Start-up of a Biogas Plant

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London, Ontario
February 28, 2011

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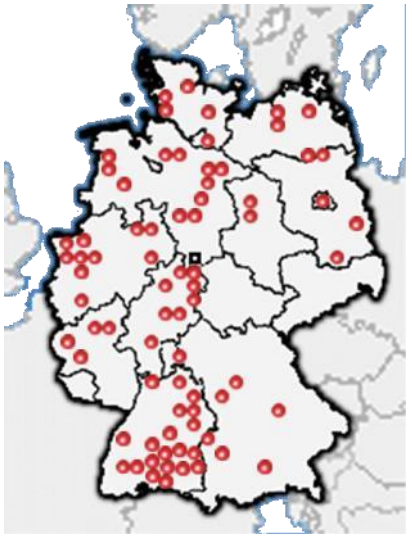
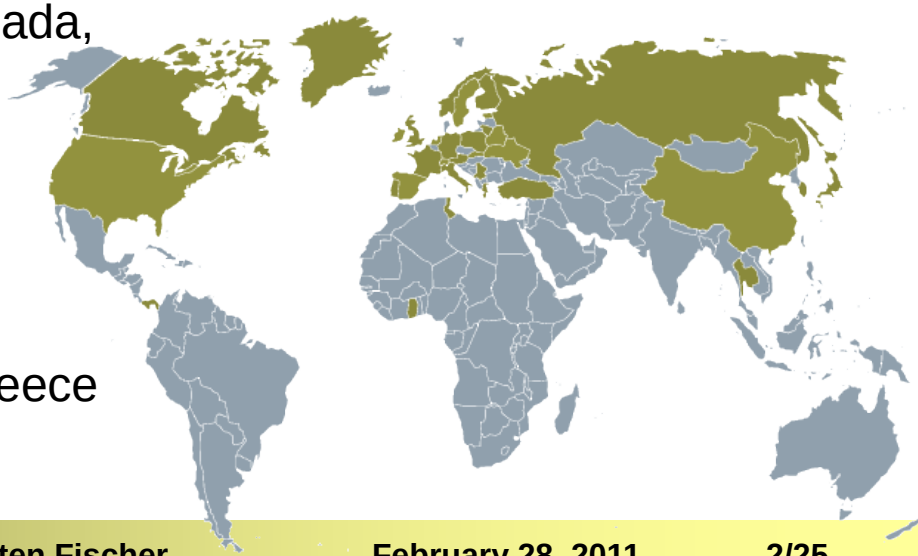


Engineering Office, specialized in Design and Engineering of Biogas Plants

Foundation:	1999
Team:	23
Experience:	> 25 years
References:	ca. 150 biogas plants
in:	Germany, Japan, Netherlands, Austria, Switzerland, Lithuania, Italy, Slovakia, Canada, USA, Spain, France, Ireland
Partner:	Japan, Korea, USA, Canada, Bulgaria, France, Hungary, Turkey, Poland, Italy Spain, Ireland, Serbia and Greece



Service offerings of Krieg & Fischer in the field of Biogas

- Studies
- Concept Development
- Calculations
- Permits & Approvals
- Engineering
- Tendering and Commissioning
- Construction
- Start-up
- Optimization/Retrofits
- Supervision and Consulting

References worldwide

Cudworth Pork

Prince Edward Island

Tottori

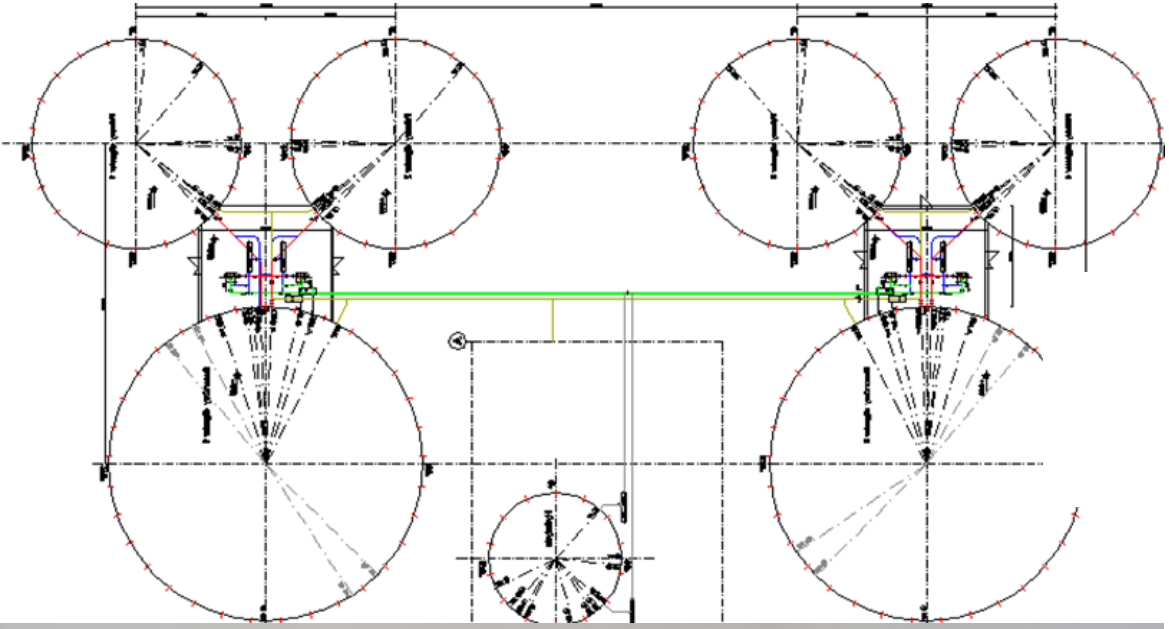
Inland Empire

Prato

Montargull

Noyon

Kensington, Prince Edward Island, Canada



- Built: 2008
- Substrate: potato residues, oil, potato, starch
- Digester: 4 x 5,500 m³, steel tank
- Size: 12 MW_{th}
- 2 stage digestion with hydrolysis,
  2 secondary digesters with gas holder roof
- Biogas is used for heating purposes – hot water production

