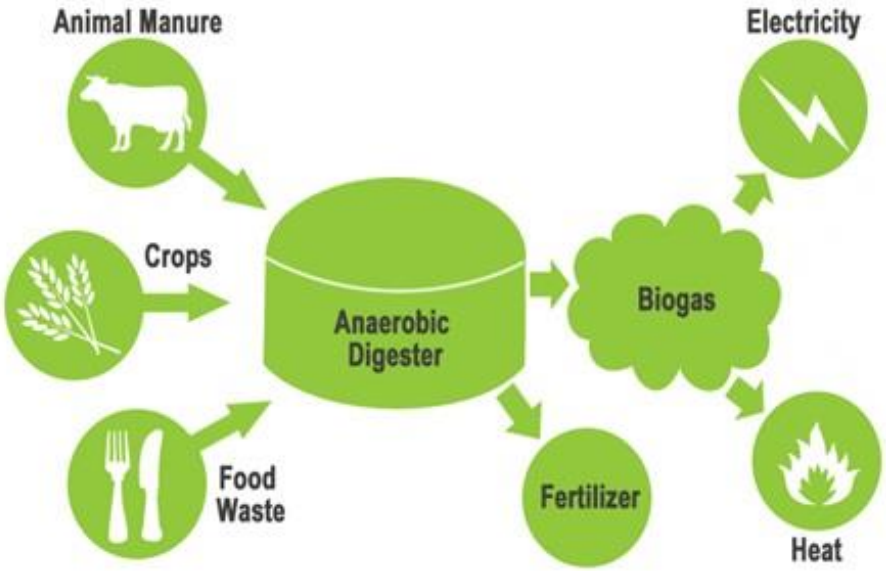
What is Anaerobic Digestion?



- Natural/Biological process
- mesophilic condition approx. 37°C
- Anaerobic = without oxygen
- Self-governing as it is unable to work if there are contamination entering the system
- “What goes in, what comes out”

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Reference Plant Melbourne

[Waste to Energy Wollert: https://youtu.be/n38znRmlQiA](https://youtu.be/n38znRmlQiA)

Aurora, Australia

December 2016

2x 530 kW

Leftovers from cafe and restaurants, grease trap waste, dairy residues, fruit & vegetable waste

5 x pre-storage
2 x digester
1 x digestate storage

The plant belongs to the water utility company Yarra Valley Water, which uses the energy to supply its wastewater treatment plant and sell surplus electricity.

Yarra Valley Water

WELTEC BIOPOWER

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Organic Substrates for Anaerobic Digestion

Experience with different substrates, e.g.

- Restaurant / café waste
- Food faulty batches
- Leftovers from supermarkets
- Grease trap waste
- Pulped Food waste
- Slaughterhouse waste
- Coffee grounds
- Dairy by-products

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Why Pasteurisation?

- Substrates can include unwanted impurities
  - Physical (e.g. metal, wood, plastic,…)
  - Chemical (heavy metals, organic pollutants,…)
  - Biological (bacteria, viruses, seeds,…)
- Minimising risk of transmitting biological impurities if digestate is used as a fertiliser

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Substrate selection

- Substrate selection vitally important for quality control of digestate
- Positive list has been developed in some countries to identify suitable substrates for AD
- Specific regulation e.g. “animal by-product regulations”

Example of animal by-products suitable for AD	Required Pasteurisation
Raw Milk waste	No
Manure	No
Meat-containing waste from foodstuff-industry	Yes
Slaughterhouse wastes from animals for for human consumption	Yes

https://ec.europa.eu/food/safety/animal-by-products_en

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Pasteurisation

Definition:

Process step during which the numbers of
PATHOGENIC BACTERIA, VIRUSES AND OTHER HARMFUL ORGANISMS
in material undergoing AD are significantly
REDUCED or *ELIMINATED*
by heating the material to a
CRITICAL TEMPERATURE for a minimum specified period of TIME

Note:

- Pasteurisation does not aim to achieve sterilisation which destroys all life forms.
- Pasteurised material might contain beneficial and other non harmful microorganisms.

