Safety of Biogas Plants

Existing and intended Safety Requirements for Biogas Plants in Germany

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1. Basis

1.1 Development of the Number of Plants

Number of Biogas Plants in Germany (about 130 Plants for Biowaste)

Quelle: Fachverband Biogas / * 2014 = Prognose
1.2 Checks by Safety Experts:

- 2011: 82% with serious deficiencies
- 2012: 71%
- 2013: 73%

Number of Checks in 2013

- Waste Treatment Plants
- Ammonia Refrigeration
- Biogas Plants
- Chemical Plants
- Other
1. Basis

1.3 Problems with Biogas Plants

1. Insufficient Risk Awareness
2. Deficits in Technology
3. Insufficient Qualification of Persons in Charge for Design, Construction and Operation
4. Insufficient Supervision, Control (by the Operator) and Enforcement (by authorities)
5. Lack of binding Rules and Regulations
6. Insufficient Compliance with Rules and Regulations
### 2. Regulations and Technical Rules

#### 2.1 Existing Technical Rules:

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3. TRGS 529

3. Technical Rule for Hazardous Substances 529: Activities in Production of Biogas

Sections:
1. Scope of Application
2. Terms Used
3. Risk Assessment
4. Technical Protective Measures
5. Organisational Protective Measures
6. Personal Protective Equipment
7. Qualification of Employer and Employees
8. Prevention by Occupational Medicine

Attachments 1 to 4
3. TRGS 529

3. Technical Rule for Hazardous Substances 529: Activities in Production of Biogas

1. Scope of Application
   a) Activities in Production of Biogas and Operation of Biogas Plants (i.e. Plants for agricultural Substrate and Biowaste)
   b) not subject:
      • Plants for Treatment of Sewage Sludge in Waste Water Treatment Plants
      • Plants for Refining of Biogas and Feed to Natural Gas Grids

2. Terms Used
   a) A Biogas Plant is a Plant for the Production, Retention, Storage and Use of Biogas and Gas by Hyrolysis
   b) Additives and Auxiliary Substances are i.a. Trace Elements (Cobalt, Nickel and Selenium containing Mixtures), Enzymes …
3. Risk Assessment

3.1 The Employer has, 
   a) to evaluate how far employees operate with hazardous substances or 
   b) hazardous substance originate or are released in their activities 
   c) to define preventive measures 
   d) to draft a explosion protection document 

3.2 Additional Instructions 
   risks by … (hazardous) auxiliary substances 
   ➔ obligation to evaluate and implement possible substitution 

3.3 Envolvement of other Employers (contractors) 
   Obligations for co-operation
3. TRGS 529

3. Technical Rule for Hazardous Substances 529:

4. Technical Protection Measures

4.1 General Requirements

4.2 Explosion Protection Measures
   a) Requirements according to the risk of explosion
      (Definition of explosion protection zones, conditions for equipment)
   b) Special requirements for biogas plants

4.3 Fire Safety
   a) prohibition of hazardous activities in safety zones
   b) Safety measures due to hazards by flares

4.4 Measures for the Receiving of Substrates
   a) Measures for the protection of employees against gases
   b) Reception control for biowaste
   c) Safety measures for mixing of substrates

4.5 Use and Storage of Additives and Auxiliary Substances
   a) Requirements for storage and dosage
3. Technical Rule for Hazardous Substances 529: Activities in Production of Biogas

5. Organisational Safety Measures

5.1 ... 5.4

5.5 Isolated Work

5.6 Work Hygiene

5.7 Maintenance and Repair
   a) Planed and timely Maintenance and Repair
   b) Required Qualification and Experience
   c) Extension of Risk Assessent, Work Permit System
   d) Measures for Entering Shafts and Vessels

5.8 Controls and Inspections
   a) Control of closeness
   b) Corrosion inspections
   c) Control of safety equipment
3. TRGS 529

3. Technical Rule for Hazardous Substances 529: Activities in Production of Biogas

5.9 Measures in Case of Incidents

5.10 Emergency Measures, Emergency Plans, Information for fire fighters

6. Personal Protection Equipment

7. Required Qualification of Employers and Employees

7.2 Management

7.3 other employees

7.4 Further education

8. Prevention by Occupational Medicine

8.1 Envolvement of the company medical officer …

8.2 occupational-toxikological consultation
### 2. Regulations and Technical Rules in Preparation:

<table>
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4. Biogas Plant Ordinance

4. Biogas Plant Ordinance according the Federal Immission Control Act

⇒ Requirements for Emission Control and Safety!

