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Gas emissions – explosion protection: Safety in theory and practice

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DAS – IB GmbH
LFG - & Biogas - Technology

Biogas, sludge gas and landfill gas technology:

- Consulting, planning, project management
- Training of system operators
- Expert i.a. in accordance with § 29a of the Federal Immission Control Act; and Qualified Person reg. the Ordinance on Industrial Safety and independent expert

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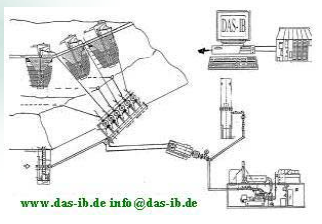

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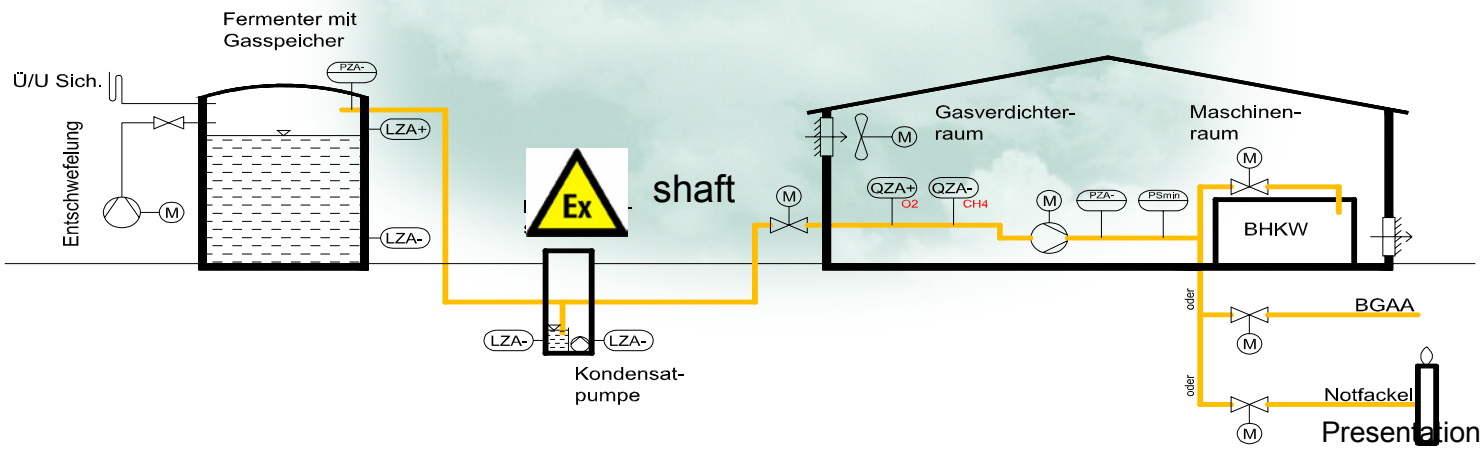
"Nothing is impossible"
or
"I take this liberty“
or
NO RISK NO FUN?

ATEX 137 (118), better known as the 1999/92/EC Directive dated December 16th 1999: „On minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres”.

Biogas plant / systems engineering

Fermenter approx. 4 mbar | neg. pressure ? | positive pressure ca. 60 – 80 mbar

Biogasplant



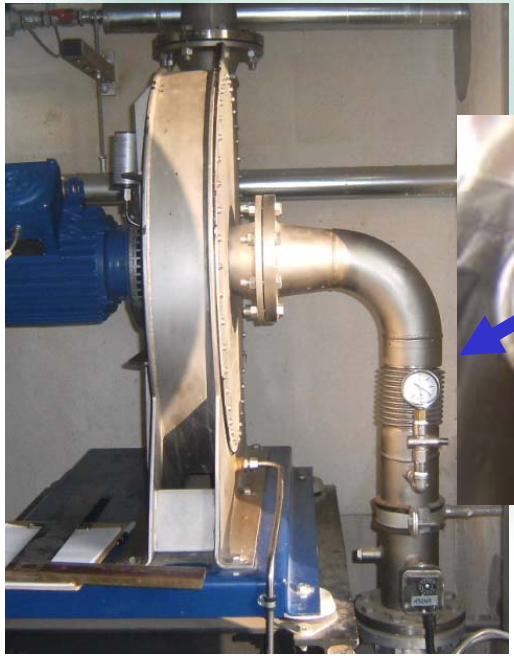
In Article (9) it is written:" … the employer [=operator] is to draw up an explosion protection document, or set of documents, which satisfies the minimum requirements … "

What is gas tight ?