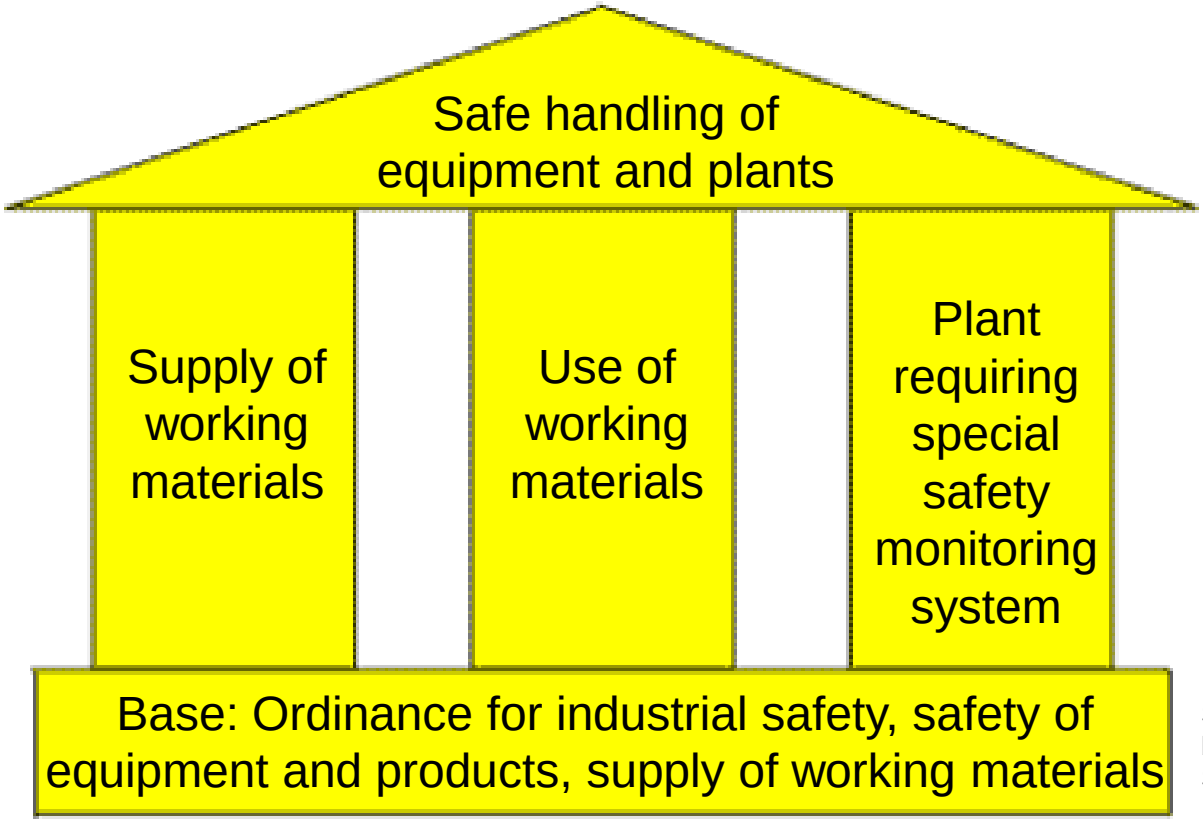
Start-up

All investment is done, but no income from selling energy has yet been generated

Aim: Full load in a preferably short period of time

Start-up too fast	→ digester acidification and collapse of biogas production
Start-up too slow	→ reduced income

German ordinance on Industrial Safety and Health (BetrSichV)



Source: http://www.umweltschutz-bw.de/images/Recht/BetrSichV_3_Saeulen.gif

Aim of BetrSichV:

More individual responsibility and more flexibility in operation

Start-up

- formal aspects
- insurance aspects
- organizational aspects
- functional aspects

Start-up: formal aspects

- Documentation of the biogas plant must be on site.
- The operator has to be instructed before.
- Who is the owner of the biogas plant during the period of start-up? And who performs the start-up?
  (EPC-contractor /general contractor or legal owner/engineering company)
- Who bears the risk?
  (Risk transfer planner EPC-contractor /general contractor or legal owner/engineering company to operator)
- Full commissioning by local authorities not yet possible.
- Obedience to the safety rules.

Start-up: formal aspects; safety rules

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Safety Rules for Biogas Systems

German Agricultural Occupational Health and Safety Agency

This is a translation from the original German version entitled "Technische Information 4 Sicherheitsregeln für Biogasanlagen". Every effort has been made to make it as accurate as possible, but the original German version should be the authoritative source.