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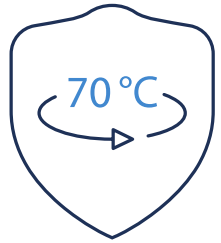
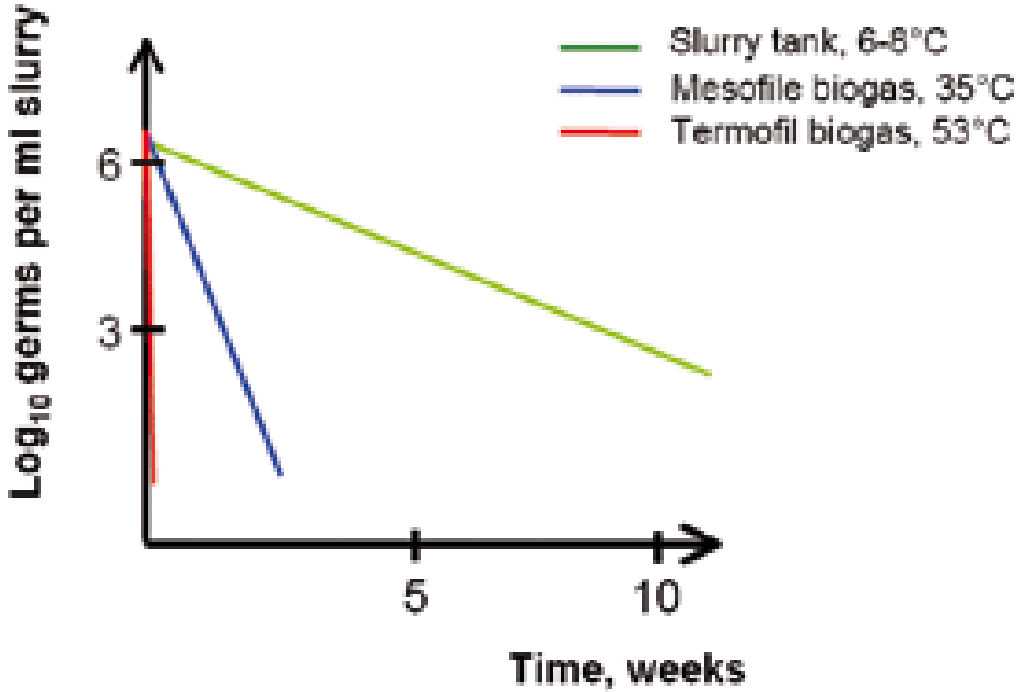
Pasteurisation





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Pasteurisation

Bacteria	AD system		Untreated slurry system	
	53°C hours	35°C days	18-21°C weeks	6-15°C weeks
Salmonella typhimurium	0.7	2.4	2.0	5.9
Salmonella dublin	0.6	2.1	–	–
Escherichiacoli	0.4	1.8	2.0	8.8
Staphylococcus aureus	0.5	0.9	0.9	7.1
Mycobacterium paratuberculosis	0.7	6.0	–	–
Coliform bacteria	–	3.1	2.1	9.3
Group D Streptococci	–	7.1	5.7	21.4
Streptococcus faecalis	1.0	2.0	–	–

* Destruction of 90% of the pathogens

Al Seadi, T., & Lukehurst, C. (2012, May). Quality management of digestate from biogas plants used as fertiliser.

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Pasteurisation

Survival of weed seeds (% germination) after mesophilic AD expressed in number of days (d) at 37°C

Plant species	2d	4d	7d	11d	22d
Brassica Napus (Oil Seed Rape)	1	0	0	0	0
Avena fatua (Wild Oat)	0	0	0	0	0
Sinapsis arvensis (Charlock)	0	0	0	0	0
Fallopian convolvulus (Bindweed)	7	2	2	0	0
Amzinckia micranta (Common Fiddleneck)	1	0	0	0	0

Al Seadi, T., & Lukehurst, C. (2012, May). Quality management of digestate from biogas plants used as fertiliser.

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Quality Requirements

	Guidelines for Beneficial use of Organic Materials Grade A	PAS 110	Test result 1h @ 70C
E.coli	<100 MPN/g	<1,000 CFU/g fresh material	<100 CFU
Salmonella	<2 MPN/g	Absent in 25g fresh material	Absent in 25g fresh material
Campylobacter	< 1/25g	-	-
Human adenovirus	< 1PFU/0.25g	-	-
Helminth ova	< ¼ g	-	-

MPN = Most Probable Number
CFU = Colony Forming Unit for BACTERIA
PFU = Plaque-Forming Unit for VIRUS
1MPN=1CFU

