13° Fórum do

BIOGÁS

O ponto de encontro internacional de investidores em **BIOGÁS** e **BIOMETANO**

VAISALA

Importance of online gas quality measurement in biogas and biomethane

Antti Heikkilä, Vaisala Oyj

AGENDA

1. Raw biogas drying and filtration to remove H2S: why humidity measurement is important

2. Inlet of biogas upgrading to biomethane: avoiding condensation at compressor and process control

3. Biomethane quality analysis, comparison study vs Gas Chromatograph

4. Conclusions

Raw biogas drying and filtration to remove H2S: why humidity measurement is important

1

Internal

ABiogás

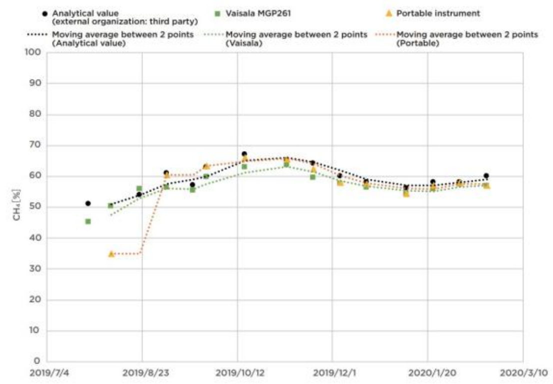
Optimization of anaerobic digester

- Online CH4 and CO2 measurement at digester outlet is important for maintaining stable biogas production

- Detect process problems early

- Keep CH4 high enough for use in engine or biogas upgrading system

- Simple transmitter installed directly in process pipe is much more simple and less expensive to operate than traditional gas analyzers

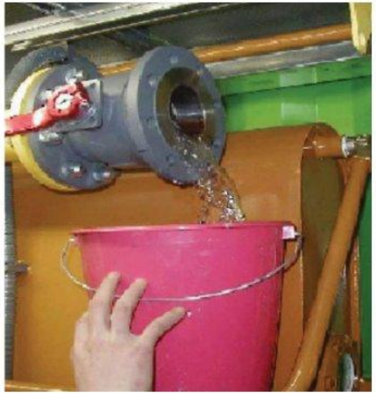


Challenges caused by humidity in biogas

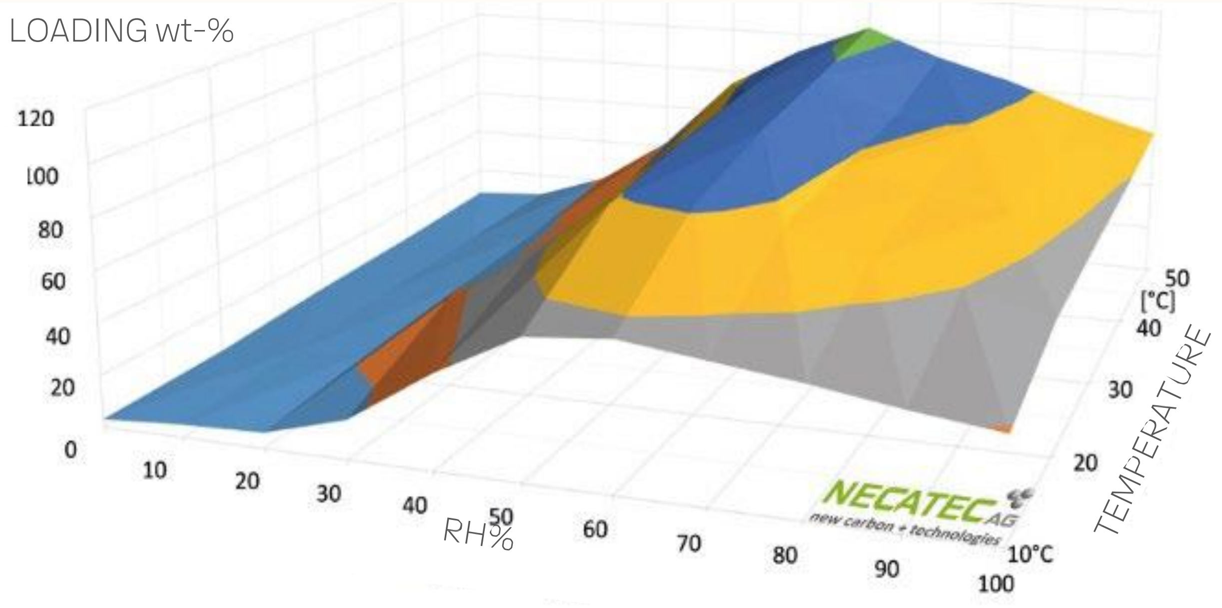
- Biogas is produced in anaerobic reactors at elevated temperature and close to 100% relative humidity
- Condensation in gas equipment must be avoided for reliable operation of the plant
- Corrosion caused by Hydrogen Sulfide or Ammonia depends on humidity – in relatively dry gas the corrosive effects are smaller
- Gas filtration by activated carbon and similar surface active materials has an optimal humidity level which is not 100% rh
- Typical biogas CHP engine specifications for humidity:

