Experiences from Emission Analysis as a Tool for Plant Optimization

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Huelsenberg Holding GmbH & Co. KG

as of March2012

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Enbycon Holding AG

Erneuerbare Energien / Cleantech

- Deutschland
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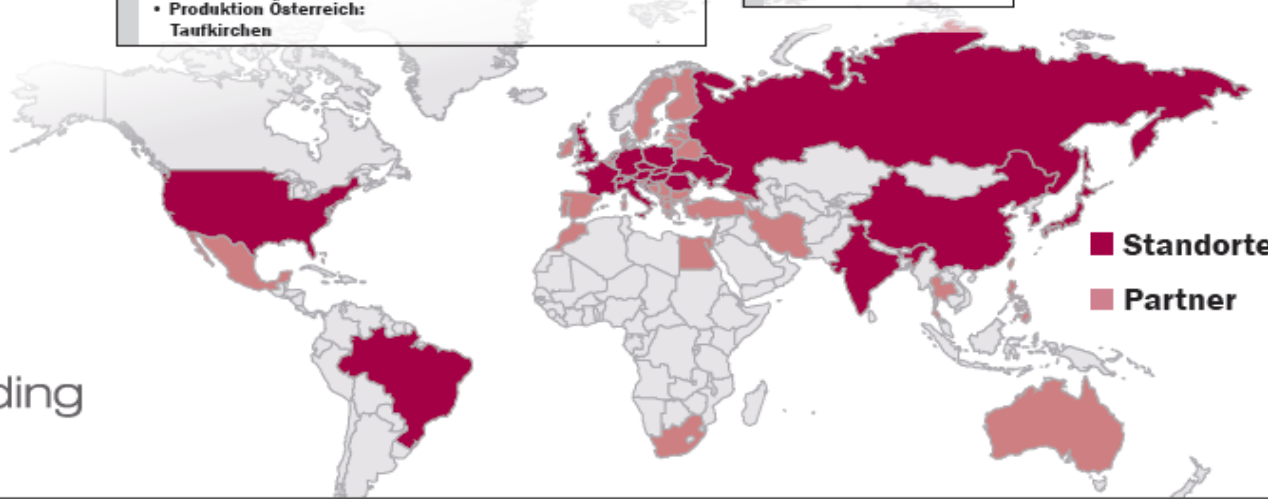
Biotic Science Holding AG

Biotechnologie

H. Wilhelm Schaumann Stiftung



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Our Focus: Biogas

Substrate



Process










Gas
(incl. odour)


Digestate
(incl. compost)

Key information

- Part of the Enbycon Holding AG
- DIN/EN/ISO 17025 accredited laboratory
- Focus: biogas (but also compost, waste)
- Receives samples from all over the world, most of , the samples form D, AU, I, UK
- Leakage detection (> 100 plants/year) and emission analysis in:
  D, NL, I, FR, AU, UK, DK, CH, PRC

- Joachim Clemens:
  - CEO of bonalytic & Head of the gas section (until the end of 2014)
  - Assistant Professor at Bonn University (GHG emissions, biogas biology)

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Own lessons learnt related to emissions from biogas plants

- Within research projects (some of them together with DBFZ, others as direct contractor from the German and Austrian Umweltbundesamt):
  - Whenever you have an aerobic posttreatment the windrows show very high CH_4 (sometimes N_2O) emissions
  - To quantify emissions on a biogas plant it takes a long time, is hard work (expensive) and is not easy (safety):
  - Only emissions from the „gastight“ part is of interest for biogas plant operators
  - There is a big need for affordable leakage detection on biogas plants
  - We defined a method that combines leakage detection with onsite analysis of diffusion through membranes

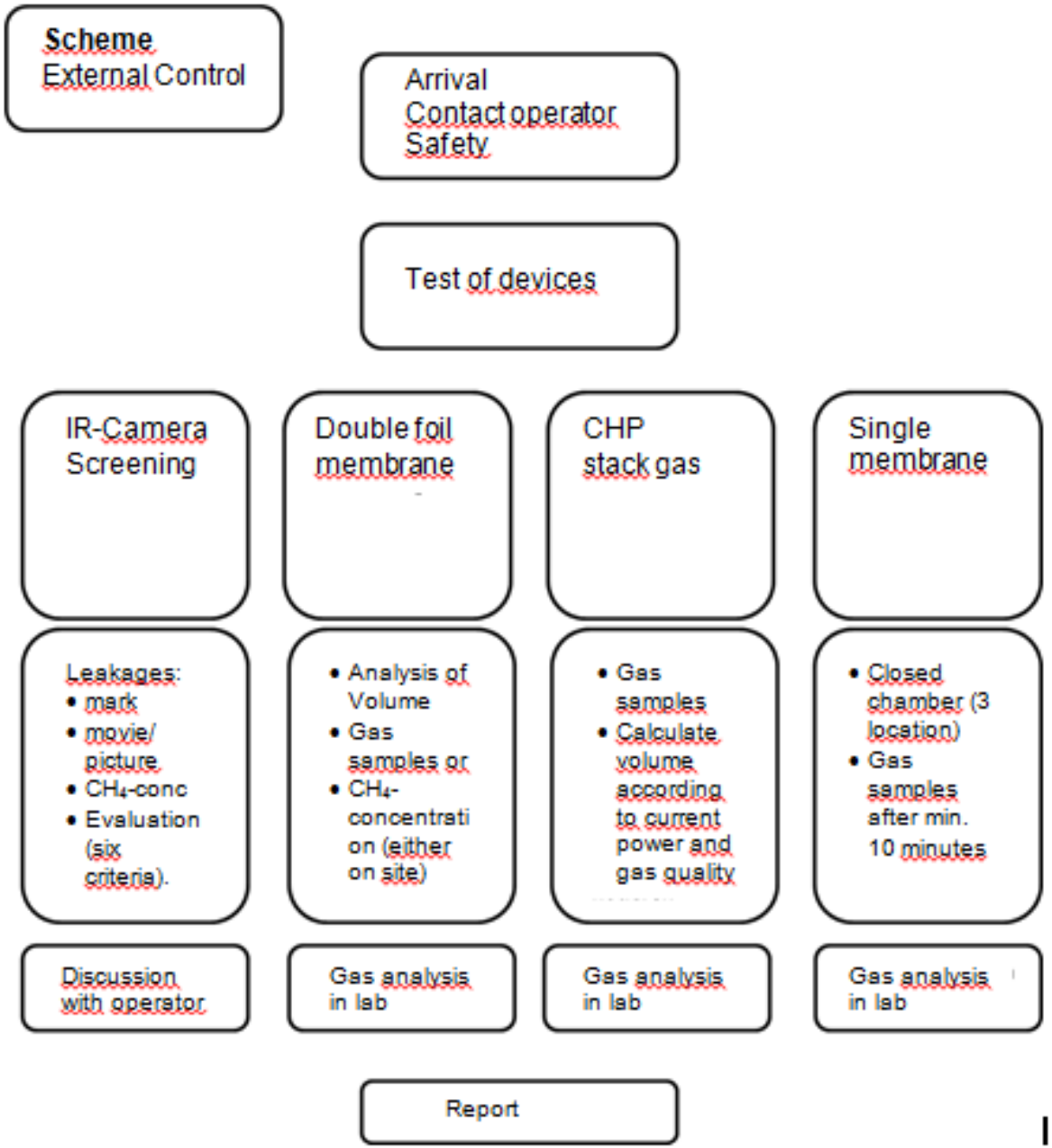
Drivers for Leakage Detection

- Safety (regulations)
- Environment (regulations)
- Economy (operator itself)

