

Preventing Accidents in Biogas Plants - Experience of an Expert Witness for Biogas Plants -

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Krieg & Fischer Ingenieure GmbH

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Engineering Office, specialized in Design and Engineering of Biogas Plants

Foundation: 1999

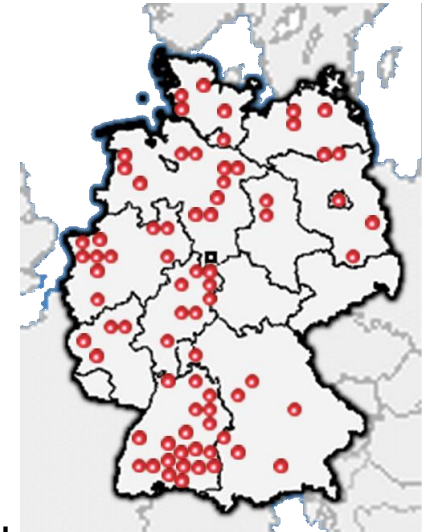
Team: 18

Experience: > 20 Years

References: ca. 140 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



Torsten Fischer

- President of Krieg & Fischer Ingenieure GmbH

→ founded by Andreas Krieg and Torsten Fischer in 1999



- Education: Engineer for Shipbuilding Construction
- Experience in the field of biogas since 1992
- **special fields:** - waste management and municipal engineering
- safety aspects of biogas plants
- **Lecturer** at Universities of Höxter and Gießen
- Accreditation of the Chamber of Engineers of Germany as **Expert Witness in the field of biogas**



References - Examples



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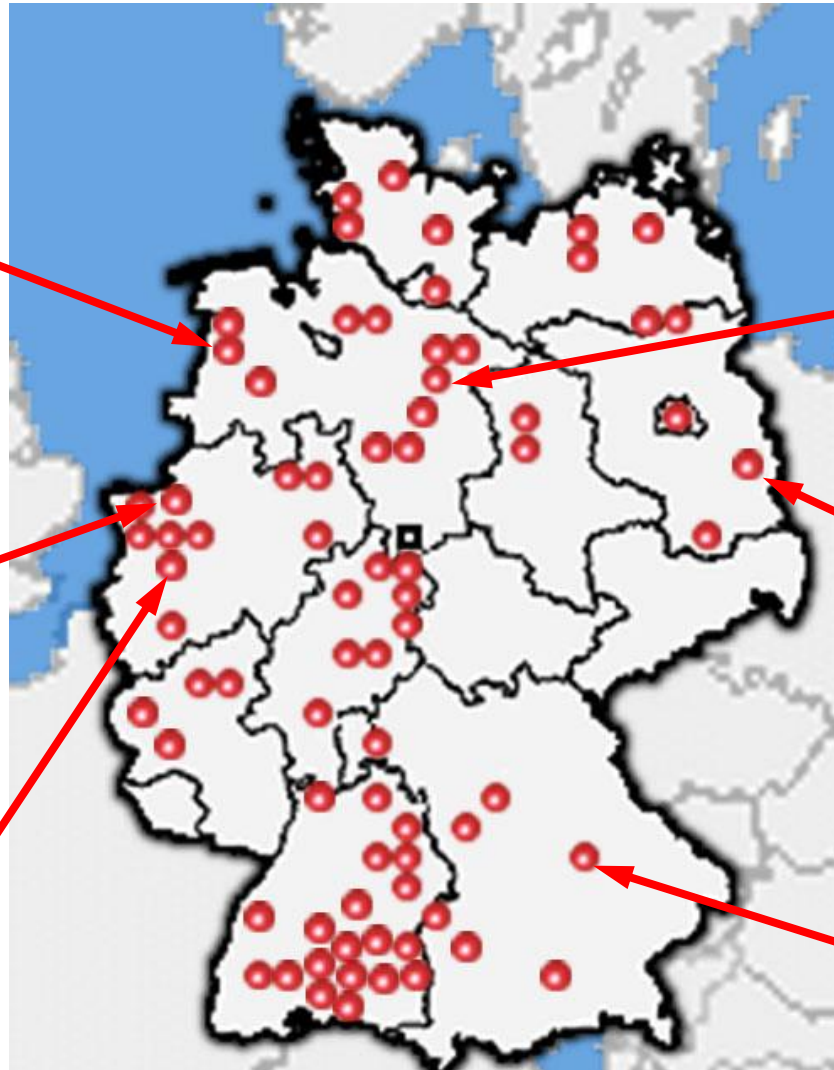
Central Biogas Plant