Inlet gas temperature of 5 to 25 °C: Relative humidity must be < 80%

Inlet gas temperature of 25 to 35 °C: Relative humidity must be < 50%



Active carbon filtration efficiency and humidity



- Filtration efficiency depends strongly on humidity
- Too high humidity is bad and condensation can ruin the filters completely → drying is needed
- Too low humidity drops efficiency significantly
- Best results in 50 … 70 %RH range
- In dew point units this means maintaining dew point 8 …10 °C below gas temperature

LOADING wt-%: 0-20, 20-40, 40-60, 60-80, 80-100, 100-120

Laboratory test with 2400 ppm H_2S in nitrogen with 0.5 vol-% oxygen Diagram courtesy of Negatec AG

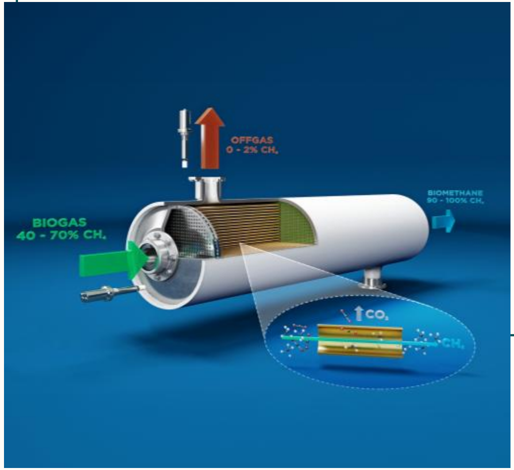
Inlet of biogas upgrading to biomethane: avoiding condensation at compressor and process control

2

ABiogás

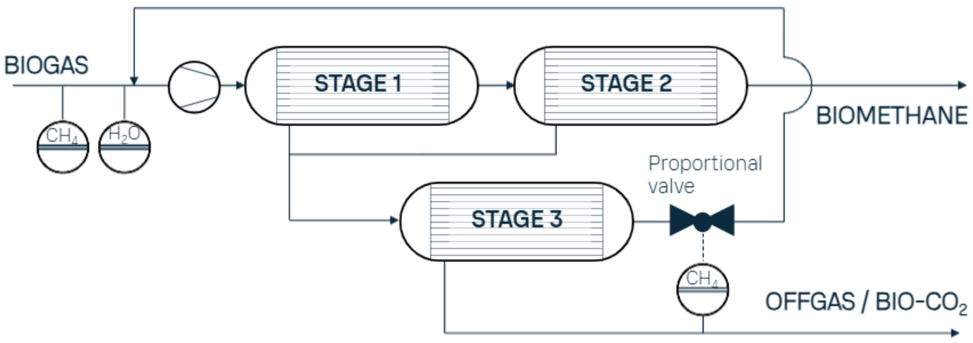
BIOGAS UPGRADING

- Most biogas upgrading technologies rely on elevated pressure and use gas compressors that are sensitive to moisture
- Membrane technology and pressure-swing adsorption technologies also require a large surface area of active material → increased sensitivity to condensation



ABiogás

Protect membranes with humidity control



	Inlet	Stage 1
Temperature	21 °C	50 °C
Pressure	0 bar(g)	15 bar(g)
Moisture	8700 ppm	8700 ppm
Dewpoint	5 °C	50 °C

CONDENSATION!

- Upgrading with membranes requires a process pressure typically in 10...15 bar range
- If the dew point of raw biogas is too high before compression, condensation will occur after compression even at high temperatures.
- Maintaining dew point at or below 0 °C is important for trouble-free operation of the upgrading plant – upgrading equipment is more expensive and delicate than a CHP engine
- Besides measuring water vapor, measurement of CH4 in inlet, biomethane and offgas streams helps in optimizing process pressure and amount of recirculation to the front of the upgrader