From turbo charger to the tanks

The 99/92 Directive (ATEX 137) is addressed to operators. The operator needs to implement safety requirements, such as:

- Prevention of ex-mixtures, ignition sources, (…) and, if this is not realisable



Boosters, …

Air in biogas …

? WHY NOT?

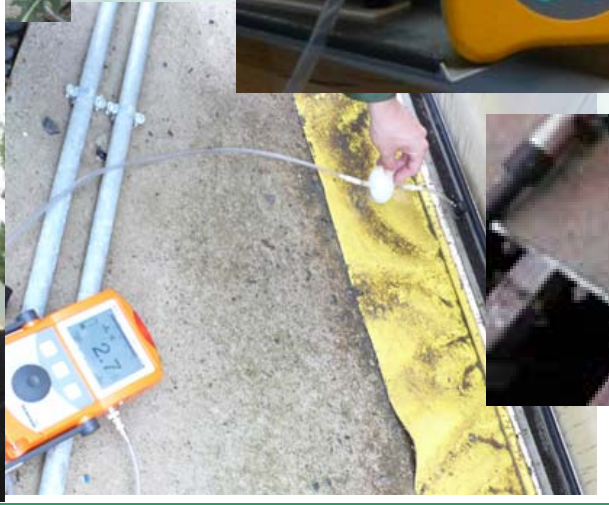
The 99/92 Directive (ATEX 137) is addressed to operators. The operator needs to implement safety requirements, such as:

- Prevention of ex-mixtures, ignition sources, (…) and, if this is not realisable

WHY an explosion?

O&M works …

Gas leakiness at the Fermenter: gasholder & concrete pass – concentration and amount with foam / bubbles



How to find gas leackage? – Yes / No – Quality and quantity?

SVK Biogas
Sachverständigenkreis

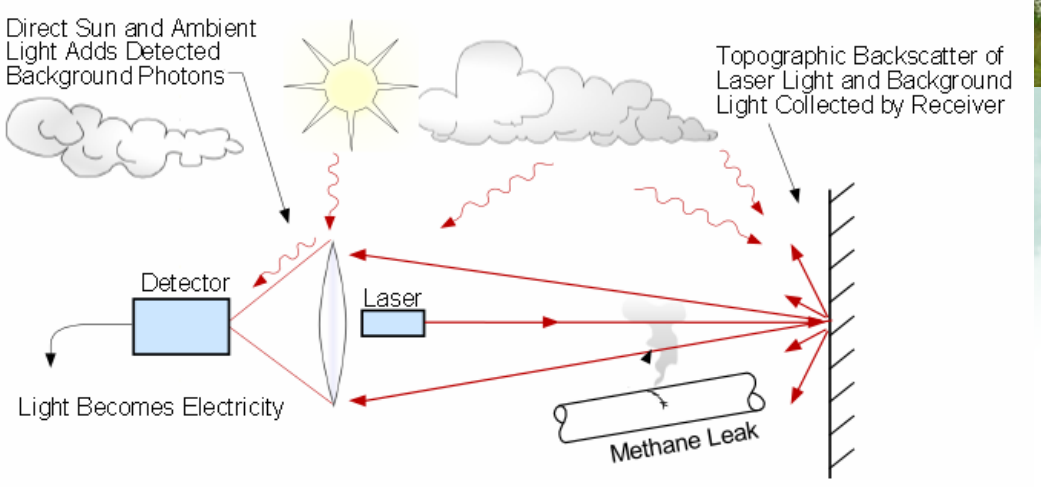
Merkblatt zur Überprüfung der Gasdichtigkeit von Biogastraglufthauben
(so genannte Doppelmembran-Biogasspeicher)
im Normalbetrieb

X 2012

How to find gas leackage? – Yes / No – Quality and quantity?

RMLD

(Remote Methane Leak Detector) – Laserabsorptionsspectrometer



How to find gas leackage? – Yes / No – Quality and quantity?

