Institute of Combustion and Power Plant Technology

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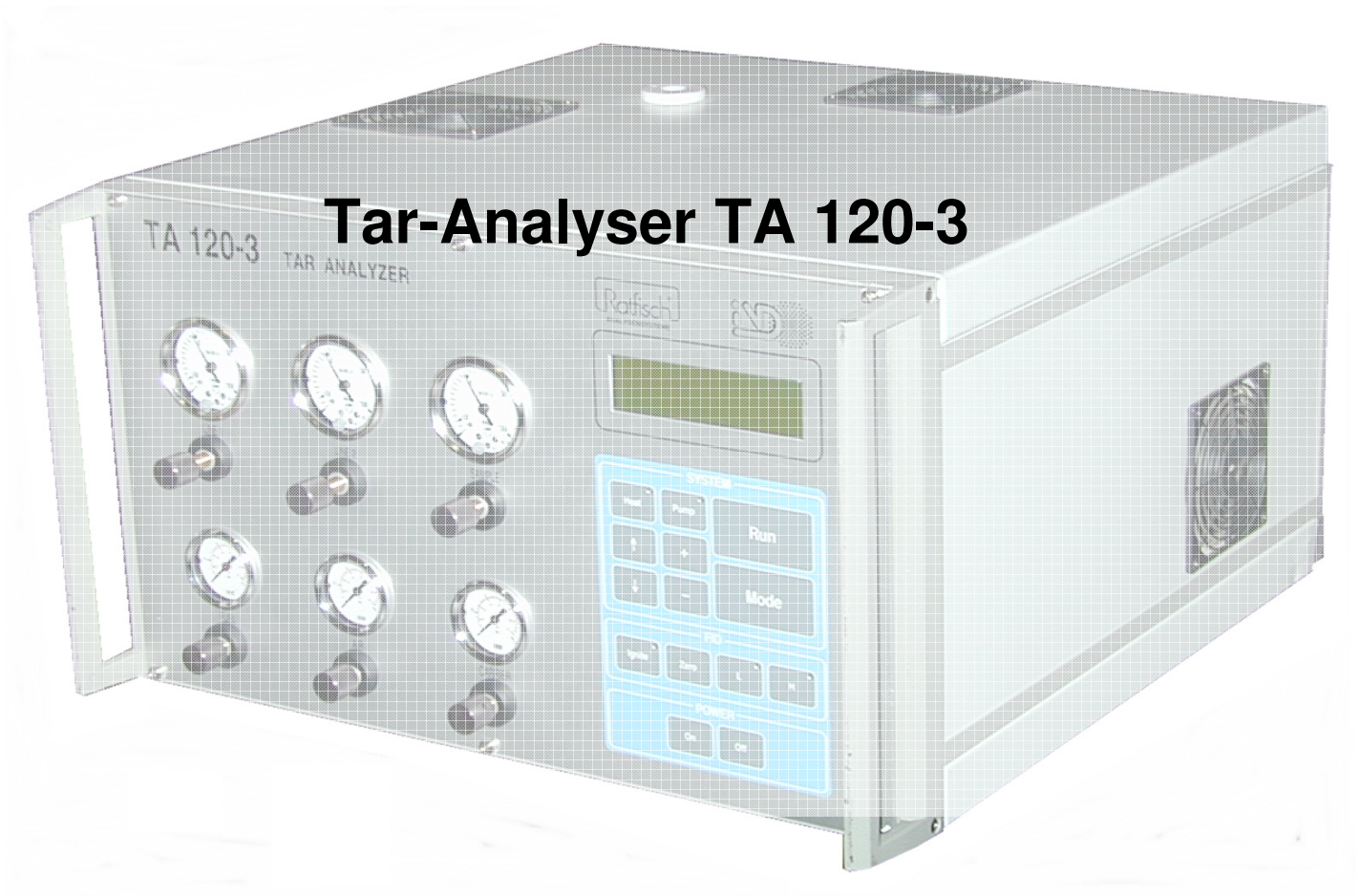
ifk