German Agricultural Occupational Health and Safety Agency

Appendix 1

Operating Instructions for Initial Startup/Restart of a Biogas System

Sample

The initial startup of a biogas system is a special operating state, which requires special actions. The EX-zones, specified in the Explosion Protection Document, consider the operating state based on various conditions. Therefore, these particular hazards are considered separately in the operating instructions.

1. During the initial startup, a hazardous, potentially explosive atmosphere can occur in the gas space of the digester container. Ignition sources (see, for example, Section 1.4.4) must be avoided (e.g., operate the agitator submerged).
2. The empty digesters are initially blocked from the gas collection system.
3. The digesters are connected to the atmosphere via the operationally ready overpressure protector and the exhaust lines.
4. The digesters are filled within a short time period with substrate that is as active as possible, until all inlets and outlets (liquid valve closure disks) are sealed with substrate.
5. The fermentation substrate is heated.
6. During the startup/heating of the system, the system must not be fed further.
7. The gas generated during the starting of the digestion process discharges via the exhaust line (gas overpressure protection) into the open air, and displaces the air that is present in the digester.
8. After testing the gas quality, biogas fills into the gas system and the gas storage. The gas quality is sufficient and there is not explosion hazard if the methane content of the gas is greater than 30% and the oxygen content is < 3%.
9. The CHP units are turned on. They automatically suction the gas from the gas storage. Sufficient biogas quality can be determined by gas measurement.
10. All safety equipment must be checked for the proper function.

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Start-up: formal aspects; safety rules

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The digesters are connected to the atmosphere via the operationally ready overpressure protector…

The gas generated during the starting of the digestion process discharges via the exhaust line (gas overpressure protection) …

All safety equipment must be checked for the proper function

Start-up: insurance aspects

- Documentation of the biogas plant has to be on site
- The operator have to be instructed
- Lightning protection
  - there are no explicit directives
- Commissioning tests have to be passed
- Full commissioning by local authorities not yet possible

Start-up: organizational aspects

- Organization of inoculum as seeding material
- Heating of the digester
- Test of leak tightness of the tanks
- Safety device
  - Depending on building material (steel/concrete)
  - Depending on gas holder
- Desulphurization

Start-up: functional aspects

- The construction of the plant is finished.
- All tanks are leak tested, equipped with all instrumentation and are insulated.
- All piping and valves connected with the digesters are leak tested and tested for free flow.
- Motors for pumps and other driven equipment items are tested and functional.

Start-up: functional aspects

To be tested and positive in function:

- heating system
- substrate system (mixers, grinders, pumps, valves, pipe work…)
- gas system
- instrumentation system (pressure relief…)
- electrical system
- condensate trap
- emergency flare

Start-up: functional aspects

- A heating source is needed to heat the digester. (as CHP is not working yet)

- The inoculum should be adapted to the input substrate:
  1. Inoculum from a biogas plant using the same substrate
  2. Inoculum from another biogas plant
  3. Cattle manure (old manure is most suitable)
  4. Other manure
  5. Sewage sludge from a sewage plant

Start-up: functional aspects

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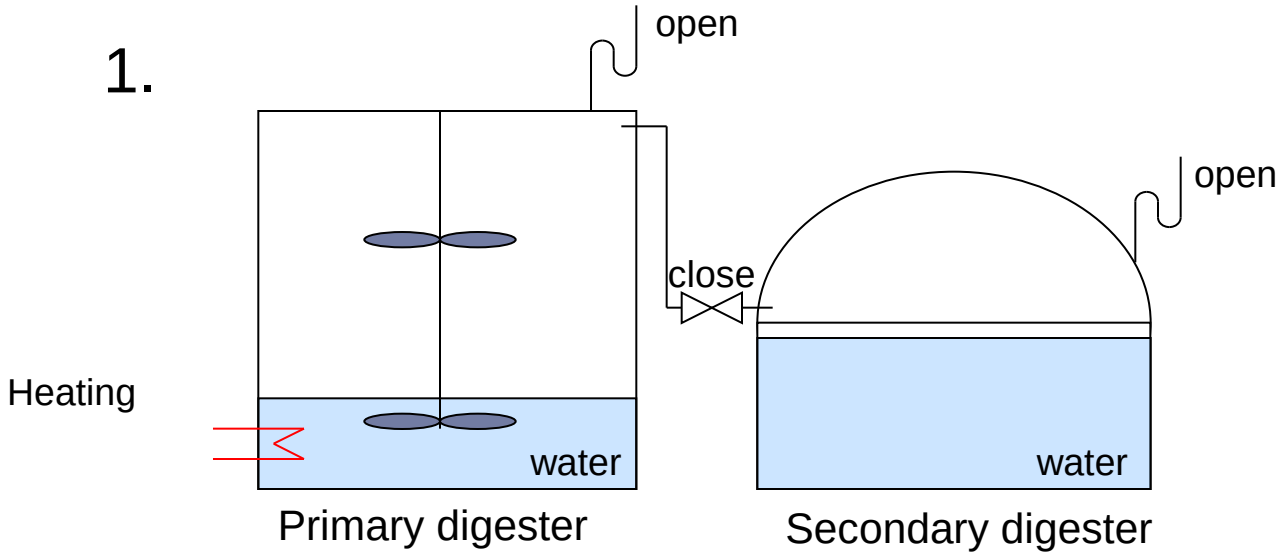
The inoculum has to fulfil some criteria:

- pH value 7.5 – 8.0
- IA/PA value < 0.3
  (IA: intermediate alkalinity,
  PA: partial alkalinity)

- Low acetic acids < 1,000 mg/l
- Low heavy metals content
- No trash, no impurities

Stages of Start-up

1.