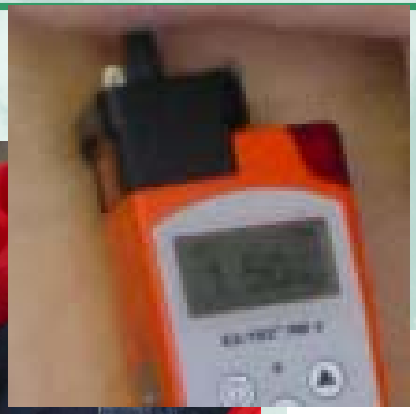
RMLD – selektiv CH_4

(Remote Methane Leak Detector)
- Laser

MBT / MBP– mechanical biologic pre-treatment plant

Gas holder

How to find gas leackage? – Yes / No – Quality and quantity?



SVK Biogas
Sachverständigenkreis

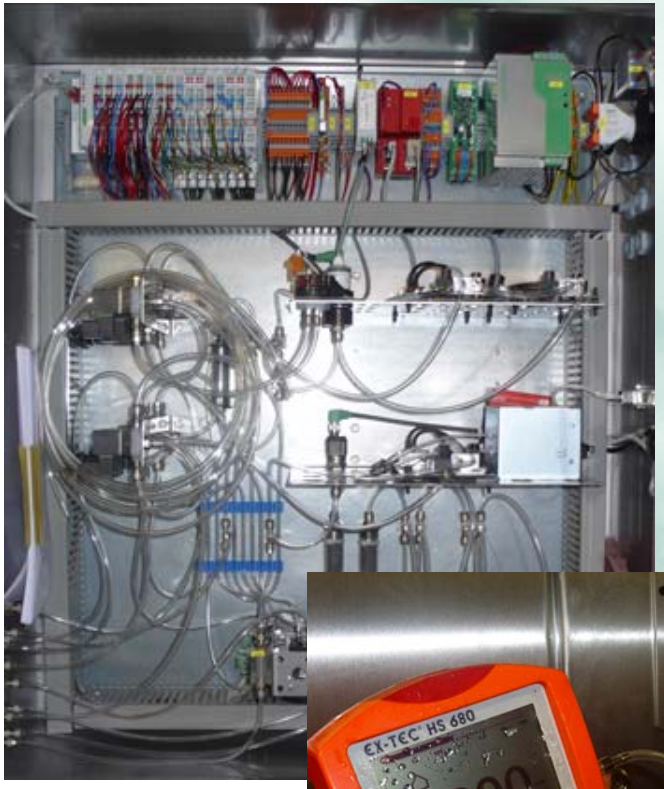
Information zur Überprüfung der Gasdichtigkeit und Leckagenermittlung insbesondere mittels Meßgeräten an Biogasanlagen (BGA)
zur Vermeidung von Verwechselungen bei Gasdichtheitsnachweisen und Leckageprüfungen

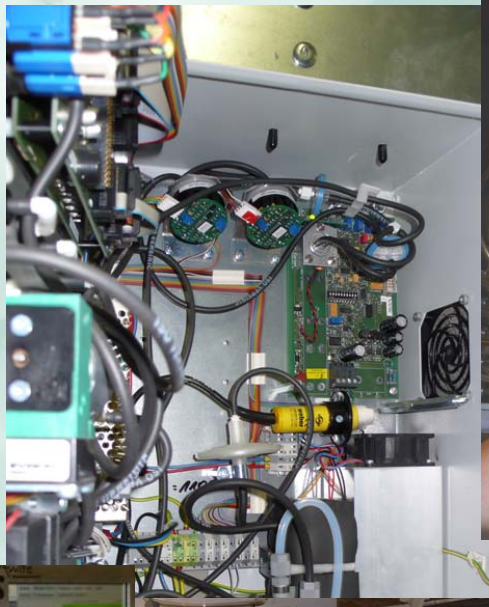
How to find gas leackage? – Yes / No – Quality and quantity?