Energy Crop Biogas Plant



Kitchen Waste Digestion



Potato Residue Digestion



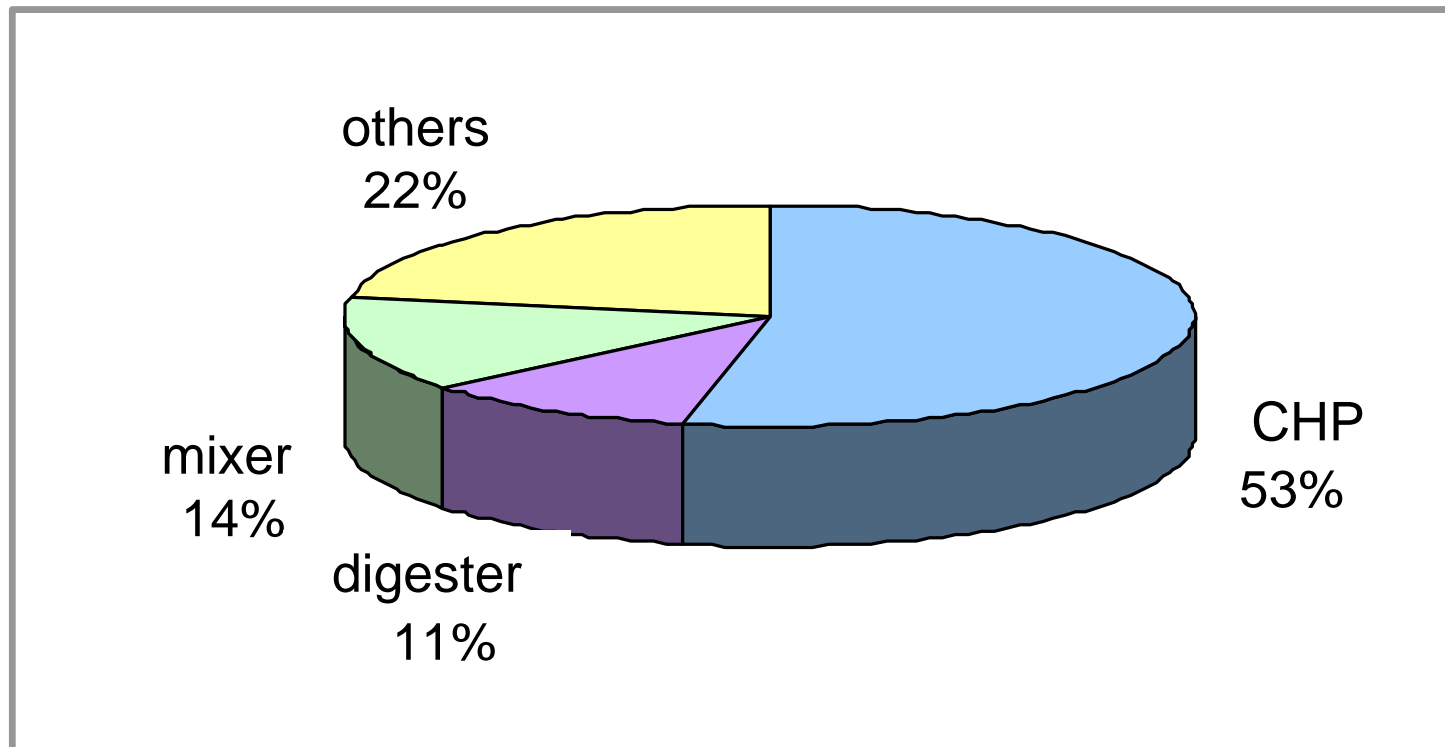
Energy Crops with Cattle Manure



Biowaste Digestion

Experience of an insurance company

Damages at different parts of the plant
- payments related to different plant parts