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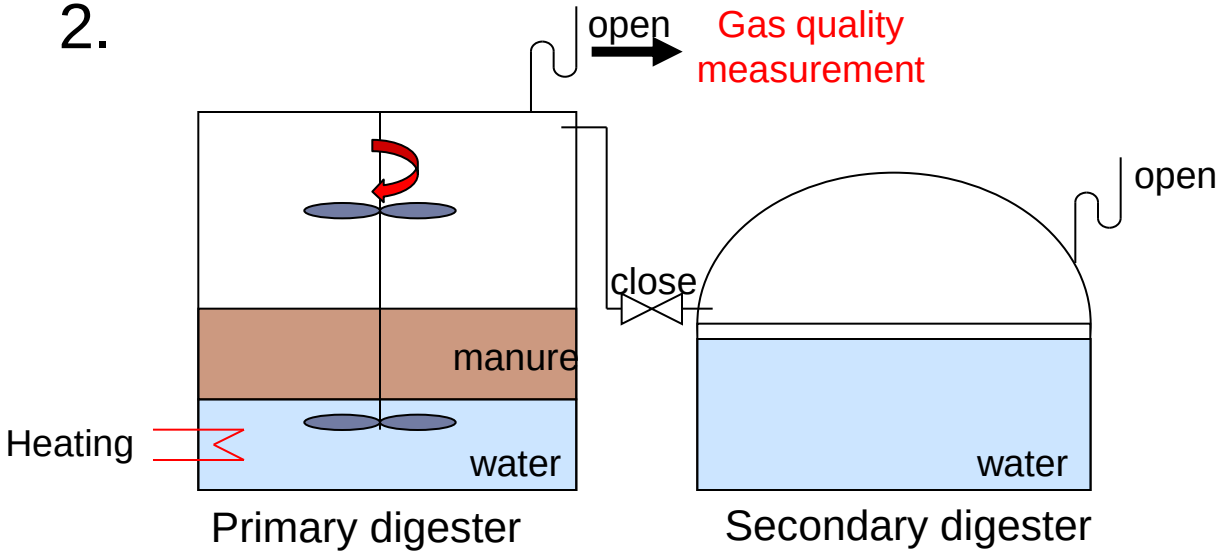

Stages of Start-up

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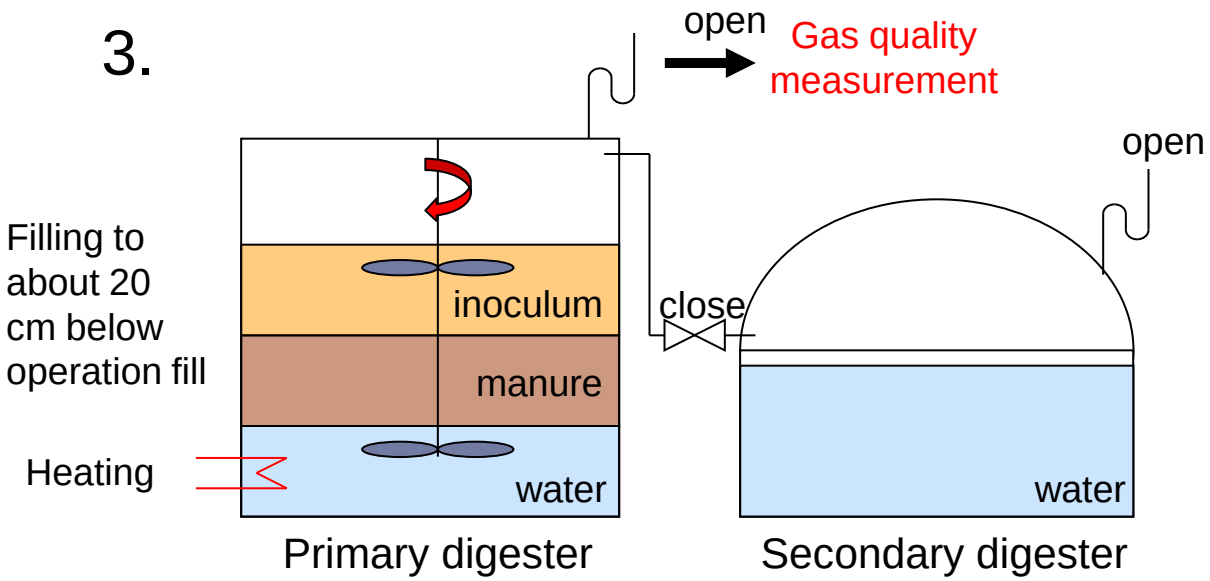
3.