- **Prerequiste for the biogas operators: Sources of leakages must be identified**

Our Method for Leakage Detection

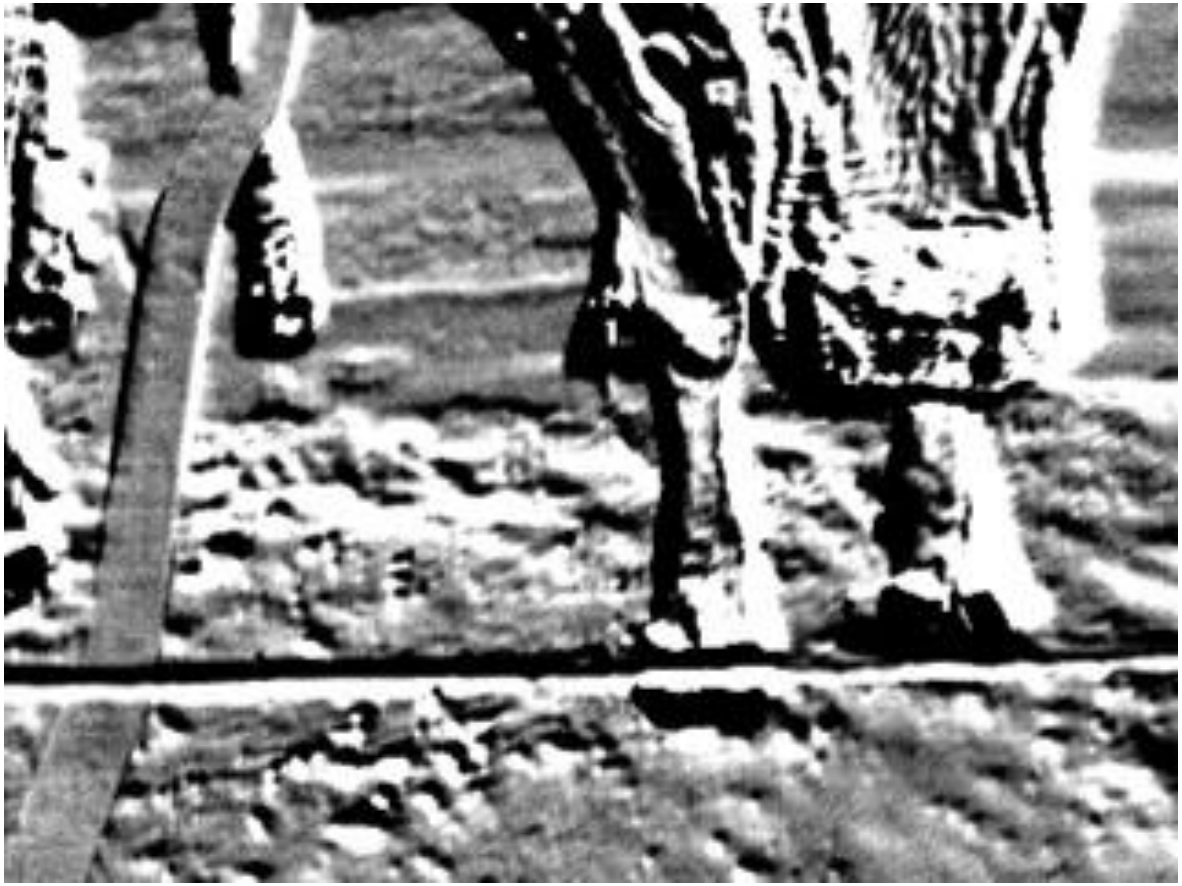
- Identify leakages with a non destructive analytical method (Laser/IR)
  - Anlayse conncentration at every leakage point
  - Evaluate each detected leakage (six criteria including estimation of CH_4 emission rate)
- Analyse diffusion through membranes
  - Double gas holder systems
  - Single membrane systems
- Analyse CH_4 in the stack gas
- Evaluate the biogas plant (including gCO_2/kWh)


Scheme
External Control
Arrival
Contact operator
Safety
Test of devices
IR-Camera
Screening
Double foil
membrane
CHP
stack gas
Single
membrane
Leakages:
• mark
• movie/
picture
• CH_4-conc
• Evaluation
(six
criteria).
• Analysis of
Volume
• Gas
samples or
• CH_4-
concentrati
on (either
on site)
• Gas
samples
• Calculate
volume
according
to current
power and
gas quality
• Closed
chamber (3
location)
• Gas
samples
after min.
10 minutes
Discussion
with operator
Gas analysis
in lab
Gas analysis
in lab
Gas analysis
in lab
Report

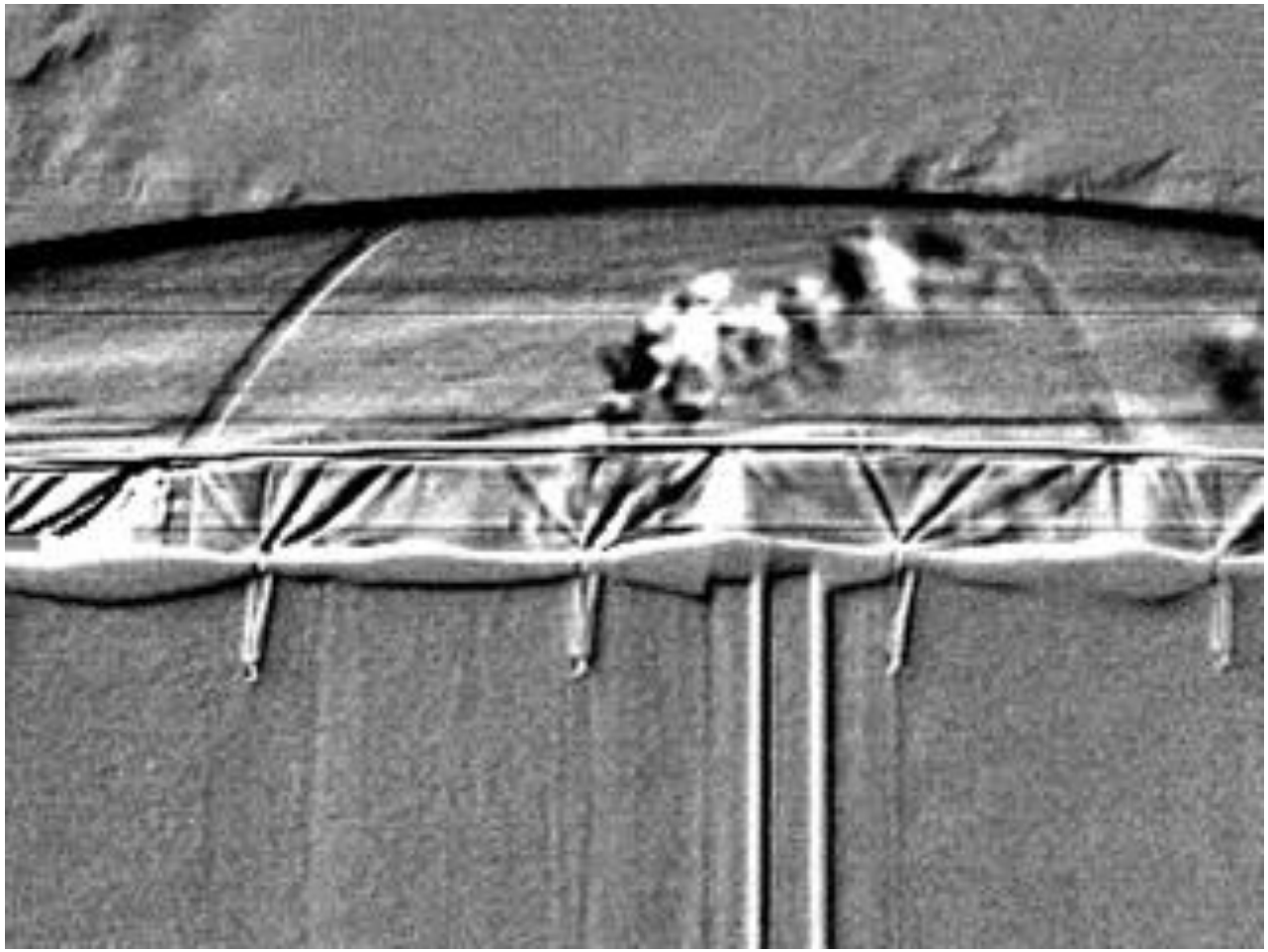
What is more useful (for our purpose): Laser or IR?

