
tunable
Simple, fast and reliable Multi gas measurements

Introduction

who and why we are

In the next 10 years data stream revolutions as Industry 4.0, IoT and AI will redefine our view on process optimization and automation.

Process optimization is only possible with reliable process data. Efficient measuring techniques are essential for this.

Existing gas analysis technology has limitations – Tunable have the next generation technology – representing a giant leap in collecting reliable measurements from the air, process gases, fluids or exhaust.

Making the world's most versatile gas analyzer

Using nano- and microtechnology, we miniaturize a gas analyzer from room size to a sugar cube. Making a disruptive solution on analysis capability and cost.

Tunable - a high tech company

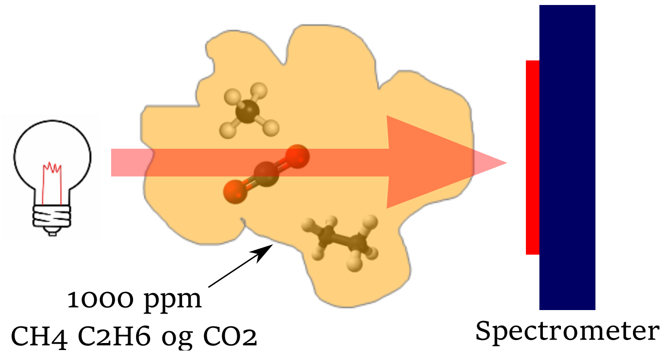
Established 2015 to develop and deliver a high sensitive multi gas analyzer based on micro and nano technology

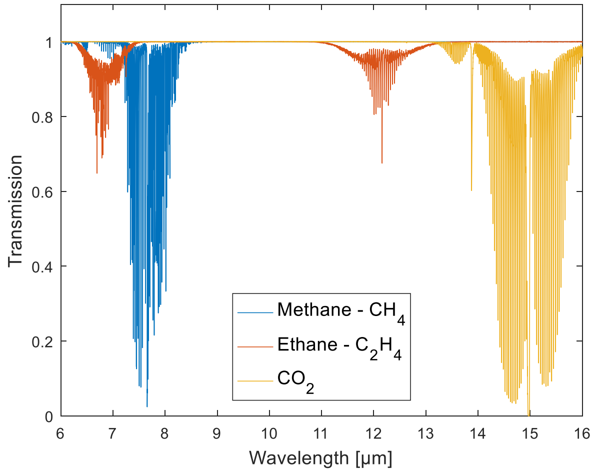
11 employees – World class technology competence in development of micro and nano technology in sensors and gas analysis

Behind Tunable is a team with impressive company growth track record and financial strength