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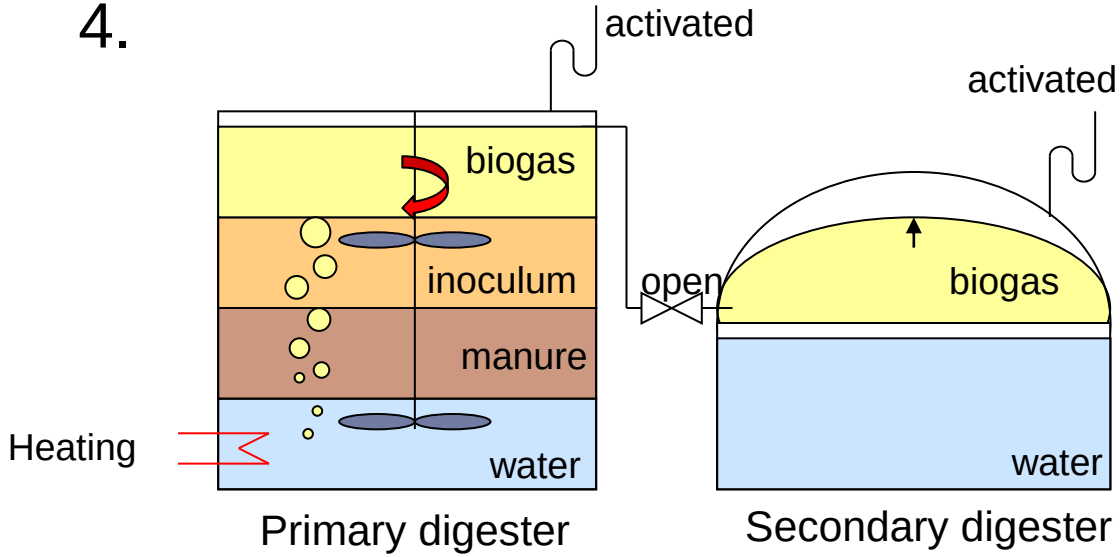

Stages of Start-up

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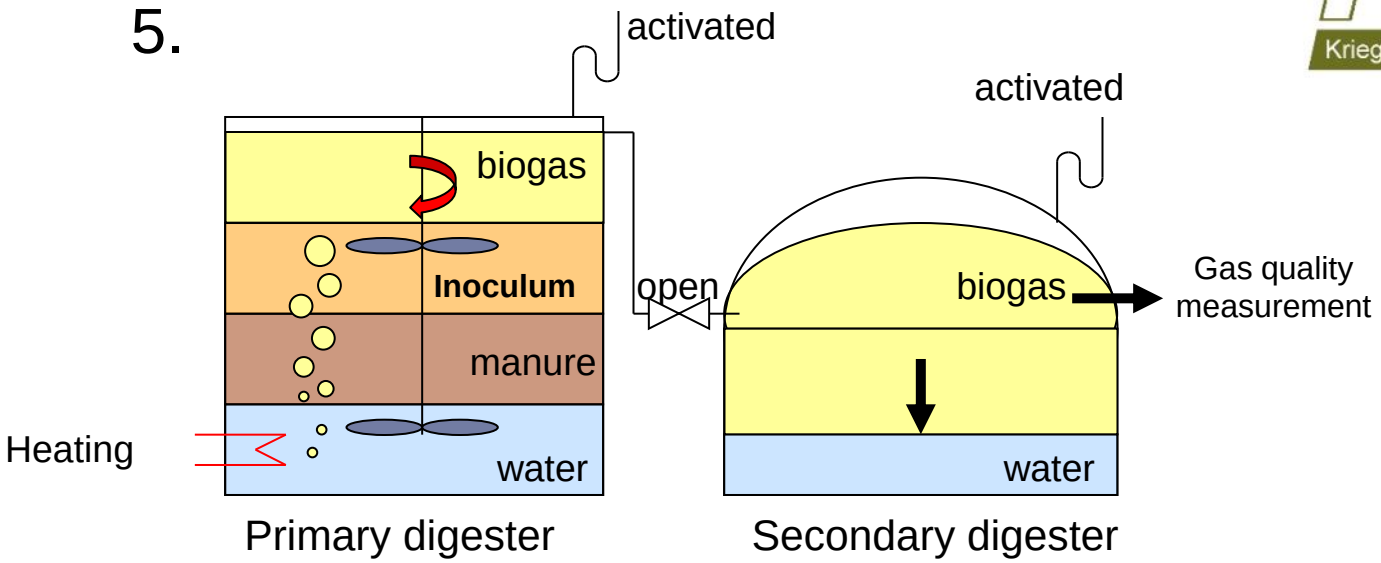

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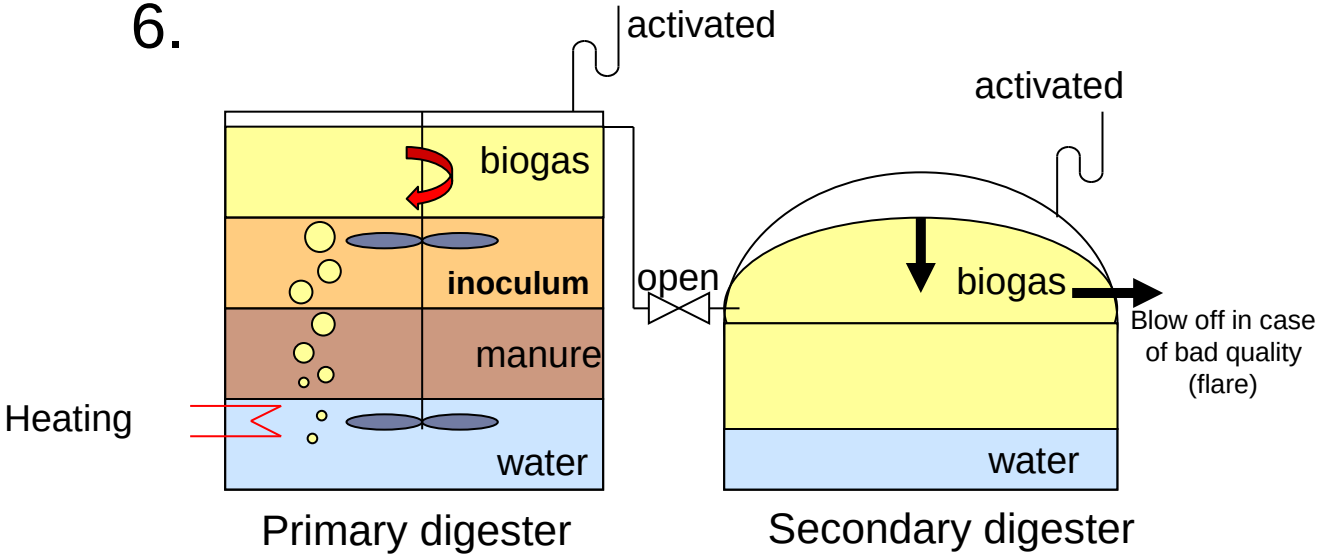