- Laser: Methane sensitive Laser (Crowcon Mini tunable diode laser absorption spectroscopy (TDLAS), no additional retroreflector)
- IR-cameras: FLIR GF320 (23 and 38 mm lenses)
- Biogas was released via calibatration gas and flow meter

IR-camera: one of many mobile biogas plants

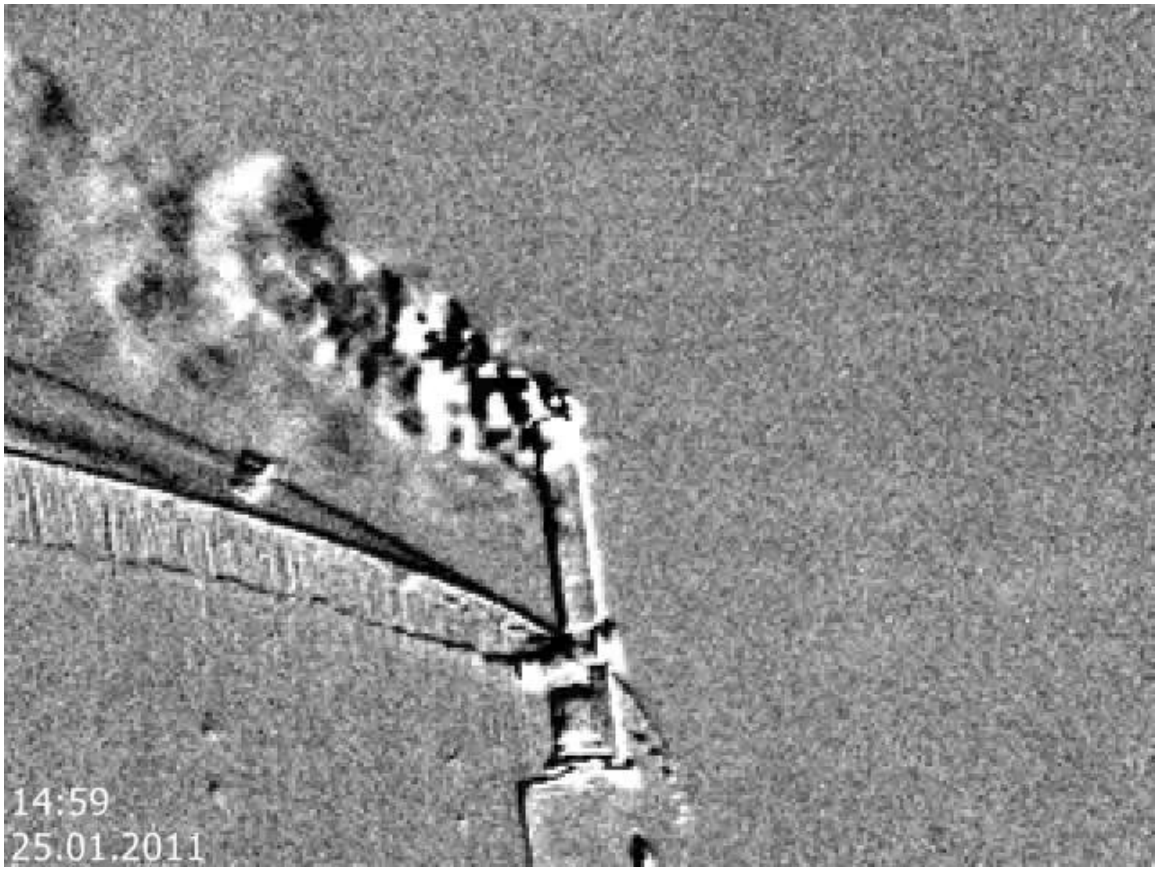


Leakages



