Biogas Safety Guidelines: Overview

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Structure of the guidelines

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  • Hazard assessment
  • Fire protection
  • Documentation

• **Part 2** Specific requirements
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  • Proper implementation of ex-zones

• **Part 3** Inspections and tests
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  • Visual inspection and functional test
Structure of the guidelines

• **Part 4** Biogas upgrading
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  - Conditioning
  - Injection

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  - Template of an hazard assessment
  - Instruction record for subcontractors and employees for maintenance, installation and repair work
Hazards on biogas plants

- **Heat**
- **Electrical hazards**
- **Mechanical hazards**
- **Fire hazards**
- **Hazardous substances**
- **Noise**
- **Crash or falling down**
- **Gas hazards**

Examples of hazards on biogas plants

Mechanical hazards:

• Moving parts of machinery

• Dangerous surfaces
Examples of hazards on biogas plants

- Explosion and subsequent fire due to welding

- Total loss of 80,000 €
- Commissioning of the biogas plant
- No injured persons
Hazards on biogas plants

- In 2012 in Germany:
  - About 7,500 biogas plants
- About 270 accidents with injured people

Source: SVLFG = German Agricultural Occupational Health and Safety Agency

Types of accidents with injured persons at biogas plants

- Mechanical: 86%
- Chemical: 7%
- Thermal: 4%
- Radiation: 1%
- Noise: 1%
- Not specified: 1%

Source: SVLFG = German Agricultural Occupational Health and Safety Agency
Where do these hazards occur?

Biogas production side
Where do these hazards occur?

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Risk evaluation and precautions

Risk Assessment

- The focus for the issue of a hazard assessment is to protect and to reduce the exposure to risk and hazards of employees.

- The employer must determine, evaluate, and minimize the hazards and must consider the acquired knowledge by
  - the design and selection of work tools
  - as well as the design of workplaces
  - work and production processes
  - work procedures
  - and interactions of all of the above
Risk evaluation and precautions

T-O-P Principle

Sequence

**Technical protective measures**
- Gas warning devices
- Mechanical ventilation
- Protective covers for rotating parts
- Enclosed metering station for process additives

**Organisational protective measures**
- Work instructions
- Briefing on procedures
- Emergency plans
- On-call service
- Inspections and tests
- Requirements for lone working

**Personal protective measures**
- Gloves
- Work clothing
- Respiratory protection
- Safety shoes
- Safety glasses
Risk evaluation and precautions

Integrated explosion protection

**Primary Ex-Protection**
- Prevention of formation of explosive atmospheres
  - Substitution, inert atmosphere, limitation of concentration, intensive ventilation

**Secondary Ex-Protection**
- Prevention of ignition
  - Ex-Zoning, preventing sources of ignition, organisational measures

**Tertiary Ex-Protection**
- Reduction of explosion consequences
  - Personal Protective Equipment (PPE), explosion suppression, explosion pressure resistance
  - Evacuation or enough distance
Risk evaluation and precautions

Ex-Zoning

- **Danger !!!**
  - **Zone 0 or zone 20**: An area in which a hazardous explosive atmosphere consisting of a mixture of air and combustible gases, vapours or mists is present continuously or for long periods or frequently.

- **Danger !!**
  - **Zone 1 or zone 21**: An area in which a hazardous explosive atmosphere consisting of a mixture of air and combustible gases, vapours or mists is likely to occur occasionally in normal operation.

- **Danger !**
  - **Zone 2 or zone 22**: An area in which a hazardous explosive atmosphere consisting of a mixture of air and combustible gases, vapours or mists does not normally occur but, if it does, does so only rarely and for a short period.
Documentation

Operating instructions and instruction manuals

- The manufacturers introduce products into the market with operating instructions.
- The operating instructions from the component manufacturers must be collected and stored safely from the plant operator.
- For the operation of different resources, equipment, etc., the operator has to provide an instruction manual which includes operating instructions, as well as information about hazards that result from the installation conditions.
- In addition, special operating states such as startup and shutdown of the system need a specific instruction.
- The employees must be instructed regularly about safe operation, e.g., using the instruction manual.
- The risk assessment and the explosion protection document have to be updated when there are changes in the operating processes. The operator bears the responsibility.
Inspections and tests

The inspections and tests can be divided into the following separate segments:
# Inspections and tests

<table>
<thead>
<tr>
<th>Test object</th>
<th>Test frequency</th>
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<tbody>
<tr>
<td><strong>Fire extinguishers</strong></td>
<td>Every 2 years</td>
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<tr>
<td><strong>Safety equipment (e.g. gas warning equipment, ventilation systems and inerting equipment)</strong></td>
<td>At least once a year</td>
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<tr>
<td><strong>Apparatus, protection systems and safety systems</strong></td>
<td>Every 3 years</td>
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<tr>
<td><strong>Explosion protection testing (general)</strong></td>
<td>Prior to commissioning and periodically at least every 6 years</td>
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<tr>
<td><strong>Inspection for compliance with water legislation</strong></td>
<td>Prior to commissioning, then every 5 years, in water protection areas every 2.5 years</td>
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<tr>
<td><strong>Safety-related testing</strong></td>
<td>Prior to commissioning, then every 3 or every 5 years (depending on approval)</td>
</tr>
<tr>
<td><strong>Electrical testing of switchgear/’E-Check’ inspection</strong></td>
<td>Every 4 years</td>
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<tr>
<td><strong>Pressure vessels</strong></td>
<td>External inspection every 2 years</td>
</tr>
<tr>
<td></td>
<td>Internal inspection every 5 years</td>
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<td></td>
<td>Strength test every 10 years</td>
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Biomethane: additional safety measures
Lessons learnt

- Biogas plants are complex process plants with several hazards.

- The operating staff and the plant owner need professional skills and knowledge. Important is periodic retraining!!

- Also well-qualified plant designers and manufacturers are required.

- The German biogas plant manufacturers collected a lot of experience over the past 14 years.

- Experienced designers and manufacturers of biogas installations are available. Ideally, they have diverse references.
Lessons learnt

• Enhanced measures for the standardization of components and materials for biogas plants are in progress

• Currently in preparation: development of safety management systems

• Problem in Germany: we have a lot of responsible authorities and too many confusing rules.

• For the plant operator and the manufacturers, it is hard to be informed on the different regulations.

• Great danger of over-regulation and the disproportionate burden to the operators and manufacturers => economy in danger!

• Keep it safe and simple!
Thank you for your attention!