Tar-Analyser TA 120-3



Norman Poboss

Intention for development, purpose of measurements /Field of application

A time resolved online tar analysis can utilized in:

I. Process monitoring before gas engines to enlarge motor life and decrease maintenance costs

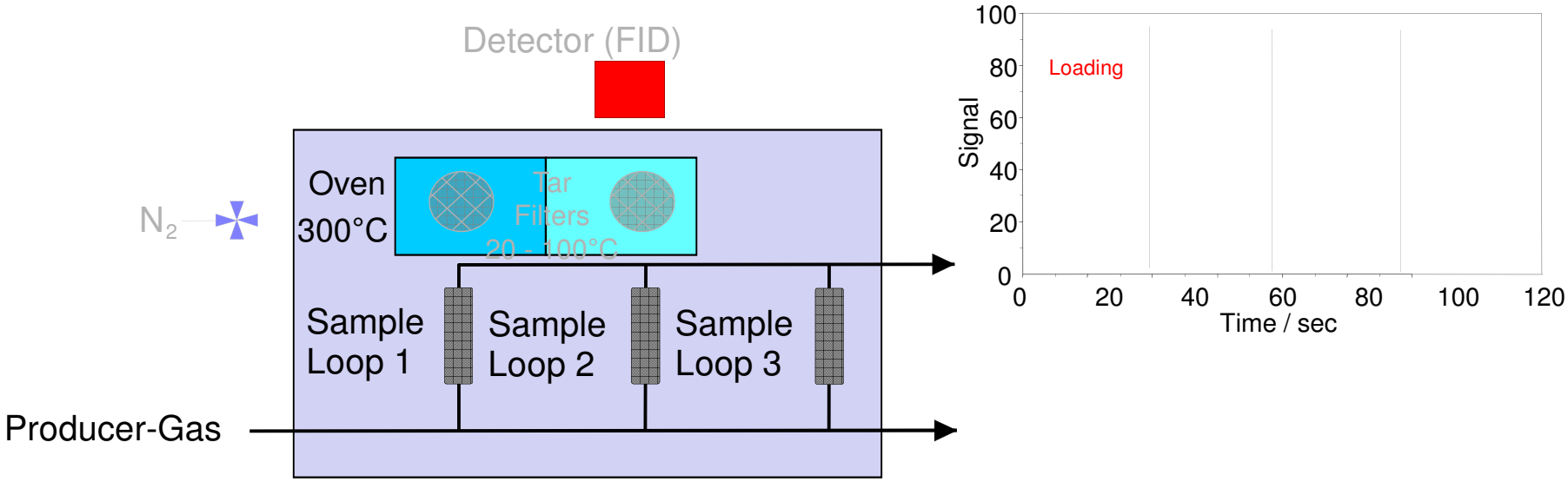
II. Monitoring of the efficiency of tar scrubber and catalytic tar reformer