Technology

Use of optical spectroscopy in multi gas analysis

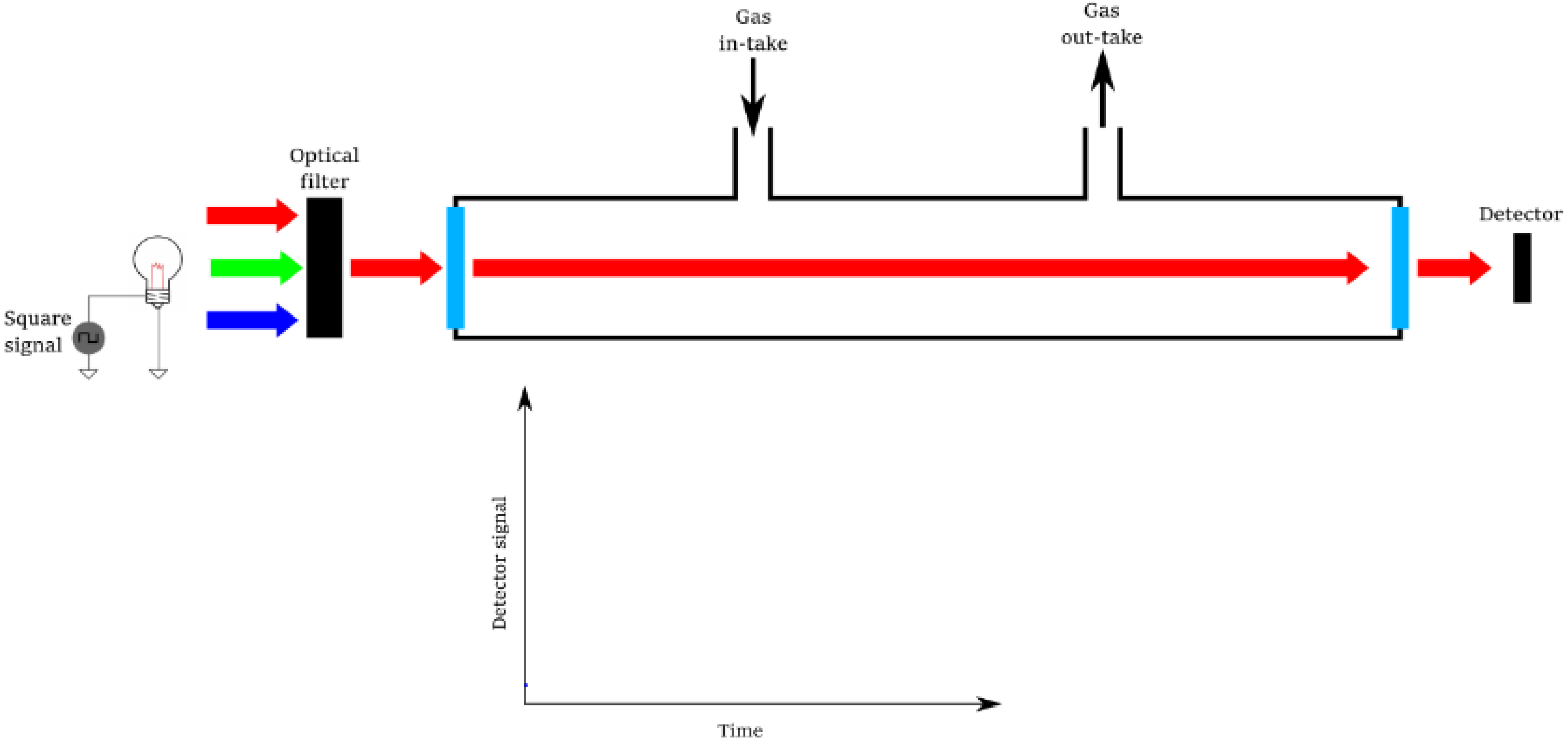




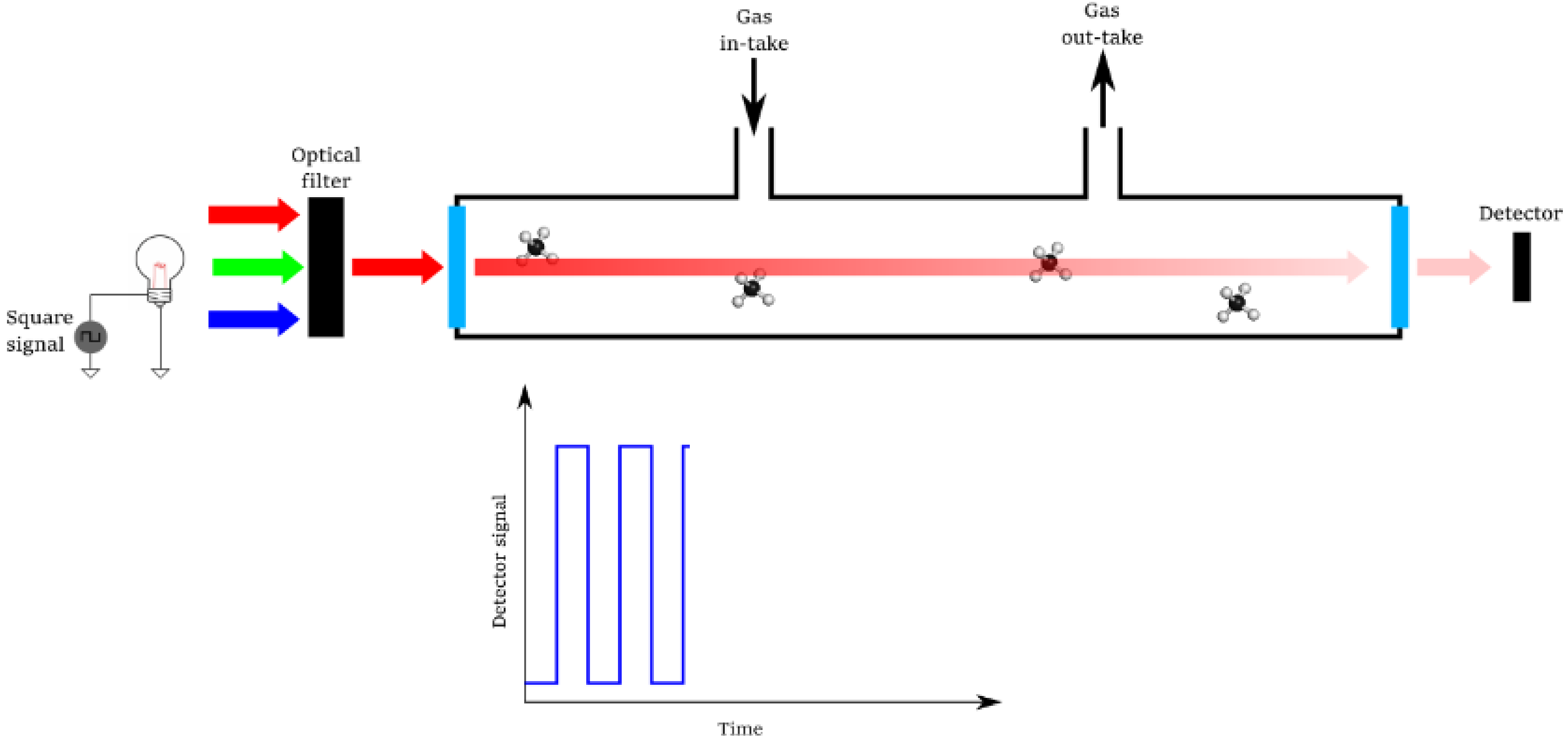
Beer's law:

$T=T_0 \exp(-c\ \alpha\ l)$

Basic principle for measuring gas



Basic principle for measuring gas

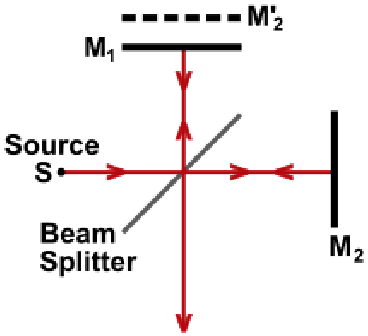


How an optical filter is implemented

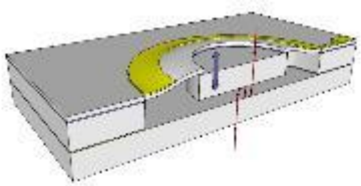
Prism

Filter wheel

FTIR

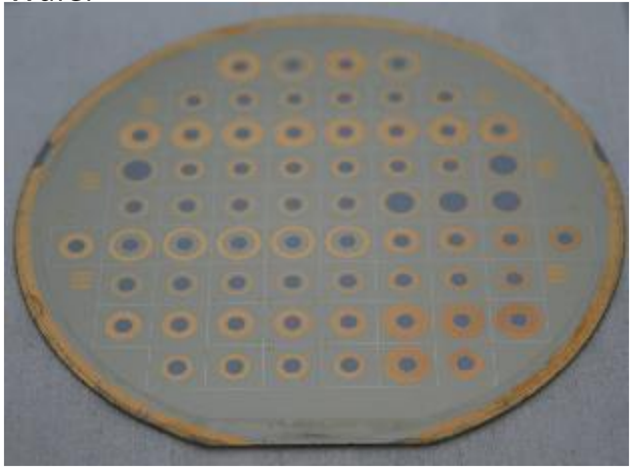


Micro Mechanical Fabry-Perot

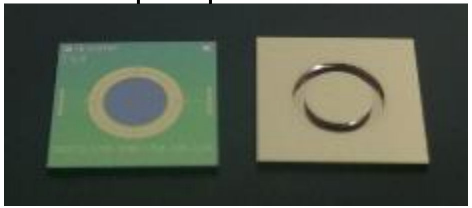


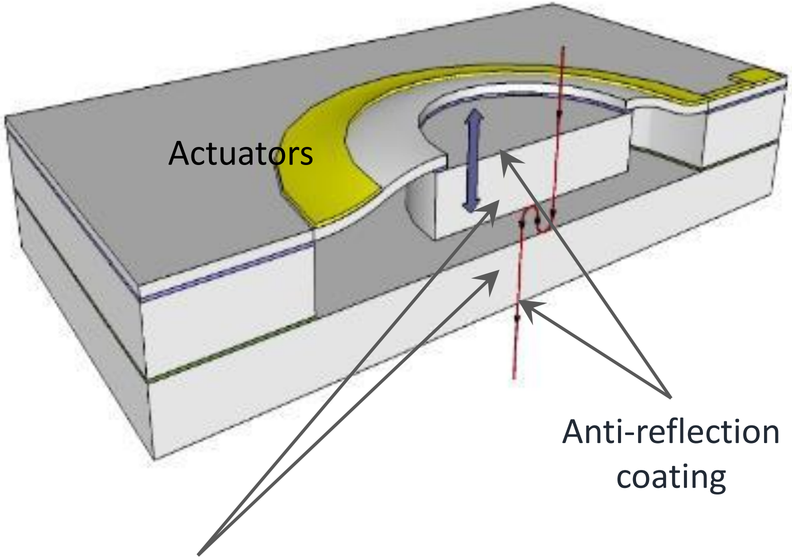
Production of Fabry-Perot