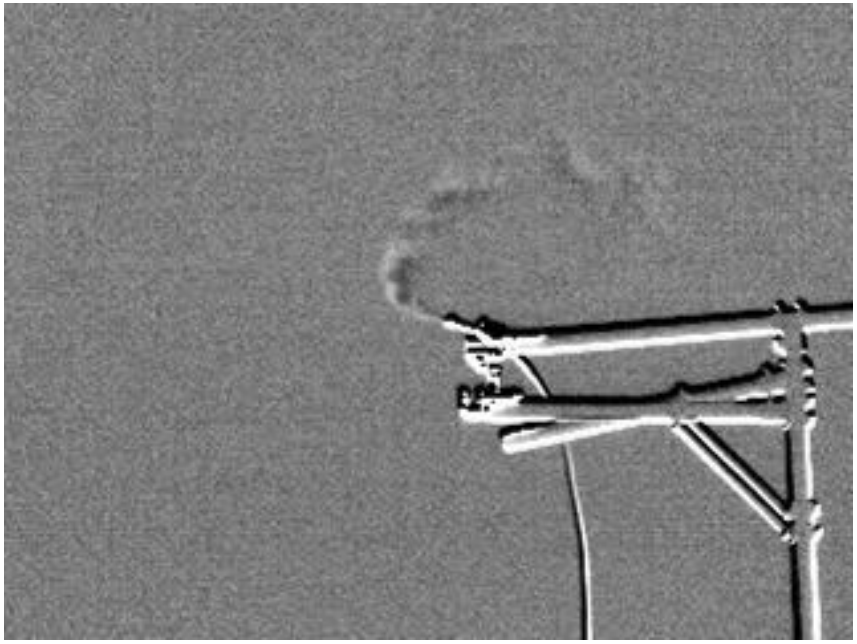
Examples for Leakages

Over pressure valve

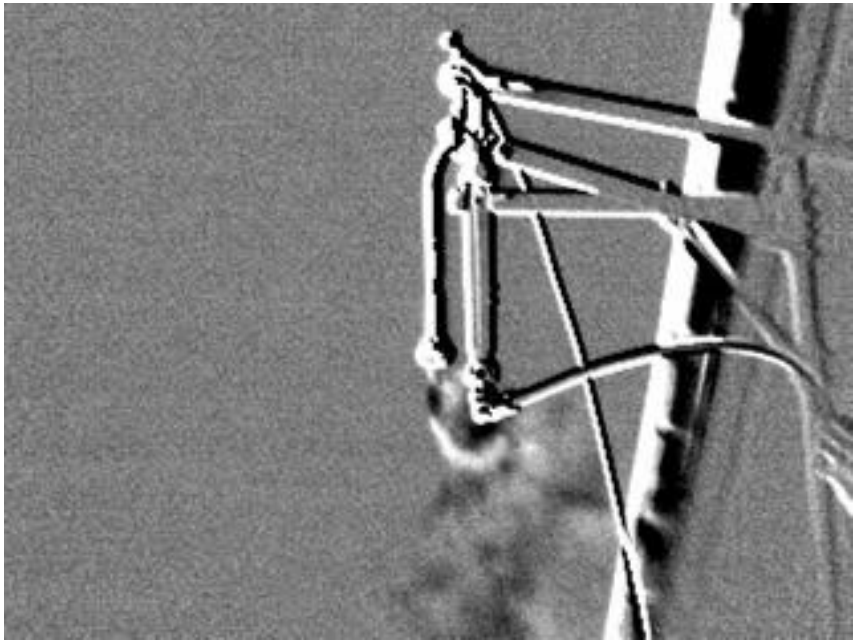


Emissions

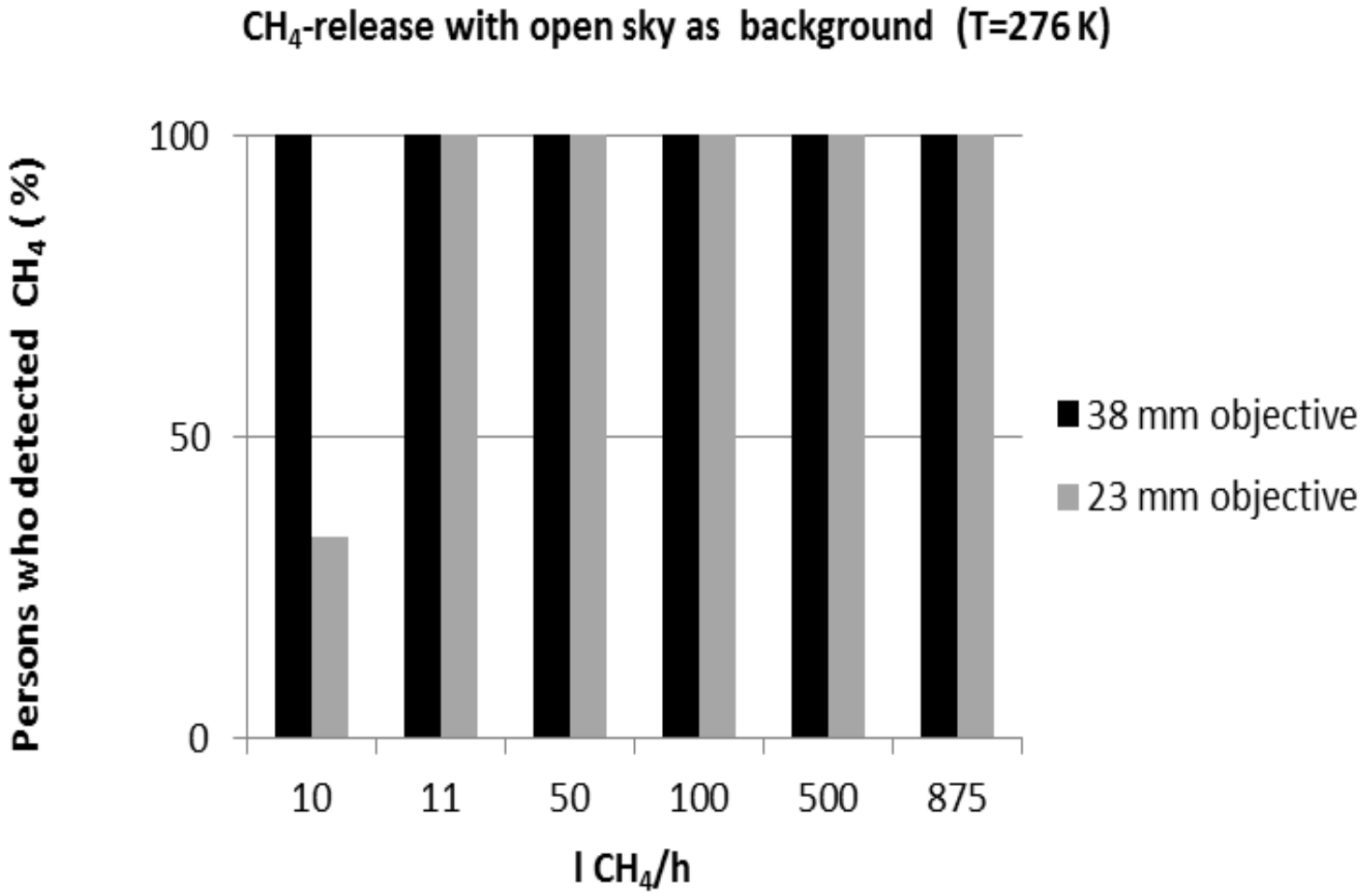
100 Liter CH_4/h



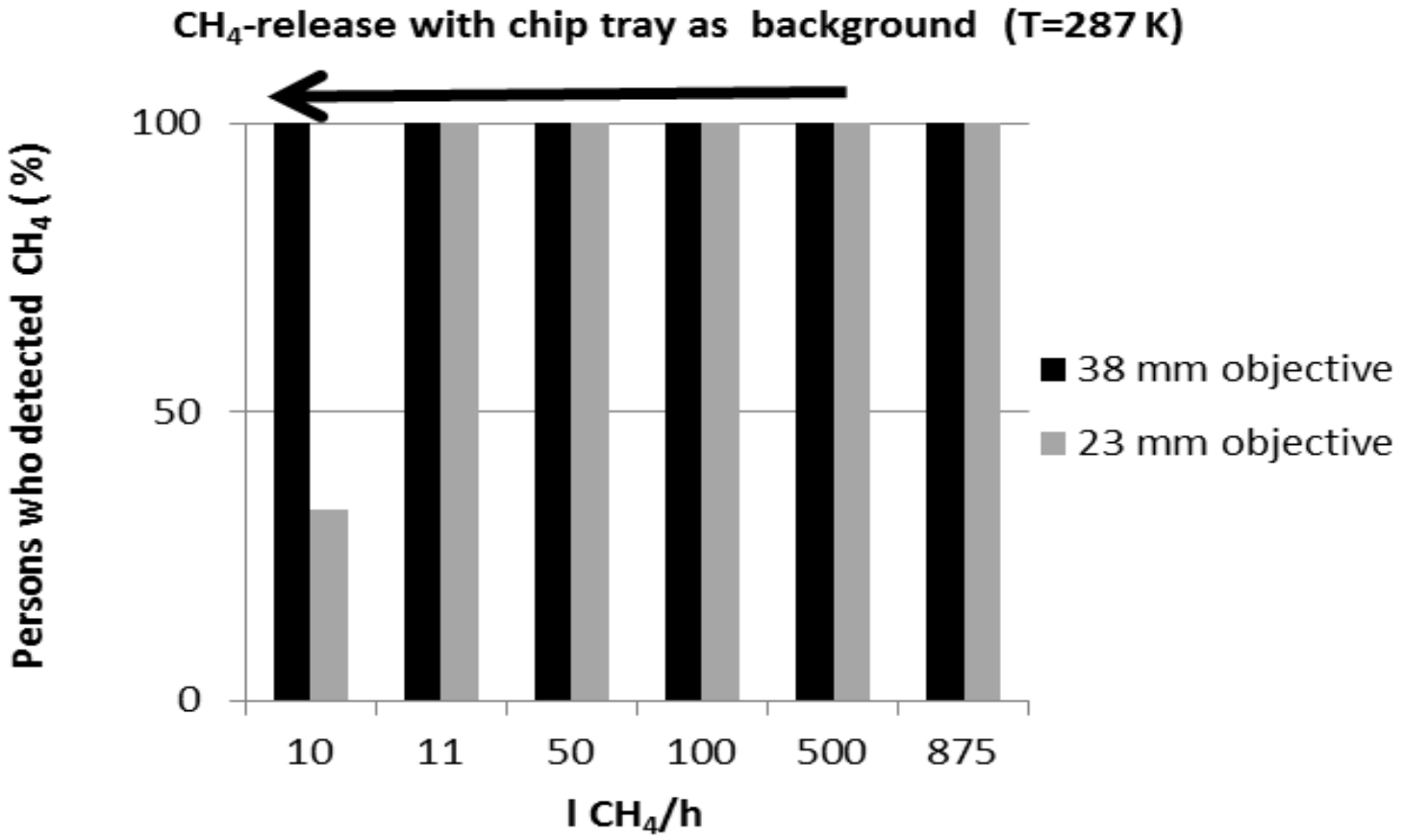
1.000 Liter CH_4/h



IR-Camera I: minimum detection rate

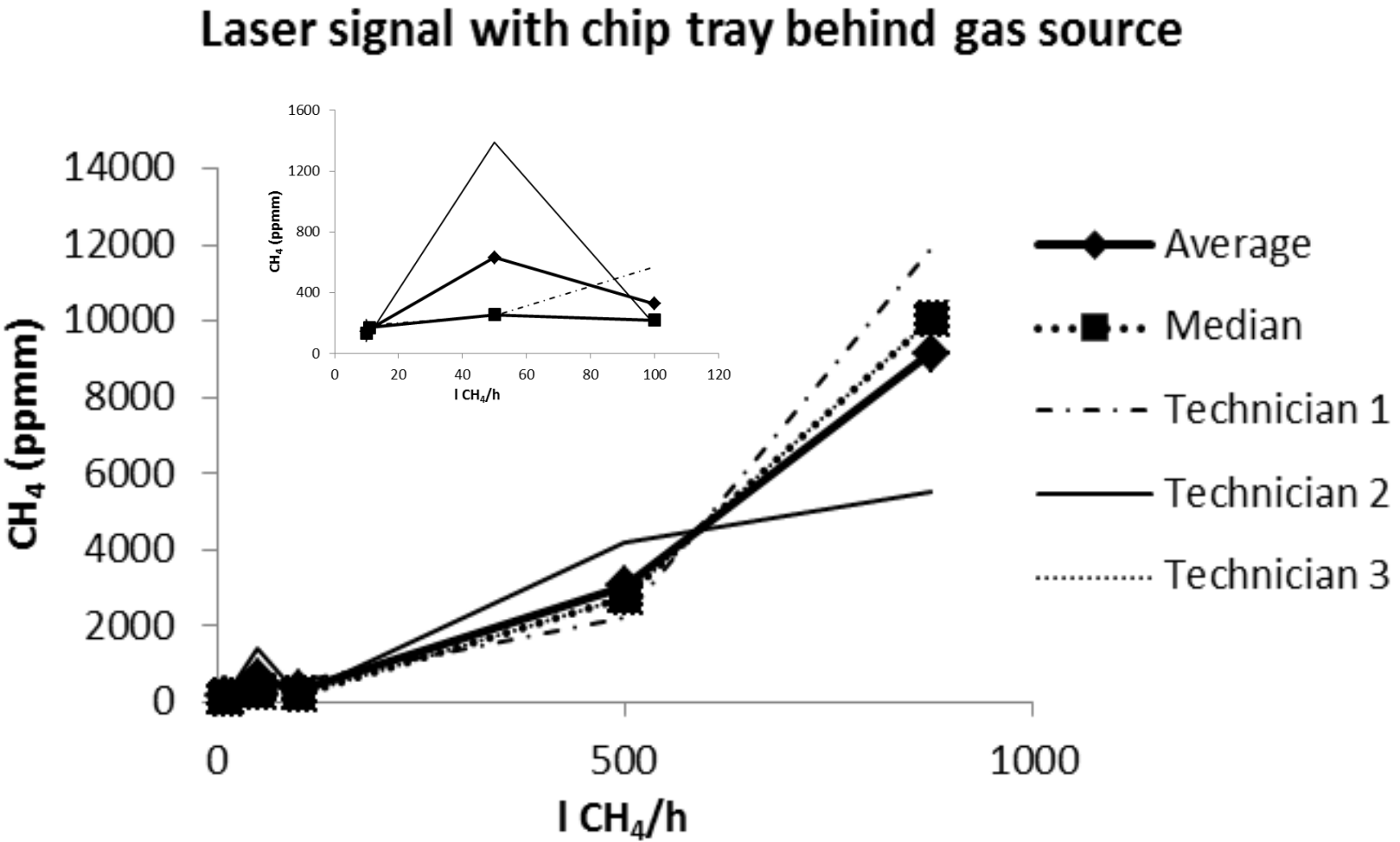


IR-Camera II: minimum detection rate



Laser: minimum detection rate

- Without a reflection possibiliy there was no CH_4-signal (especially a problem for wall/roof connection)



Detected leakages on plants – a comparison

	IR-camera	Laser
leakages located at the mounting ring between fermenter wall and gas holder membrane	4	1
Leakages on a concrete roof	5	4