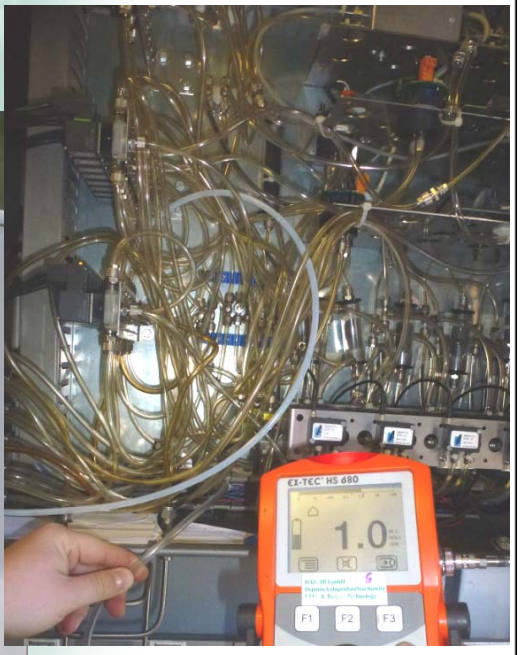
Gas leakiness at the Fermenter: gasholder & concrete pass – concentration and amount with foam / bubbles

How to find gas leackage? – Yes / No – Quality and quantity?

Rohgasanalysenschränke – Undichtigkeiten - Sicherheit







Ternary (three component) diagram, atmospheric

For the explosion area methane / air / C02- N2 - mixture

Acc. to Tabasaran / Rettenberger (UBA – Forschungsbericht 12/1982, Nr. 10302207 Teil1)

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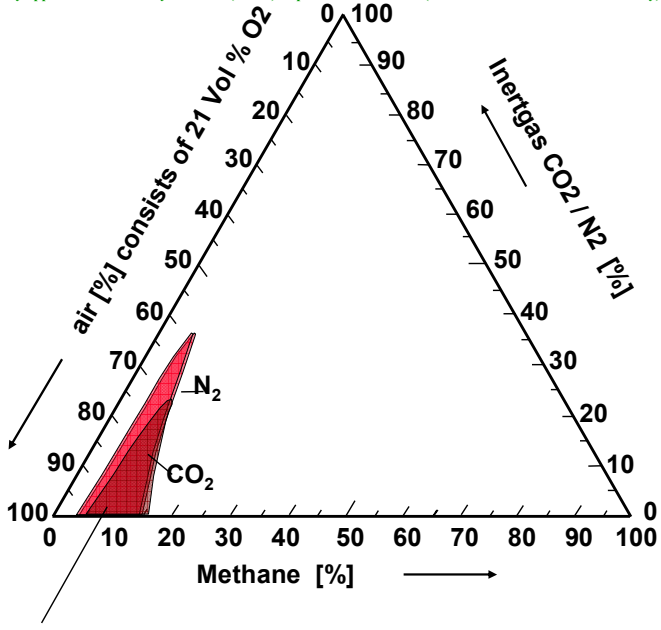
Biogas, sewage gas and landfill gas technology:
- Consultation, planning, projecting
- Training of operating personnel
- Expert services (among other things in accordance with § 29a BImSchG (Federal Immission Control Act) and a publicly appointed and Publicly Certified (sworn) Expert at the IHK Kiel (Chamber of Commerce and Industry)



Explosion area : Exceeding of 11,6 Vol % oxygen

and

between 4,4* (5)**Vol % methane (100 % LEL) and 15 (16,5) Vol % methane (100 % HEL)

* IEC 60079-20 and PTB ** EN 50054

Explosion prevention

Primary explosion protection:
Through the prevention of the formation of an explosive atmosphere

e.g.:
Monitor and optimise gas plants with regard to operation, inertisation, safety-related control, meaning concentration limitation below the lower and above the upper explosion limit, aeration & measurement

Secondary explosion protection
Through the prevention of the ignition of an explosive atmosphere
For ignition sources please refer to - > EN 1127-1

Tertiary explosion protection
Through the prevention / reduction of effects
e.g. compression-proof (shockproof) material

Zone 1

Previous definition: includes areas in which a dangerous explosible atmosphere, caused by gases, vapours or mist must occasionally be anticipated.

New: **A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.**

Zone 2

Previous definition: includes areas in which a dangerous explosible atmosphere, caused by gases, vapours or mist must rarely be anticipated and only for a short period of time.