Stages of Start-up

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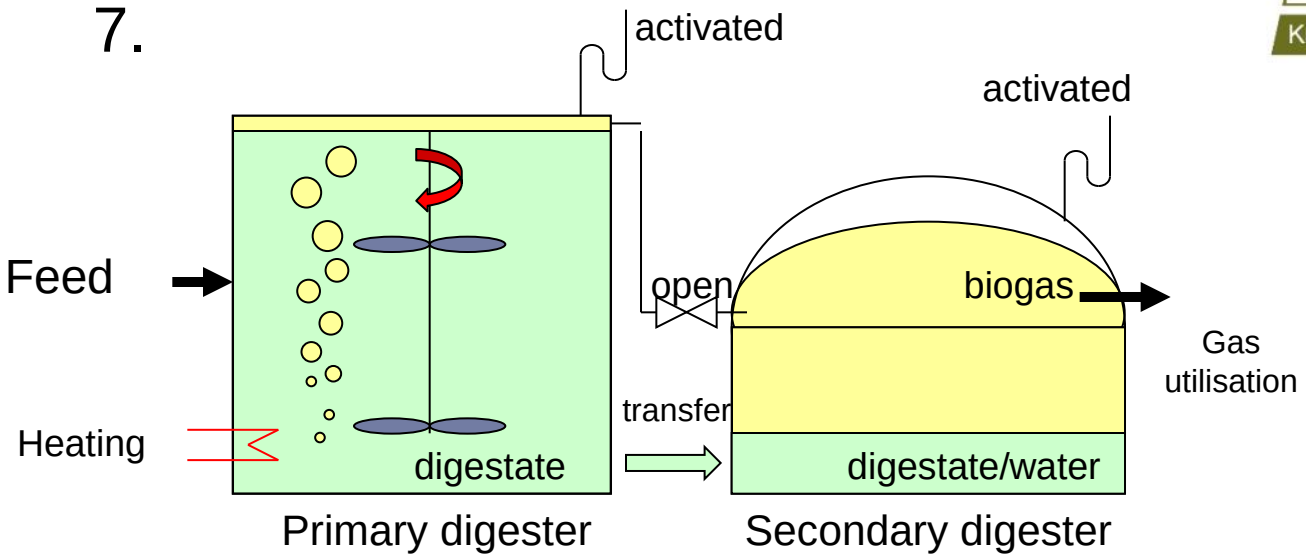

- Desulphurization with iron salt, no addition of oxygen
- Keep the volume of gas as small as possible to accelerate the production of biogas with good quality
- Temperature increase with 3-4 K per day

Stages of Start-up (flat digester)

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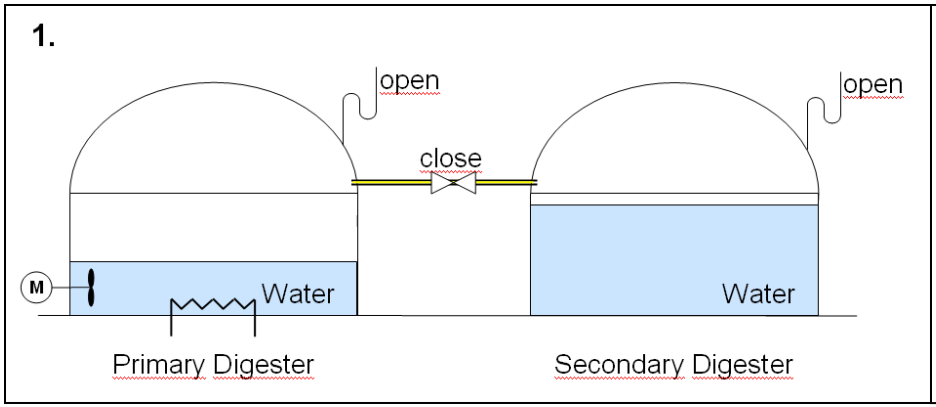