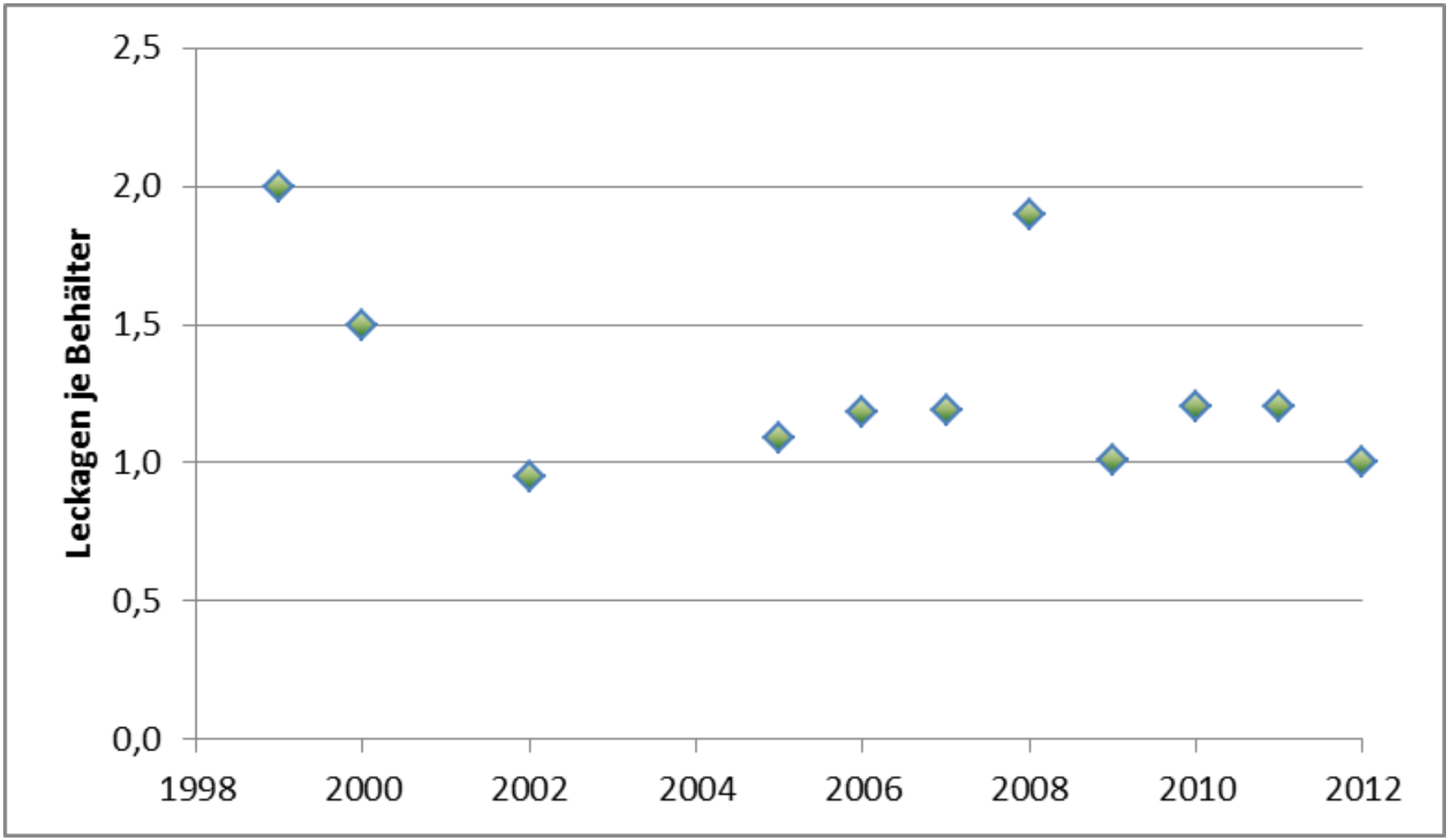
…. Comparison is ongoing!!!

Laser or IR-Camera- our conclusions

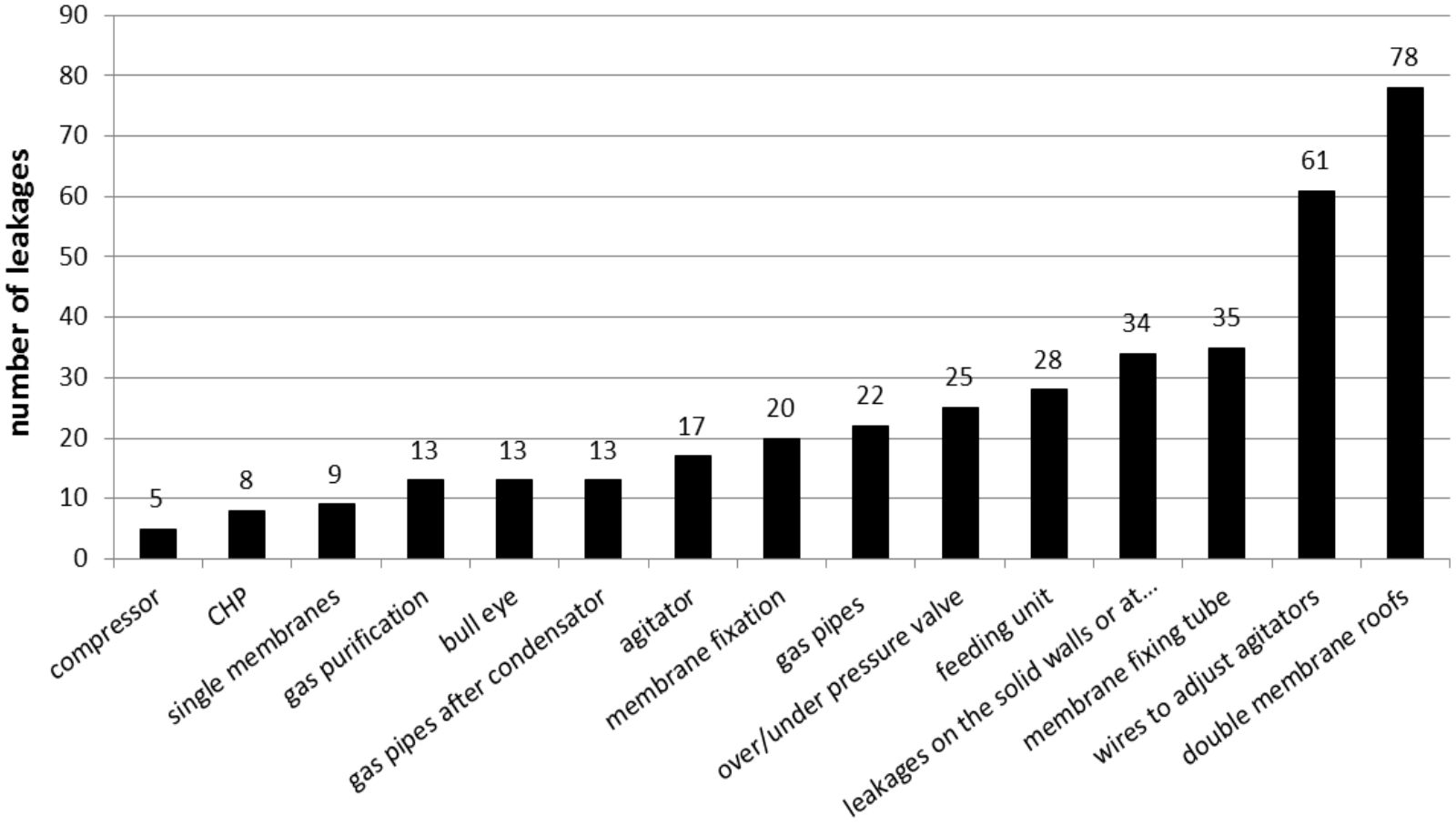
- The IR-camera can detect emissions starting from 11 l CH_4/h
- With a IR-camera the plant has to be checked from different angles, otherwise leakages may not be detected.
- The laser is useful in rooms for a first screening
- The laser does not detect CH_4 without reflector, this makes handling difficult
- Membranes show poor reflection