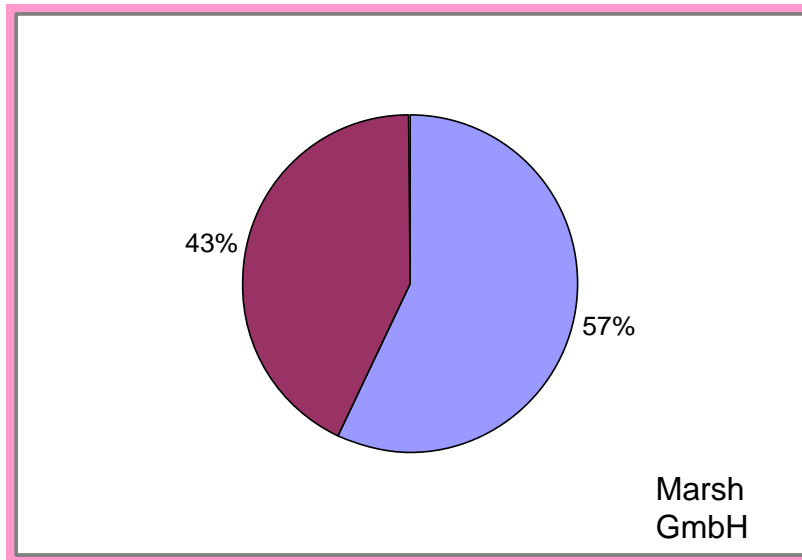


Marsh
GmbH

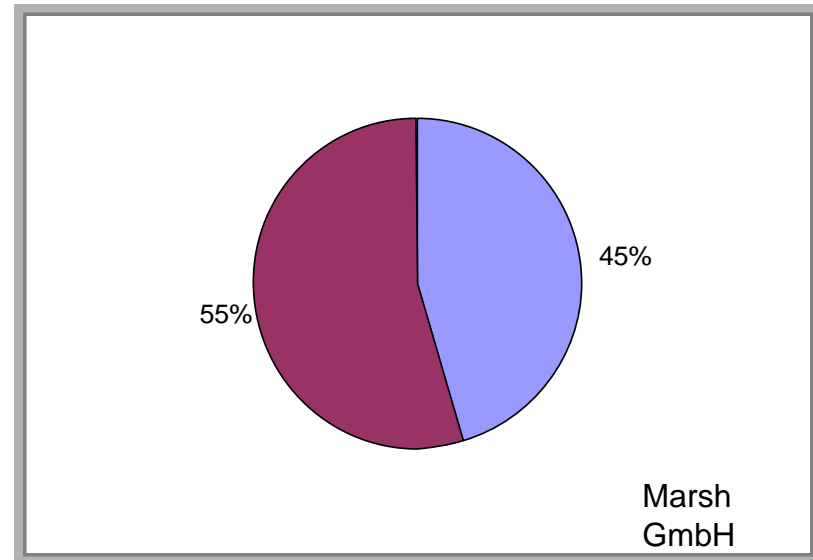
Additional damages - Digester Tanks-

Part of financial Losses in Digester Damages

Contracts up to 2005



Contracts starting 2005



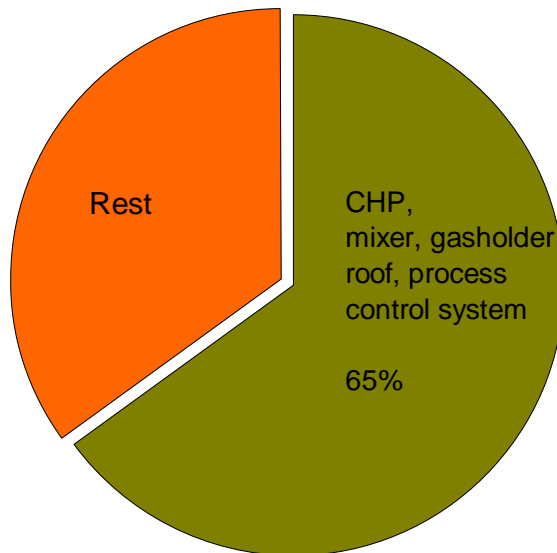
■ Damages caused by
Biological Breakdowns

■ Material Damage

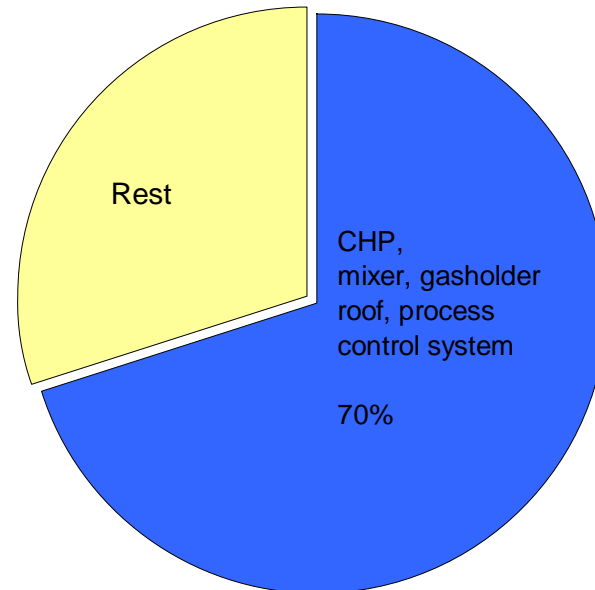
Insurance of the digester biology becomes more important.