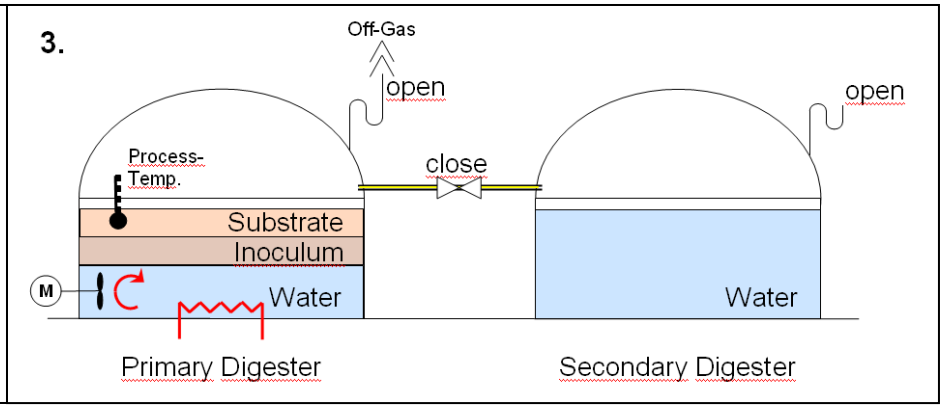

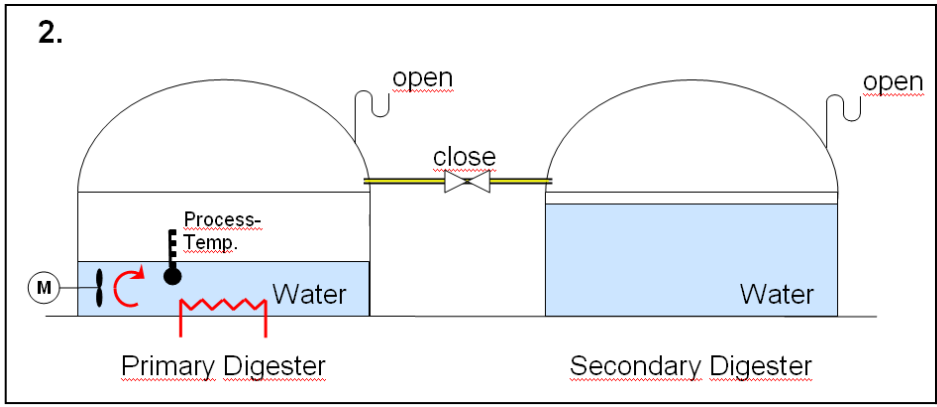

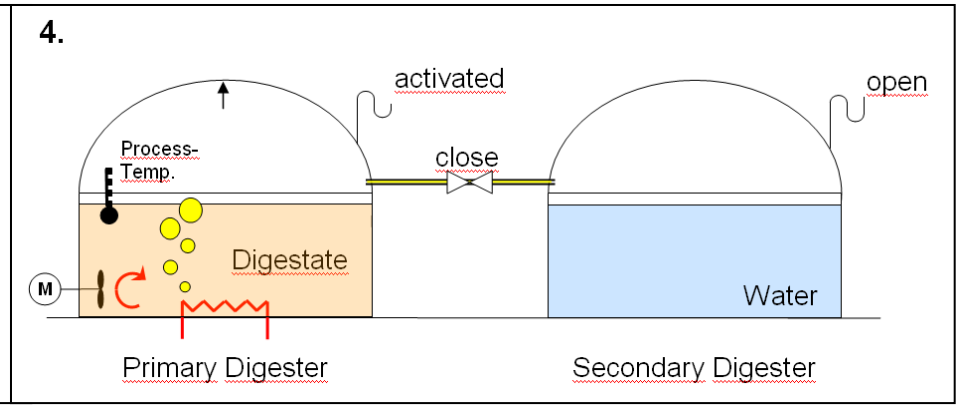

Stages of Start-up (flat digester)

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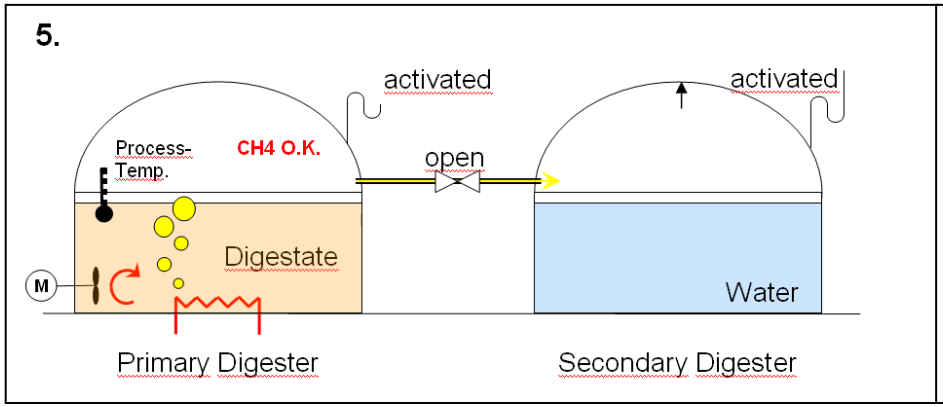