III. Optimization of tar scrubber facilities and therefore waste water and solvent optimization

IV. Monitoring for general gasification process (tar peak tracing)

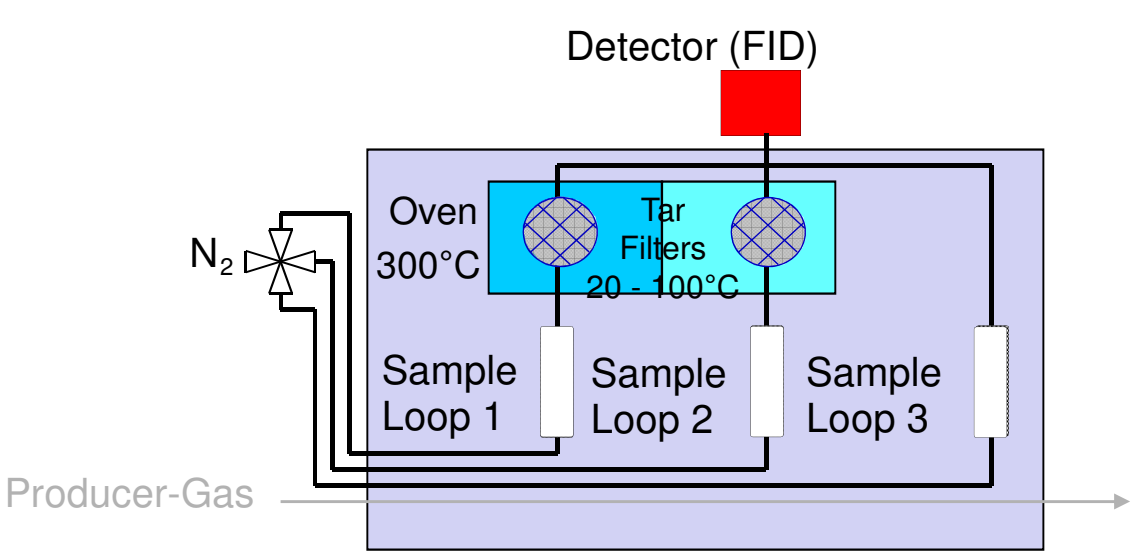
V. Fundamental tar research projects

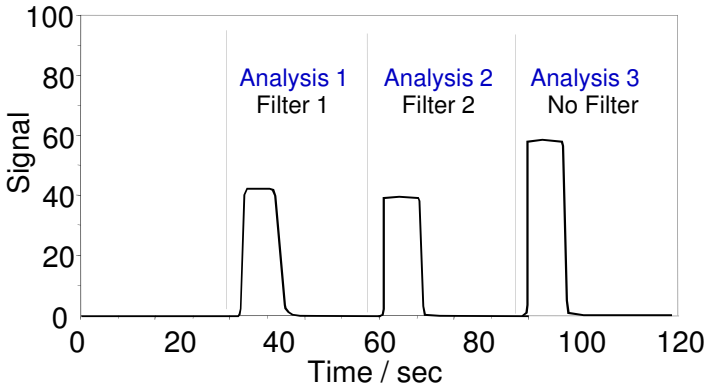
Basic Principle of the Analyzer – Sampling Phase



- Sample gas is sucked into the analyzer by three injection pumps/venturi nozzels
- 3 sample loops are laden simultaneously
- Tar filters are backflushed during loading phase

Basic Principle of the Analyzer – Analyzing Phase



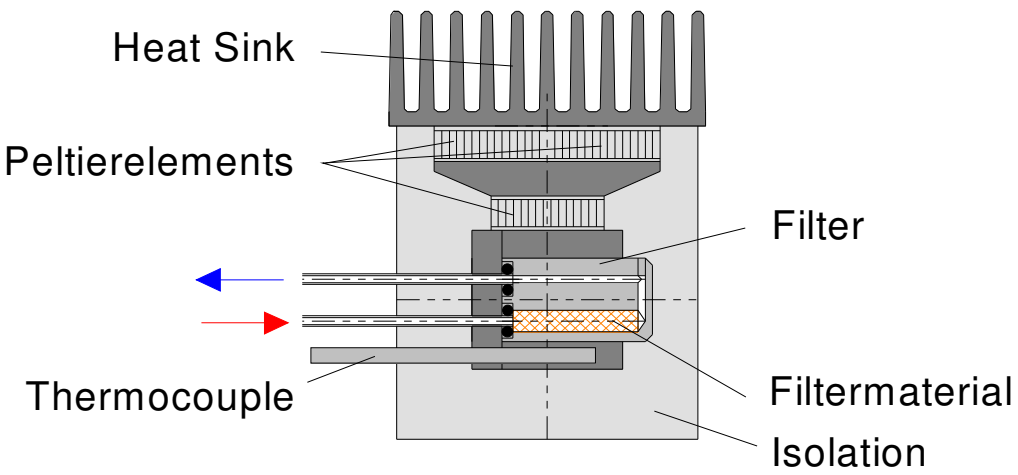


- Sample Loops are flushed subsequently to the Flame Ionization Detector
- Temperature of both Tar Filters can be regulated independently from each other
- Difference between Loop 1 and Loop 2/3 determines the tar content

Tar Filter and Filtermaterials

Characterisation of tars by :