Experience of Gothaer Insurance Company

Frequency of damages



Payment of damages

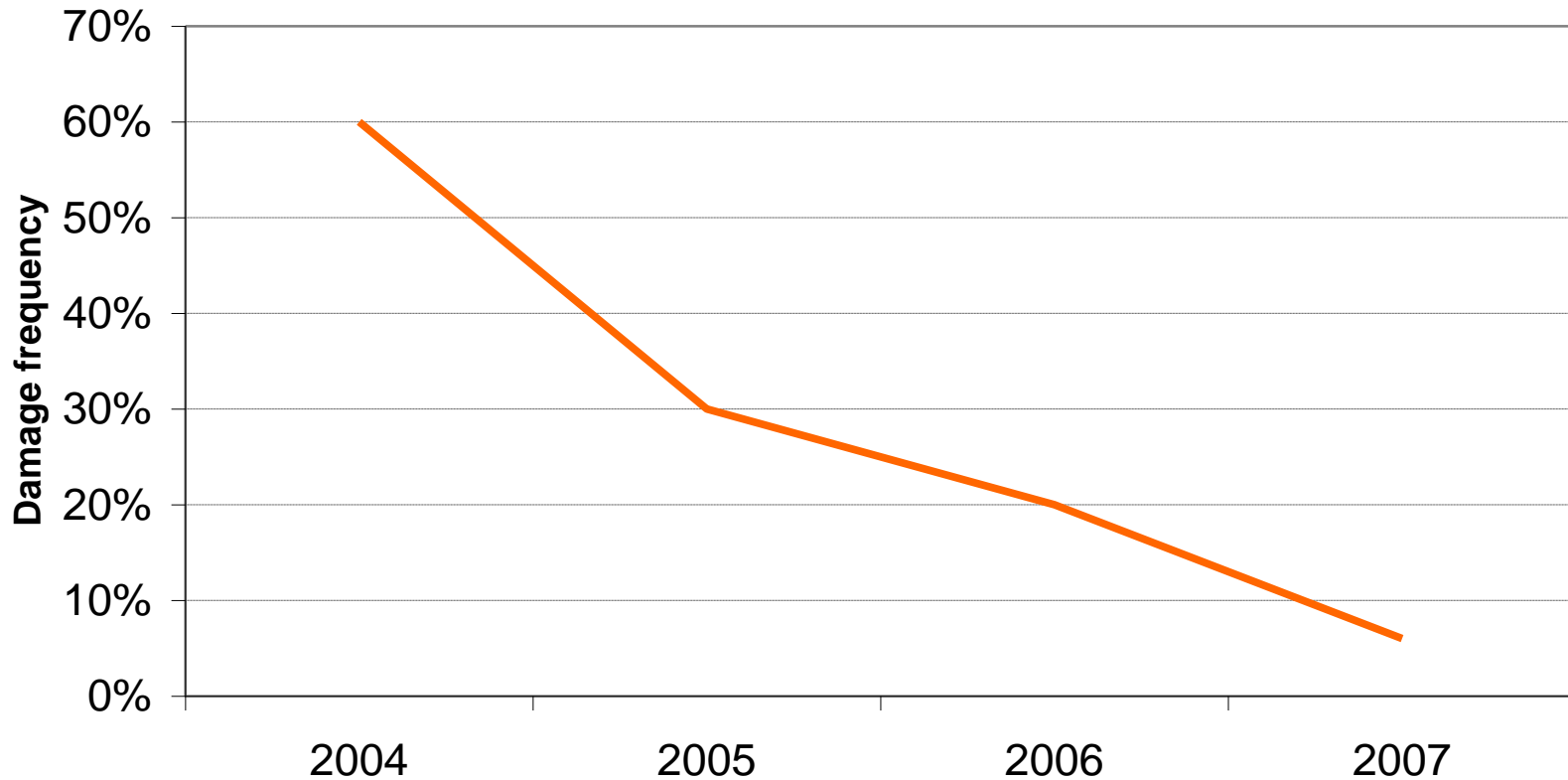


- more than 50% of all damages cause payments of less than € 10,000
- payments of damages above € 50,000 are paid at 5% of all damages

Experience of Gothaer Insurance Company

- different quality of the plants
 - plant construction
 - operation
- about 80% of the insurance contracts are damage-free (lots of new plants still have warranty)