New: **A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.**

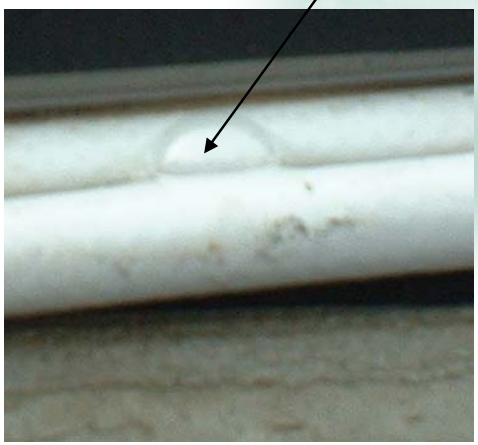
2 different booster systems 500m3/h each

Booster station: „EX“ and „Normal“ but gas tight

What is NORMAL? Should everything be ex-protected or gas-tight

Leak tests to prevent the formation of an explosible atmosphere

Leak tests (e.g. in accordance with DVGW (The German Technical and Scientific Association for Gas and Water),G 469 A4: inspection method with operating pressure and foaming agents



Ignition sources part I

Hot surfaces - > T4, methane > 500 °C

Flames and hot gases (form, structure, residence time)

Mechanically produced sparks - > rubbing, striking, abrading

Electrical plants - > sparks (switching operations, loose connections, compensating currents), hot surfaces (component)

Electrical currents, cathodic corrosion protection

- > stray, return currents (welding facilities)
- > body contact or earth fault
- > magnetic induction (> I, HF)
- > lightning stroke, Static electricity
- > discharge of charged conductive parts which are arranged in an isolated fashion
- > charged parts made of non-conductive materials (plastic) – bunch discharges, separating processes

Ignition sources part II

Lightning stroke - > direct and indirect (induction)
Electromagnetic waves 10,000 Hz – 3, 000, 000, 000, 000 Hz (HF)
- > radio transmitters, welding machines
Electromagnetic waves 10,000 Hz
- 3, 000, 000, 000, 000 Hz (HF)
- > radio transmitters, welders
Electromagnetic waves 300,000,000,000 Hz – 3,000,000,000,000,000 Hz -> focusing, strong laser radiation
Ionising radiation - > X-ray, radioactive radiation
Ultrasonic
Adiabatic compression and impulses
Exothermic reaction, including self-ignition of dusts

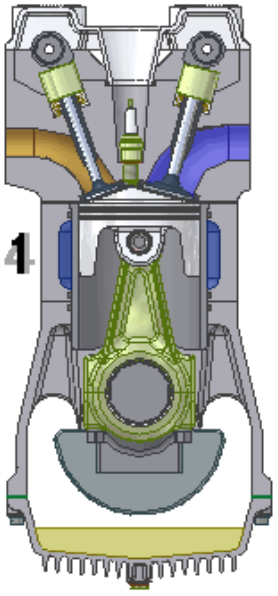
Forecast of undesirable events

Who can help: prophets - palmists - fortune tellers - oracles or **risk analysis?**

However, the risk is the product of the:
Occurrence probability x significance of the event
PROBABILITY CONSEQUENCE (effects)
Function / product of

SAFETY prevails, when the risk is justifiable!

Fire by accident (CHP units) but no trouble with the gas pipes - why?



Normal operation of gas engines:

- 40 Vol % of methane
- NO explosive atmosphere

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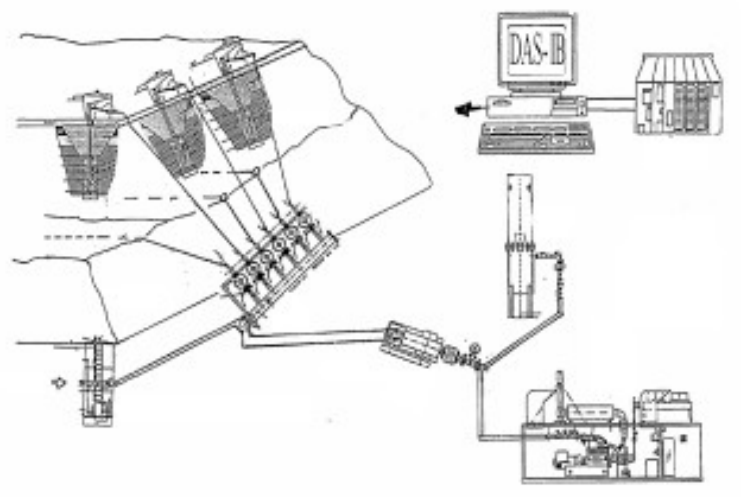

Thank you for your attention

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Biogas-, Sludge gas and Landfill gas technology:

- Consulting, planning & design, project management
- Familiarisation and training of system operators
- Independent Expert & Specialist
- Expert in ATEX – Zoning according to 99/92/EG and 94/9/EG