We prefer the IR-camera

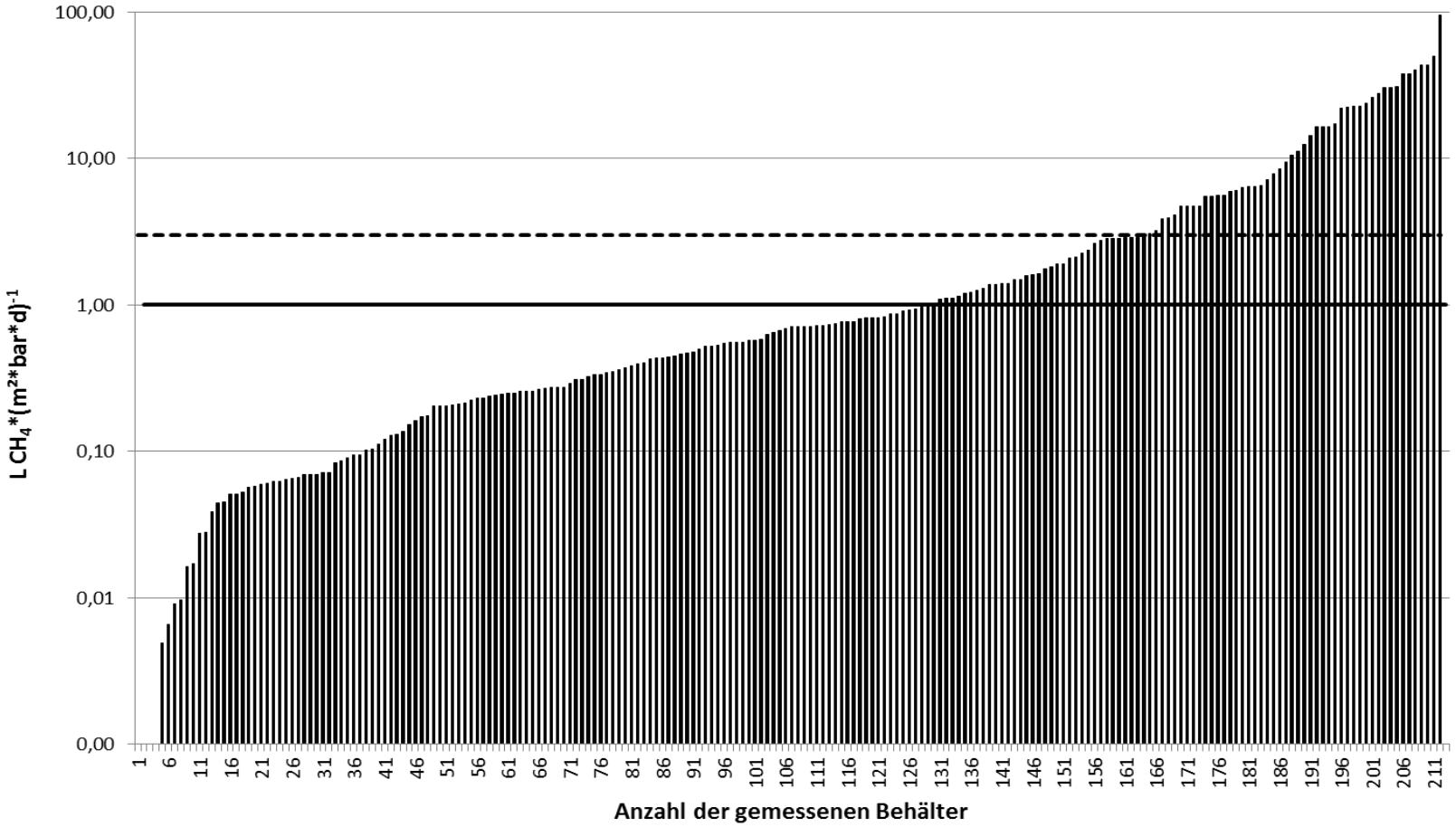
Leakages per Fermenter (combined with the start of fermenter´s operation)