Experience of Gothaer Insurance Company



Number of Damages increase disproportionate to Age of Plant

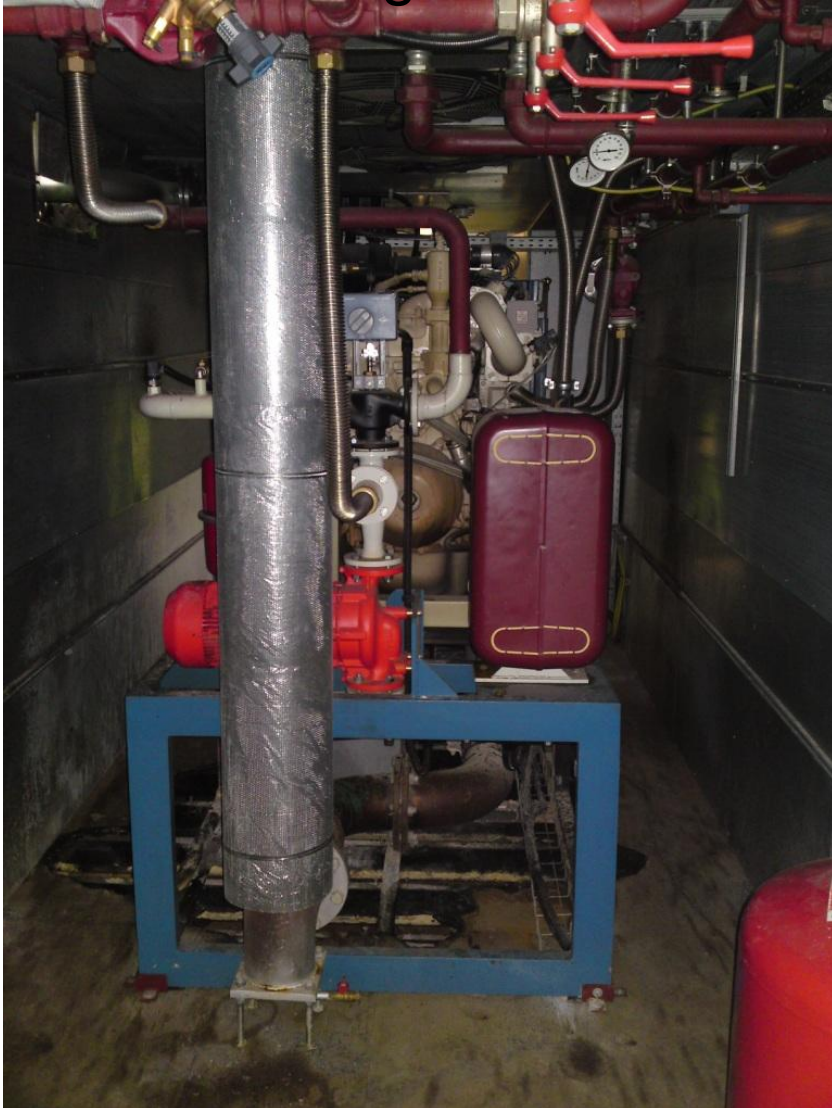
Case Study 1: Fire Damage CHP-Container



Construction: 2007
Input: Energy Crops
CHP: 191 kW_e

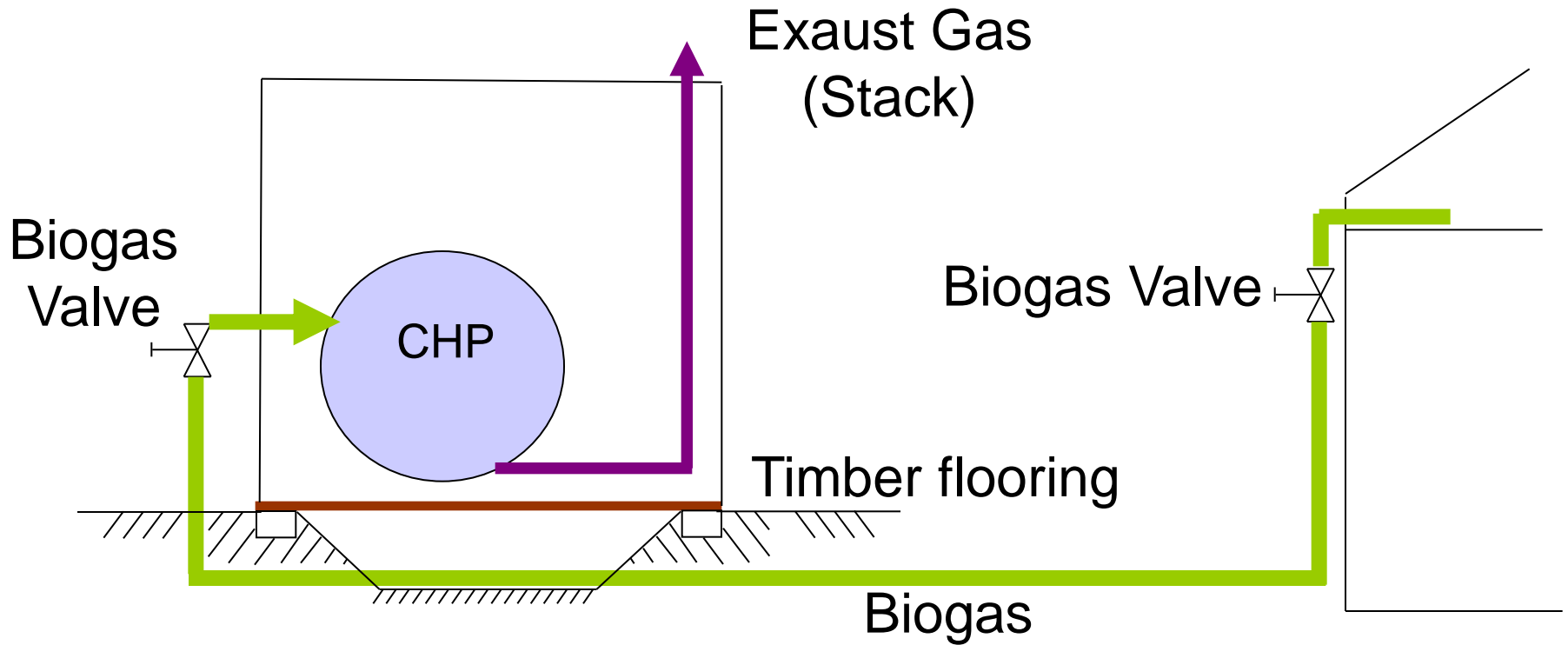


Case Study 1: Fire Damage CHP-Container



The CHP-Container had a
Timber Flooring.