Biomethane quality analysis, comparison study vs Gas Chromatograph

3

ABiogás

Overview

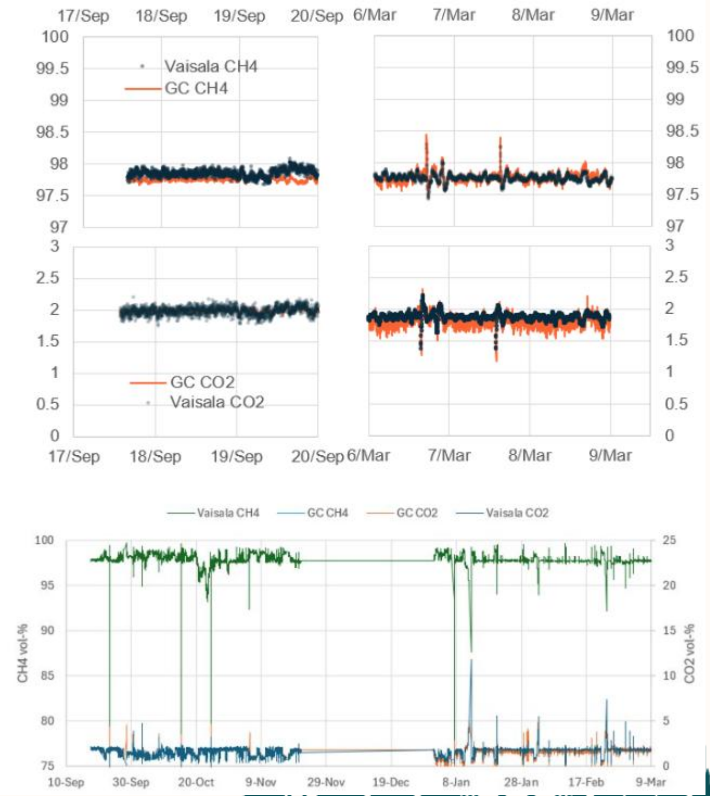
- Test carried out together with Fluvius, the natural gas grid operator in Belgium
- Test location is a biomethane to natural gas grid injection point operated by Fluvius
- Goal was to determine the suitability of simple NDIR transmitter as a fast response time 'watchdog' for off-spec biomethane
- Gas chromatograph remains as the calorific value (CV) determination device for custody transfer
- Other instruments include dew point transmitter and Oxygen transmitter

GC
- CH4
- CO2
- CV
- Wobbe

VAISALA MGP261
- CH4
- CO2

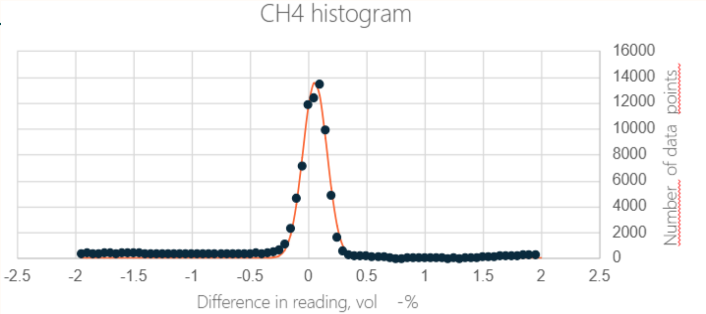
Long term stability

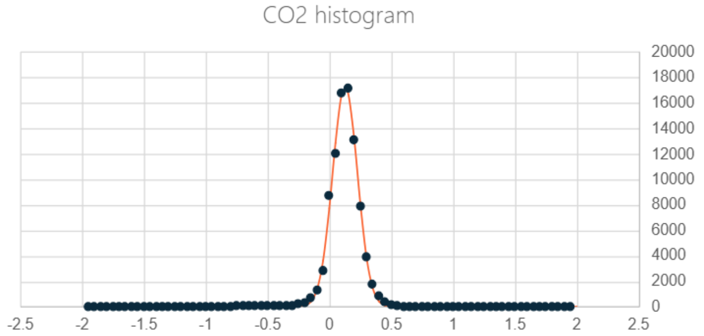
- Agreement between GC and Vaisala MGP261 was good both in the beginning of the test period (September 2025) and at its end (March 2026)
- Graphs at top show a comparison between first and last days of the test in a detailed view, no systematic drift detected
- In the overall results (bottom), agreement is equally good, but details are harder to make out due to the large amount of data (95000 points for each measurement)
    - Periods where GC underwent automatic calibration have been filtered out for clarity
    - Vaisala readings in this plot are not corrected for pressure changes



Statistical analysis

- Due to large quantity of data (over 95 000 rows) it was easiest to plot the difference between Vaisala and GC as a histogram
- The barometric pressure effect has been corrected from the histogram plots to the right
- Solid curves are gaussian distributions plotted to the data, x-axis is difference to GC readings in vol-% and y-axis is number of data points
- Compared to the gas chromatograph, Vaisala shows:
  - 593 ppm bias and 1034 ppm standard deviation for CH4
  - 1035 ppm bias and 1004 ppm standard deviation for CO2
- Conclusion: Vaisala's performance is well within its target ±1% accuracy and 99% of data is within 0.5 vol-% of gas chromatograph readings after barometric pressure compensation
  - Vaisala MGP261 results have been corrected for barometric pressure variation from 1013 mbar in post-processing, this accounts for the uneven distribution from 0 to +2% in the CH4 curve





ABiogás

Conclusions

4

Conclusions

- In situ transmitter for CH_4, CO_2, and H_2O can be as accurate as a gas chromatograph
- Humidity measurement in biogas is critical and must be done in situ
- Simple transmitter without moving parts, sample gas treatment or calibration gas bottles offers better value than gas analyzers

Visite o estande da VAISALA

S07

Baixe o guia para medir os principais parâmetros do biogás:

THANK YOU!


BIOGÁS
CEOS: ESTRATÉGIAS E INVESTIMENTOS
COMO AS EMPRESAS ESTÃO CONSTRUINDO O MERCADO
Alexandre Röpke
Daniel do Valle
Denis Soncini
Mauricio Carvalho
Pierre-Emmanuel Moussafir
Ricardo Colpo
MODERADOR