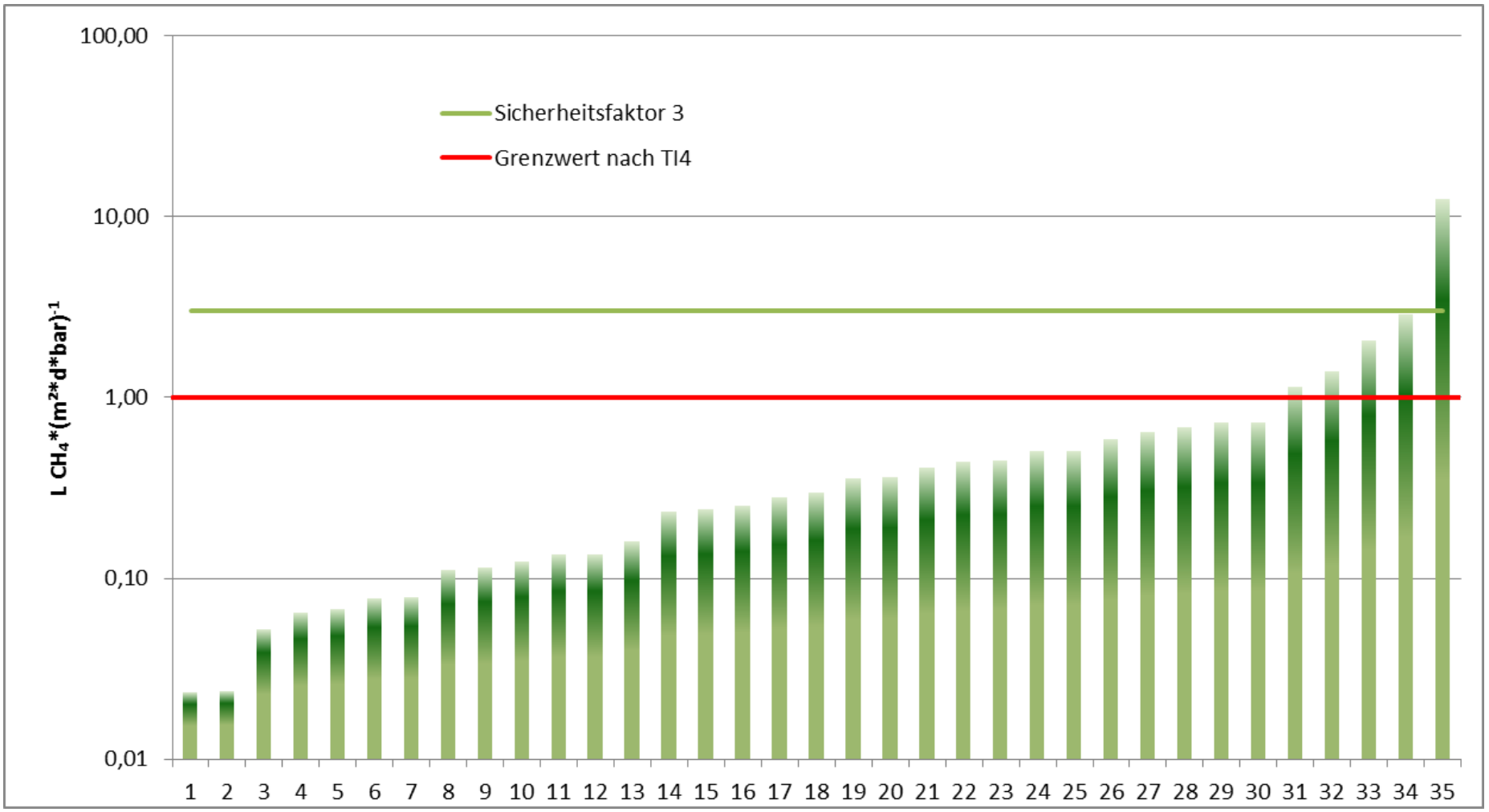
Most frequent leakages



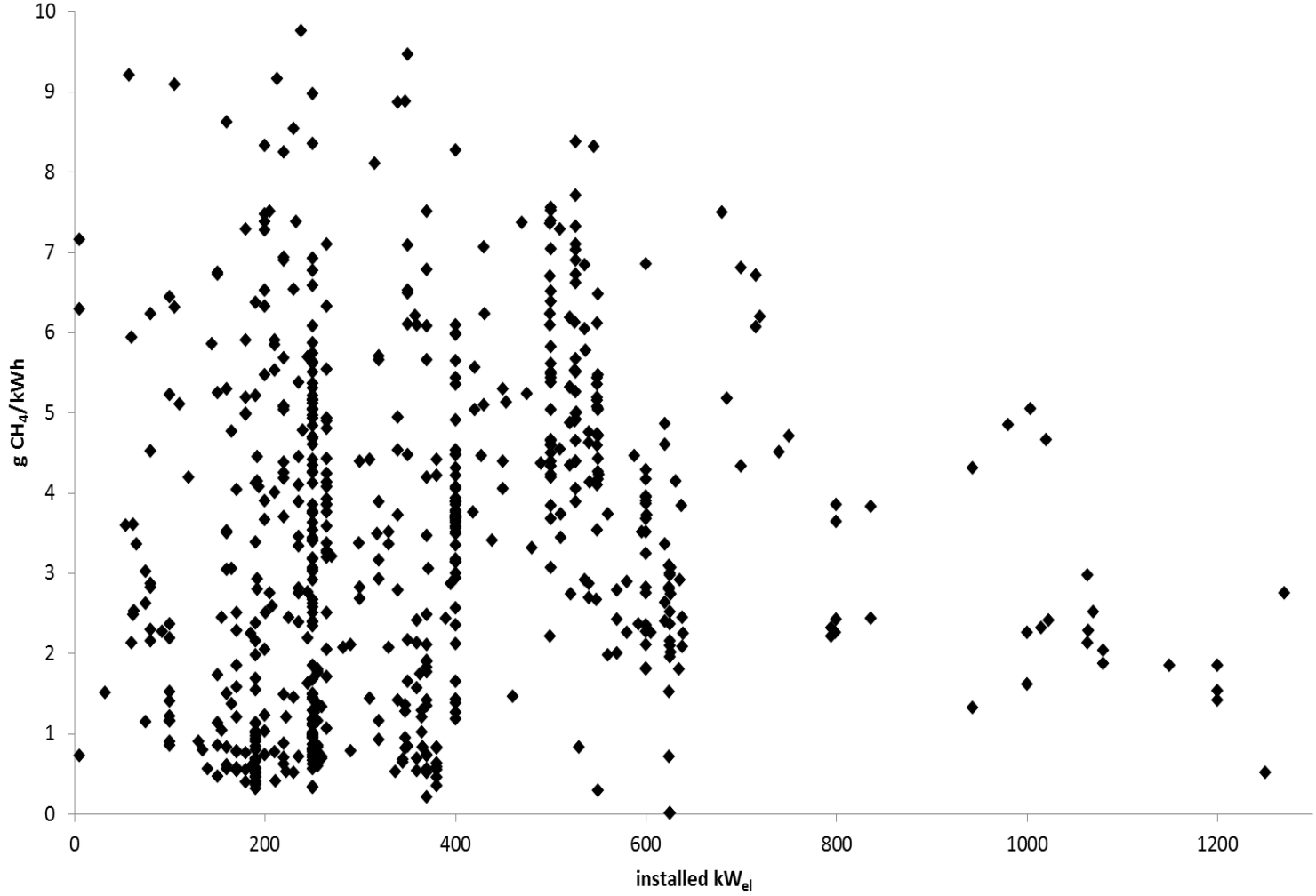
Gas permeation at double membrane roofs



Gas permeation at single membrane roofs



CH_4 in Stack Gas



Summary

- The IR camera is more suitable to detect leakages as compared to the laser system. When performing an IR analysis the plant has to be checked from different angles, otherwise leakages may not be detected.
- An IR camera analysis is the first out of different steps to check an AD plant on leakages.
- AD plants under operation reveal leakages that increase the carbon footprint of the technology and may be a safety risk.
- To reduce CH_4 emissions a regular leakage control is recommended. Frequent on site leakage control should be combined with an external leakage check on a yearly base.
- For biogas plant operators the presented leakage method is sufficient to optimze their biogas plant, detailed emission analysis is not necessary for them.

- An emission analysis –dependend on the size and the ordered analysis- costs between 600 – 2.500 €

Last but not least

- We need an accepted method for leakage detection!
  - Funding member of the working group „Qualitätssicherung Methanemissions-messung an Biogasanlagen“ (QMaB; www.qmab.de)
- Current activity of Biogas Fachverband, DWA and DVGW to define a method for leakage detection)
- **Bonalytic Advertisement :**
  Our leakage method is accredited according to DIN/EN/ ISO 17025
  (so far emission reports available in GE, EN, IT – we are looking forward to expand our report portfolio)

THANK YOU!

Further information & Download of a manuscript (from 15.September on): www.bonalytic.de