Case Study 1: Fire Damage CHP-Container



Case Study 1: Fire Damage CHP-Container



Floor was contaminated with
Oil Residues and Lube Oil.



Case Study 1: Fire Damage CHP-Container



Hot Exhaust Pipe was set up with little Distance to Timber Flooring.

- Timber Flooring dried up
- Dried Timber Flooring ignited and carbonized

Case Study 1: Fire Damage CHP-Container



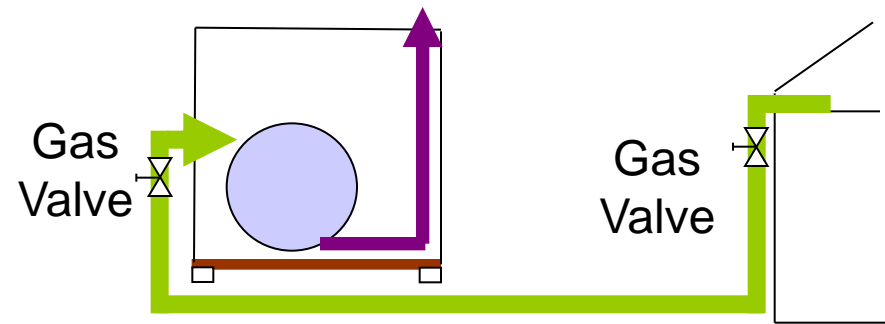
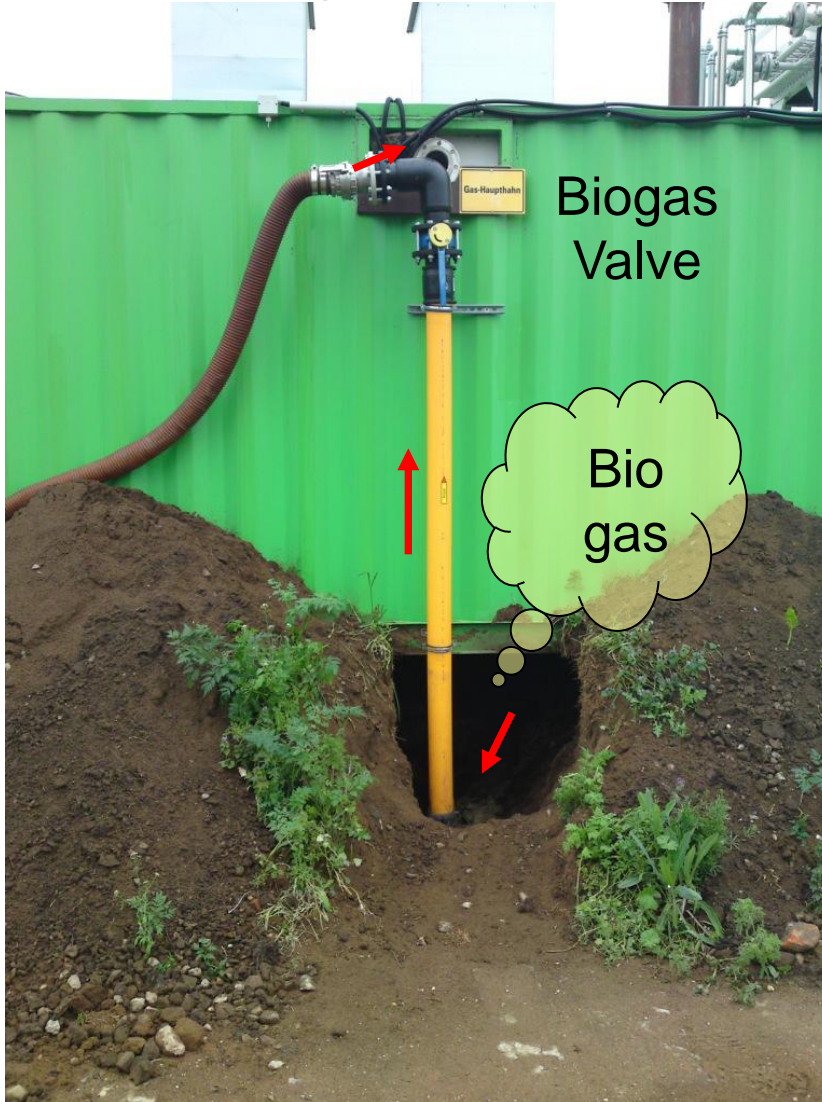
Caused by increasing Temperature the Plastics of the Cable Insulation and Holders melted and dripped off.