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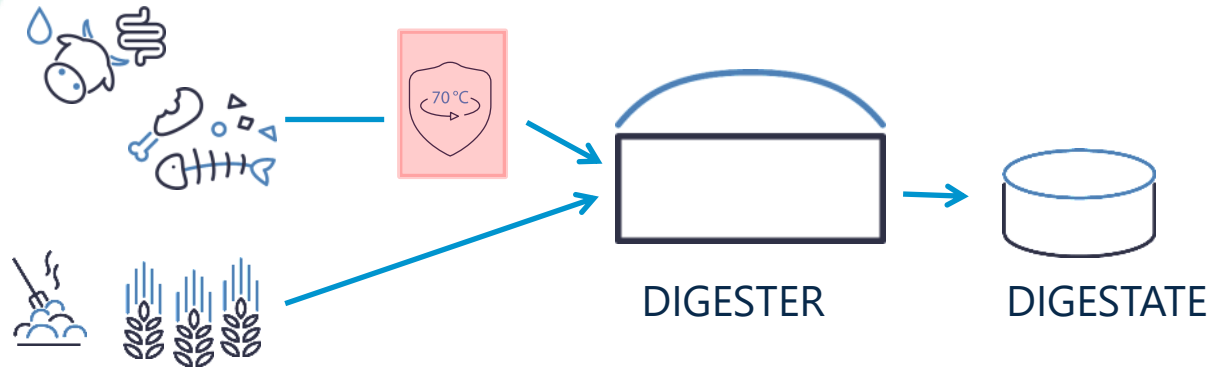
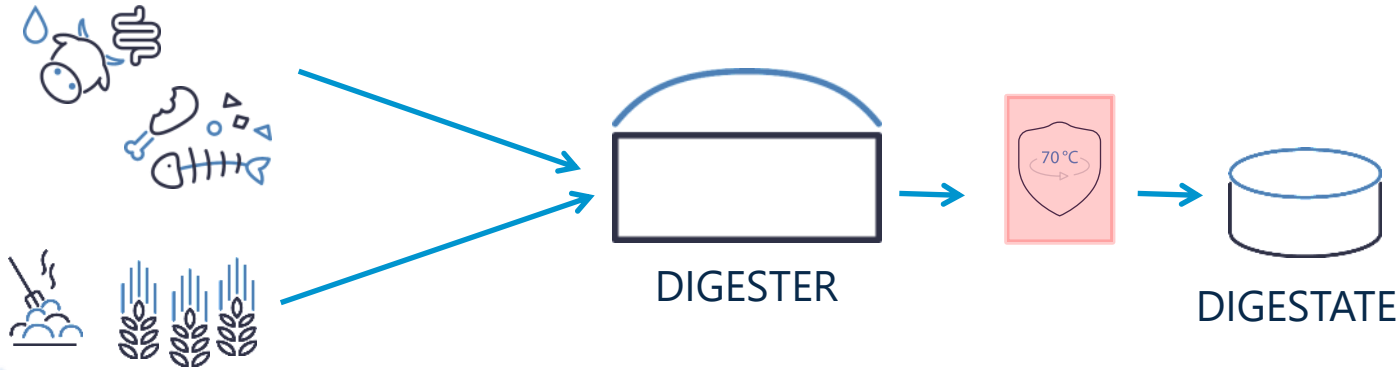
COMPARISON PRE AND POST PASTEURISATION





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COMPARISON PRE AND POST PASTEURISATION

PRE	POST
+ Less material/volume to pasteurize	+ separated process step
+ More excess heat available	+ Less limitation for substrate input
+ Heat can be utilized for digestion process	+ Easier to operate and maintain
- Some beneficial bacteria might be reduced	- Increased heat demand
- Feeding and pasteurization linked	- Additional equipment needed e.g. second heat exchanger to cool digestate
- Additional pre-treatment needed	

Technology

WELTEC BIOPOWER

tank 1					
Start time	starting temp.	starting weight	End time	min. temperature	amount
2018-07-09-10:15:2	71.5	4.5	2018-07-09-10:16:4	70.0	4.5
2018-07-09-13:19:5	71.5	4.5	2018-07-09-13:20:5	70.0	4.5

- Separate pipe connection before and after process to avoid any exchange of material
- all substrates will be pasteurized prior transfer to digestate storage
- Process: 1h @ >70°C
- Reduction of pathogenic microbes for agricultural land application
- Record for each digestate batch is available from SCADA

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Thank you

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