Sections:

1. General Requirements
2. Requirements for Construction, State and Operation
3. Additional Requirements in Case of discontinuous Operation or special Substrates
4. Safety Requirements
5. Requirements to the Organisation of the Enterprise
6. Requirements for Measurement, Surveillance, Supervision by the Operator, Maintenance, and Control

Annexe 1 bis 7
Section 1 General Requirements - Scope of Application

- Differentiation of the requirements for
  - Small installations for research
  - Small installations (<0.35 Mio. m³/a) in connection with livestock breeding
  - Installations requiring no license (BImSchG)
  - Installations requiring a license (BImSchG)

- The ordinance is not applied to
  - Emissions of stationary engines
  - Treatment for sewage sludge in waste water treatment plants
  - Installations for treatment of municipal waste (according to the 30.BImSchV)

Section 2 Requirements for Construction, State and Operation

- No acceptance of „substrates“ causing hazards
- Use of the whole produced biogas must be possible
- Fixed additional gas consumption unit for the whole amount of biogas produced
Section 3 Additional Requirements in Case of discontinous Operation or special Substrates

Discontinous Operation

- Biogas from **start or shut down** of fermentation must be **used** or **eliminated**
- The gas in fermentation units must be **controlled on explosive atmosphere**

Use of Biowaste, chemical stabilised Substrate or By-products from Livestock breeding

- Information on **substances, source** and **properties required**
- **Acceptance control** including tests
- Operation manual and **recording of information** on acceptance
- Requirements **for acceptance and pre-treatment** of (hazardous) substrates
Section 4 Safety Requirements

General Safety Requirements

- Obligation to prevent dangers and to limit consequences of occurring incidents according to the state of the art
- Requirements on the enclosure of biogas, substrates, and digistate
- Requirements for safety equipment
- Accessibility of safety relevant operation tools
- Measures against actions of unauthorised persons

Gas pressurised components

- Enclosure requirements (enclosure due to construction of maintenance)
- Special requirements for plastic film systems
- Shut off valves for fermentation, gas retention and gas consumption units
- Under and over pressure relieve devices of fermentation and gas retention or storage units
4. Biogas Plant Ordinance

4. Biogas Plant Ordinance

Fire and Explosion Hazards
- Measures to control electrostatic charging, flash protection
- Inertisation for start up
- Gas detection and technical ventilation for machine rooms

Control of harmful impacts
- On site and off site safety distances (no fire transmission)
- In case of construction: zones for fire fighters between units
- Maps for fire fighters, fire protection concepts
- Rooms for machines and transformers: fire detection
- Retaining wall / retention pond

Section 5 Requirements to the Organisation of the Enterprise
- Definition of tasks, responsibilities, and processes
- Control- and supervision concept, Control and maintenance plan
- Emergency plan
- Obligation to notify fires, explosions and releases
4. Biogas Plant Ordinance

Qualification

- Qualification of persons responsible for
  a) The operation
  b) Design and construction
  c) Supervision and maintenance
- Obligations for education and instruction of other employees

Section 6 Requirements for Supervision, Maintenance, and Control

- Supervision by the Operator
- Maintenance and Control

Problems:

- The deterministic system requires a large number of detailed obligations
- General requirements - however - may not be implemented
Thank You For Your Attention

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www.umweltbundesamt.de/themen/wirtschaft-konsum/anlagensicherheit
4. Biogas Plant Ordinance

Annexe 1  Organisation of the enterprise
Annexe 2  Emergency plan
Annexe 3  Filing of information on the plant
Annexe 4  Qualification
Annexe 5  Minimum requirements for the control by notified safety experts
Annexe 6  Notification
Annexe 7  Components requiring a type approval
1. Basis

1.3 Accidents: Rhadereistedt (05.11.2005): 4 persons killed by a Hydrogen Sulphide release due to chemical reaction in the substrate reception unit.
1. Basis

1.3 accidents:
collapse of a digester during start up (23.01.2006)
1. Basis

1.3 accidents: landed digester roof after an explosion caused by welding (08.12.2009)
1. Basis

1.3 accidents: fire in a digester – burning of sulfur in the digester (10.07.2012)
1. Basis

1.3 accidents: loss of the secondary plastic film due to storm (05.01.2012)
1.3 accidents: release of substrate (pig manure, 14.000 m³ (German Record) during start up (15.03.2010) due to collapse of a digester?

3 km² contaminated by pig manure
1. Basis

1.3 accidents: release of substrate (poultry excrement in cattle manure, 2000 m³) during start up due to insufficient fixed pipe in the digester wall (25.01.2014)