Case Study 1: Fire Damage CHP-Container



Melted Plastic dropped down on PE-Biogas Pipe underneath Container.
→ Pipe melted
→ causing Holes in Biogas Pipe

Case Study 1: Fire Damage CHP-Container



Operator closed the
wrong Biogas Valve

→ Biogas still escaped
overnight from Hole in
the Pipe

Case Study 1: Fire Damage CHP-Container

- Province-specified fire-protection regulations were not paid attention to
- Technical inadequateness:
 - exhaust pipe did not keep the required distance (to the timber flooring and to the cables)
 - exhaust pipe was not insulated against the timber flooring
 - biogas pipe below the container was not covered with soil
- The operator did not detect the reason

Case Study 1: Fire Damage CHP-Container

Conclusion:

- The damage has been categorized as extensive.
- The CHP-container has not been set up according to the actual regulations (province-specified fire- protection regulations are valid)
- No concerns have been expressed by the CHP provider
- Will the insurance pay the damage costs?

Case Study 2: Overfilling of Hydrolysis Tank

Krieg & Fischer received an E-Mail from the insurance company:

- Damage of a concrete Tank
- Which Tank was not noticeable from the Documentation of the Insurance Company
- Insurance Company asked for an Examination of the Documentation available on site the Biogas Plant

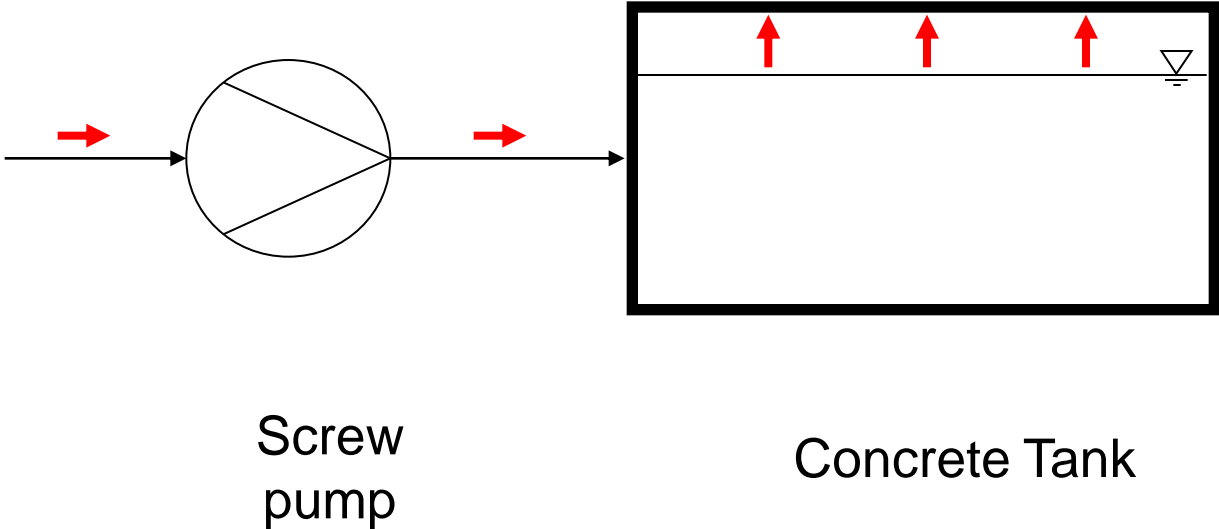
Case Study 2: Overfilling of Hydrolysis Tank

Data were only rudimental

- No Documentation
- No Flow-Sheet
- Site Layout was taken from Permission Documents and obsolete because the concrete tank was erected 2 years later

→ The new tank was not registered by the insurance company.

Case Study 2: Overfilling of Hydrolysis Tank



Case Study 2: Overfilling of Hydrolysis Tank

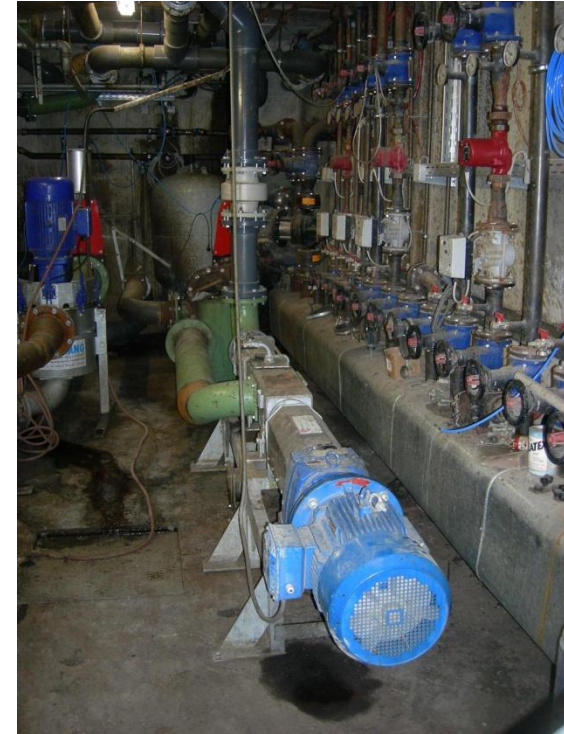


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- Construction: 2005/2006
- Input: Energy Crops
- CHP: 536 kW_e