Wafer

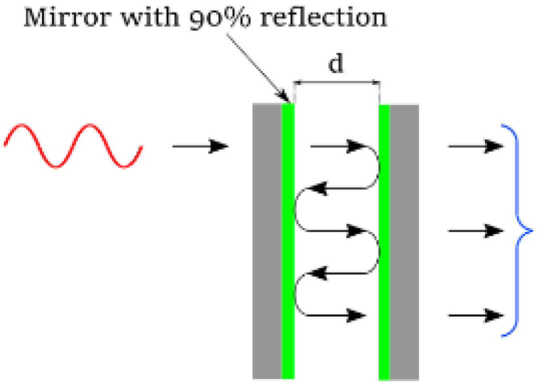


Diced top chip



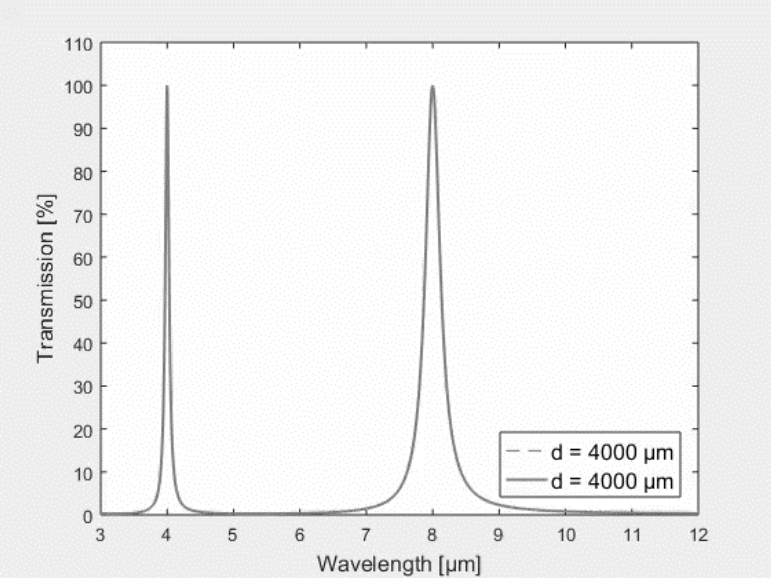


Fabry-Perot

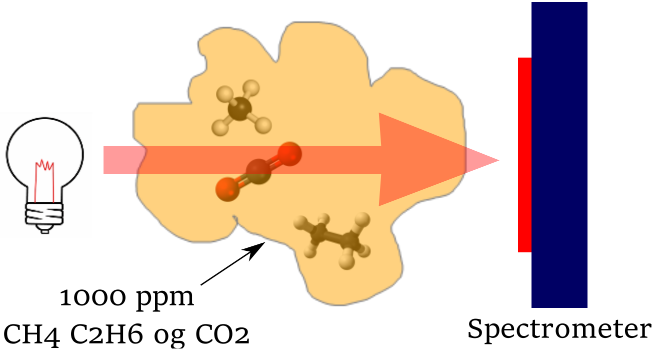


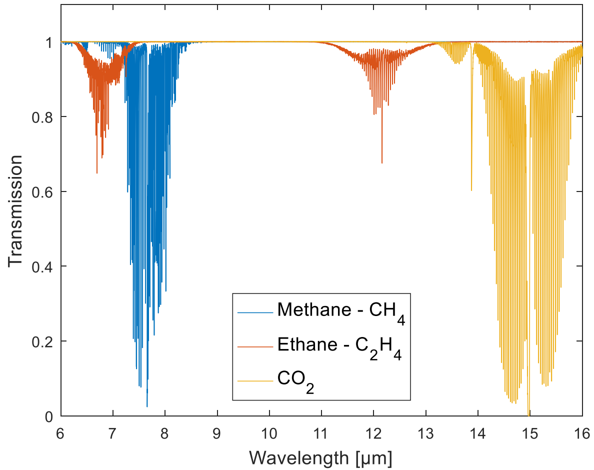
Constructive interference when

$$d = n\frac{\lambda}{2}, n = 1,2,3 \ldots$$



Infrared light is absorbed in gas





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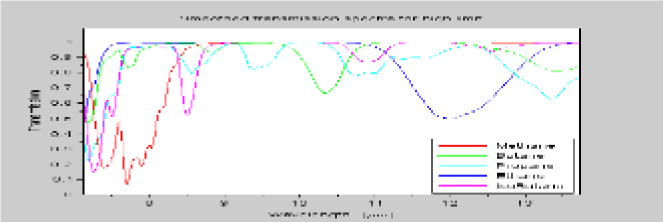