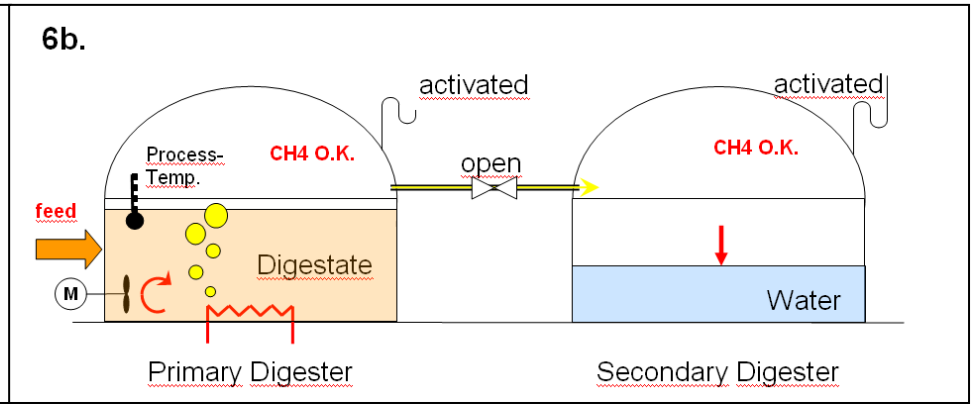

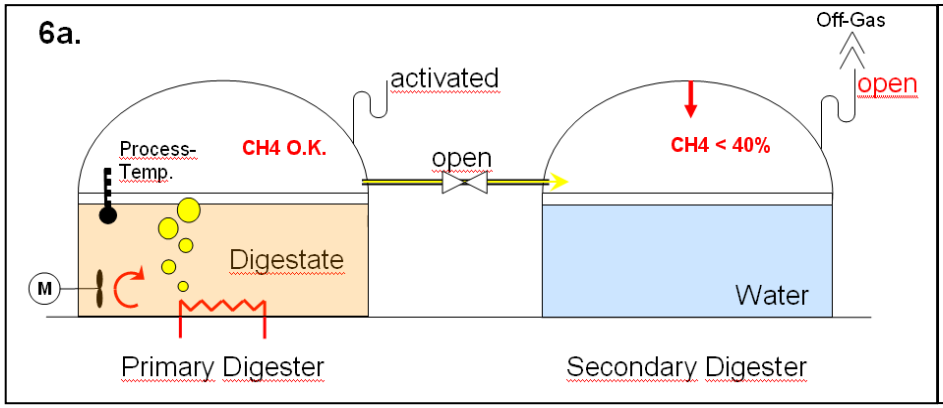

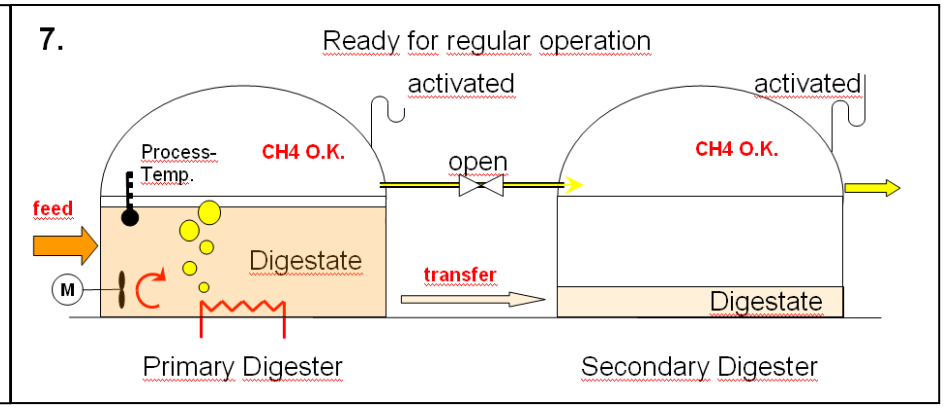

Damage during Start-up

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Frankfurter Neue Presse

Startseite | Region | Nachrichten | Sport | Ratgeber | Freizeittipps

Rhein-Main/Hessen Frankfurt Vordertaunus Limburg-Lahn Wetterau Main-Taunus Usi

Explosion an der Biogasanlage

Einer der neuen Tanks für den Gärprozess in Ostheim ist gester… ag in die Luft geflogen

Explosion of a tank

Die Erweiter…

zwei Arbeiter…

Von Jürgen W. Niehoff

Einer der vier Eigentümer der Ostheimer Biogasanlage, Stefan Bauer, zeigt die Teile, an denen vor der Explosion geschweißt wurde. Dahinter sind die Reste der Dachhülle zu erkennen, die durch die Explosion zerstört wurde. Foto: Jürgen W. Niehoff

Die Erweiterung der Biogasanlage in Ostheim sollte am 21. Dezember ans Netz gehen. Daraus wird nun wohl nichts. Bei einem Unfall wurden gestern zwei Arbeiter leicht verletzt.

Nidderau. Ein ohrenbetäubender Knall hat gestern um kurz nach 12 Uhr nicht nur die Bewohner von Ostheim hochschrecken lassen. Der Lärm war selbst im Nachbarstadtteil Windecken noch gut zu hören. Grund war die Explosion eines übergroßen Tanks der Biogasanlage am Ortsrand. Deshalb galt für die Feuerwehren aus allen Stadtteilen auch sofort Großalarm. Obwohl der Knall zunächst Böses erahnen ließ, hatten die Feuerwehrleute vor Ort dann doch nicht viel zu tun. Denn als die Einsatzkräfte wenig später eintrafen, brannten nur noch Kunststoffteile auf den Rändern des

mächtigen Tanks.

The Start-up of a digester is a critical stage

- for an period of time an explosive methane / oxygen mixture exists.
- the operator is not yet experienced with his biogas plant

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