Case Study 2: Overfilling of Hydrolysis Tank



The screw pump was not equipped with a pressure sensor on the pressure side of the pump or a protection against dry running.

→ The pump could only be stopped manually.

Case Study 2: Overfilling of Hydrolysis Tank



If the maximum filling level of the tank is reached a warning message is sent to the cell phone of the operator. He switches off the pump manually.

Case Study 2: Overfilling of Hydrolysis Tank



At the day of the accident the operator forgot his cell phone.
The pump continued pumping manure into the tank...

Case Study 2: Overfilling of Hydrolysis Tank



...until the cover of the hydrolysis tank had been pushed up by the fluid pressure and blasted from the tank.

Case Study 2: Overfilling of Hydrolysis Tank



- No documentation of the plant
- No process flow sheet
- Hydrolysis tank had been enhanced and equipped with a cover by the operator
- no structural calculation of the tank
- no safety-regulated documentation

Will the insurance company pay for a damaged tank they do not know about?

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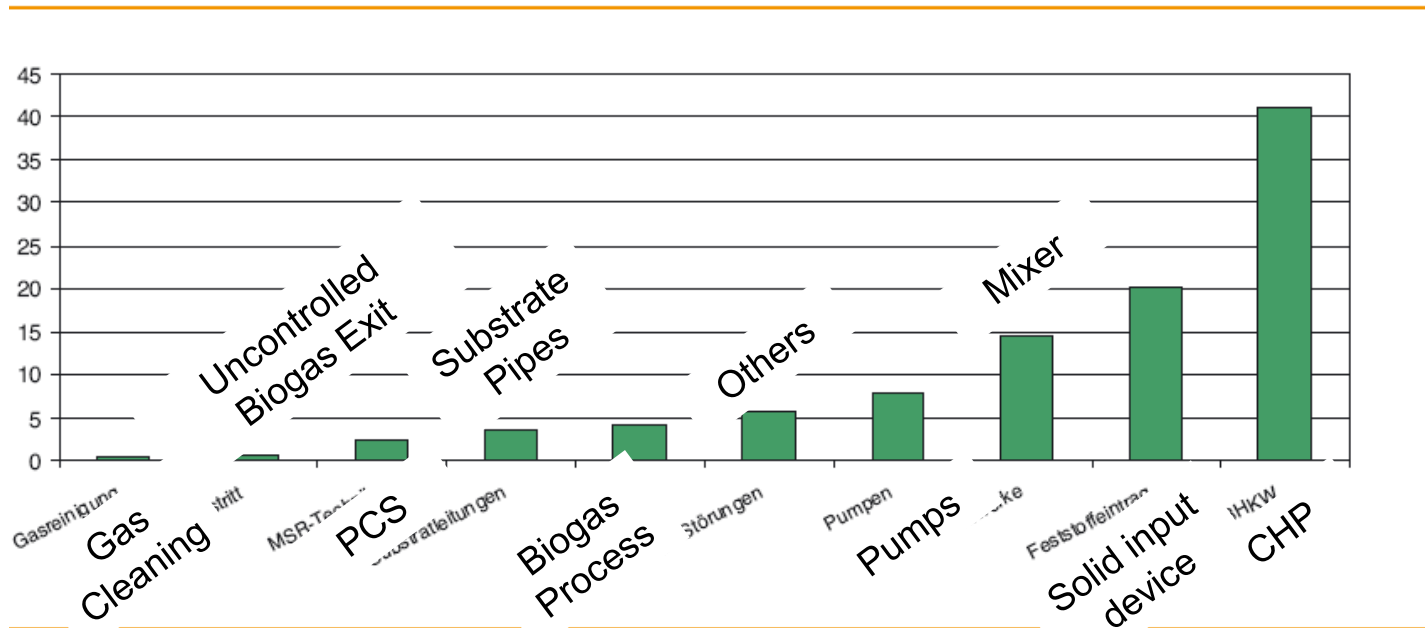
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Study published by Federal Government of Germany

Part of the total amount of work compared to trouble shooting [%]



Mittlerer Anteil der einzelnen Störungen am Gesamtarbeitsaufwand zur Störungsbeseitigung und rel. Häufigkeit der einzelnen Störungen