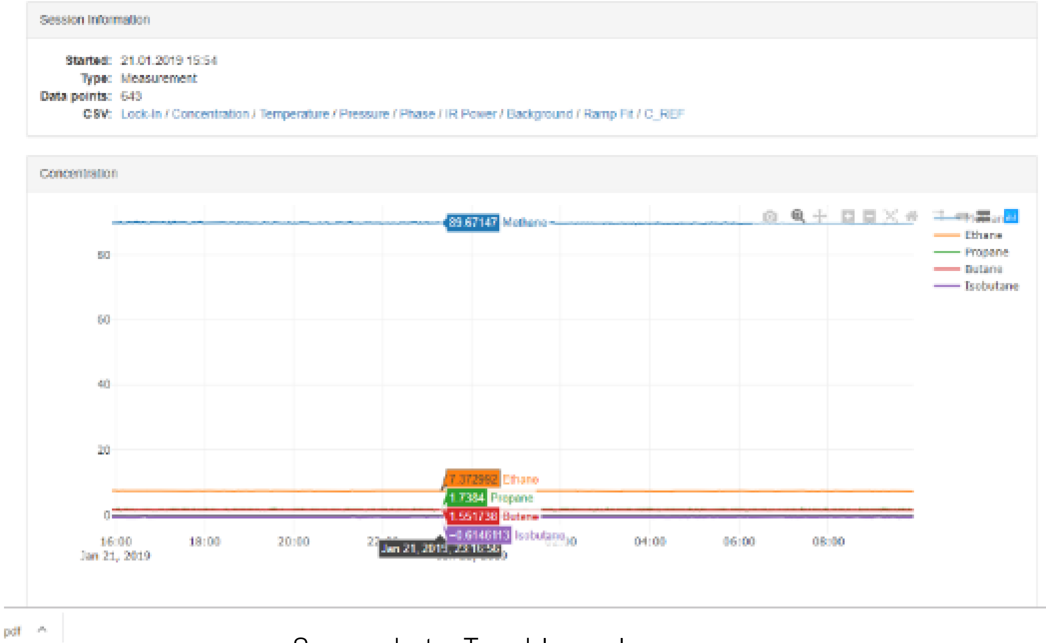
User data stream

The concentration of each gas is measured real time in %Volume / % mol of analysed gas stream.

Data is available as through RS485/Ethernet and can be presented by the Tunable analyzer SW on PC/Tablet.

Component	Range	Accuracy
Nitrogen	0-20%	Balance
Methane	0-100%	0.5%
Ethane	0-25%	0.5%
Propane	0-25%	0.5%
Iso-Butane	0-10%	0.2%
N-Butane	0-10%	0.2%
C5 (N and Iso Pentan)	0-3%	0.2%

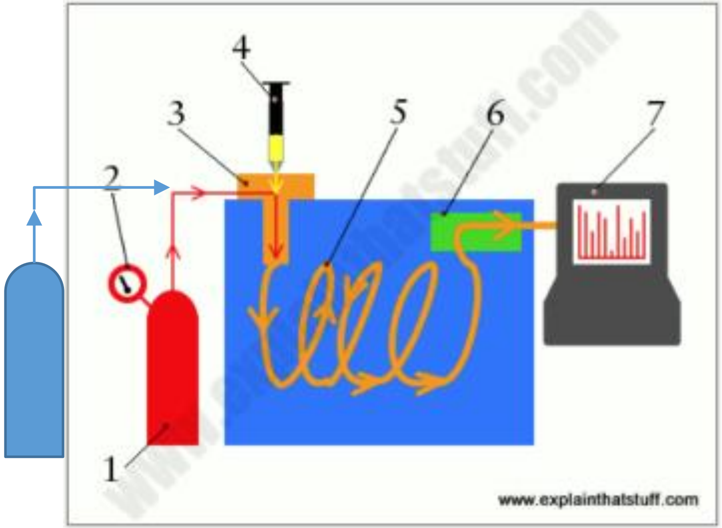




Screenshot – Tunable analyzer

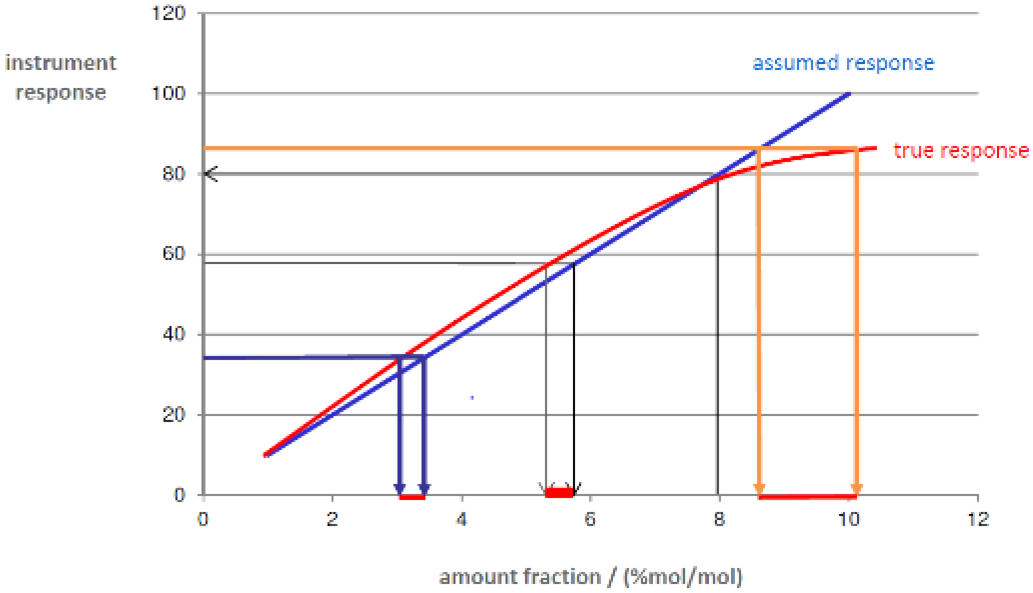
Optical versus GC

How does a GC work?



- Gas separation though a capillary tube, 30-60 meter long, often heated
- Gas separation a function of flow and surface chemistry
  - Changes over time => drift
- Needs a “Calibration gas” to compare with
  - Only accurate at calibration point
- A GC can never be more accurate than the calibration gas

GC nonlinear response



A GC has a nonlinear response, giving deviations if not corrected for

Needs multiple calibration gases

The GC response change over time

The GC is a comparator, only correct around the concentrations of the calibration gas

From: Instrument Performance Evaluation, comparing ISO 10723 and NORSOK I-106
Dr Paul Holland, EffecTech Group & Jon Carlsen, Norsk Analyse
North Sea Flow Measurement Workshop 2017

	Gas chromatography	Optical methods
Measurement method	Indirect (time separation)	Direct (absorption by molecules)
Carrier gas	Yes, helium, argon or hydrogen	None, but zero offset calibration with nitrogen to reduce maintenance needs.
Calibration mixture	1) At least one needed 2) Several needed for high accuracy	Not needed
Maintenance	Column need to be changed (18 months, dependent of gas and how clean the gas is)	None or little maintenance needed if clean gas (filters etc)
Repeatability	High at calibration gas concentration (comparator), typically 0.01% Lower at other concentrations	Medium
Accuracy	Never better than the accuracy of the calibration gas 1) Accuracy of calibration gas +/- 2,1, 0.5 or 0.25 %? 2) Calibration gas life time 3 months 3) Special storage, shaking and rotation of cylinder required to obtain 3 months life time	Medium
Response time	3 to 20 minutes	0.01 to 2 minutes
Cost of ownership	High	Low
Size	Cabinet with gas bottles	Small (25x24x42 cm^3)

Compact Natural gas analyzer, needs only power

Measurement range

Component	Range	Accuracy
Nitrogen	0-20%	Balance
Methane	0-100%	0.5%
Ethane	0-25%	0.5%
Propane	0-25%	0.5%
Iso-Butane	0-10%	0.2%
N-Butane	0-10%	0.2%
C5 total	0-3%	0.2%

Hazardous zone

Zone 1 group IIB

Power & communication

Power <5W

Communication: RS485 Modbus and Ethernet

Calibration and consumables

None. Does not require calibration gas or carrier gas.

Dimensions

420mm/250mm/240mm

Summary

- Optical methods are well suited for analysis of composition of natural gas
- Optical instruments will not replace the GC (due to all a high number of standards made for GC), but will offer a low cost alternative, enabling measurements at new places for process optimization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