- different Filtermaterials
- different Filtertemperatures

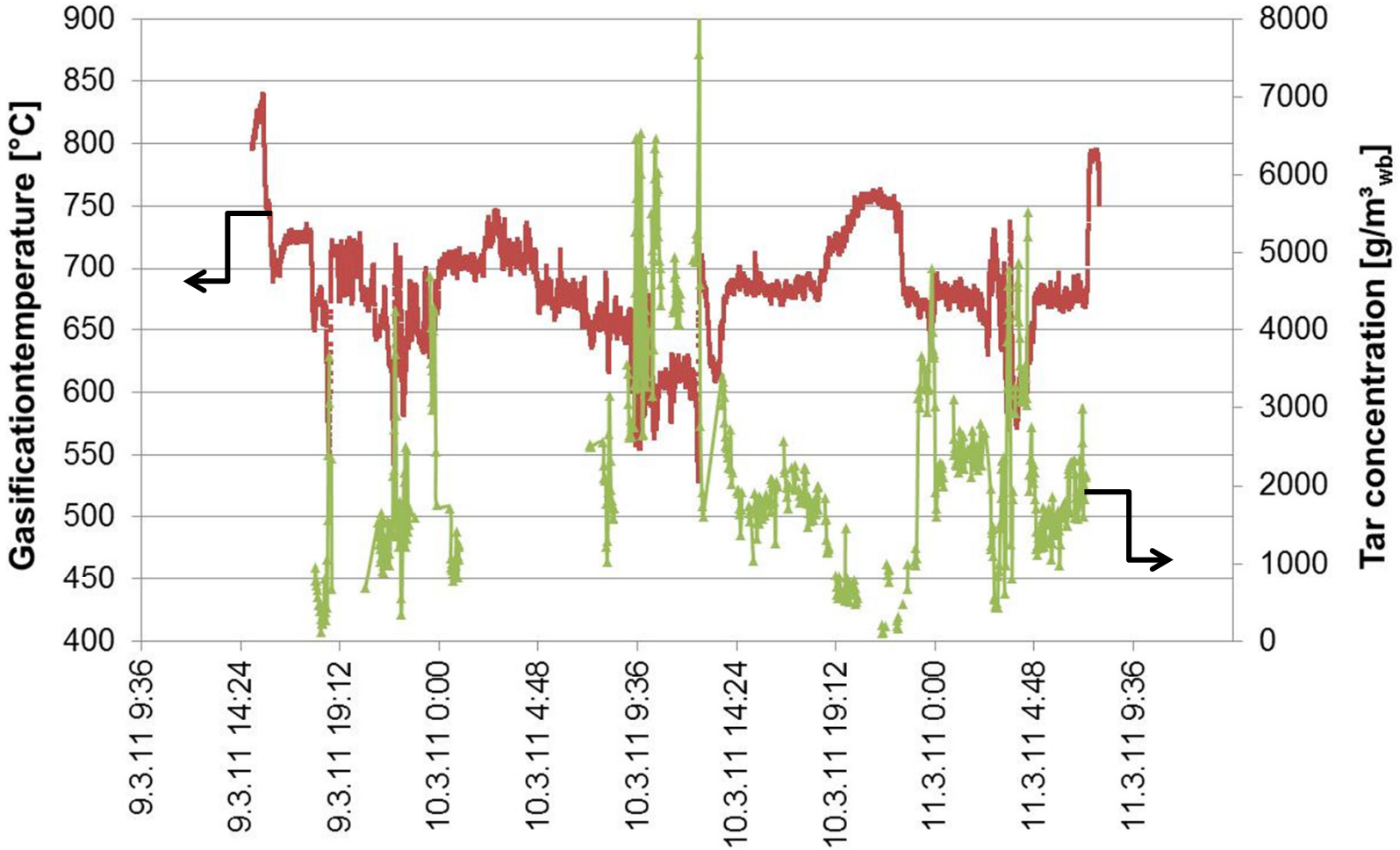


Possible Filtermaterials

- Activated Carbon
- LC-NH_2 / SPA-Material
- Silica Gel
- Quarz Whool
- User Defined

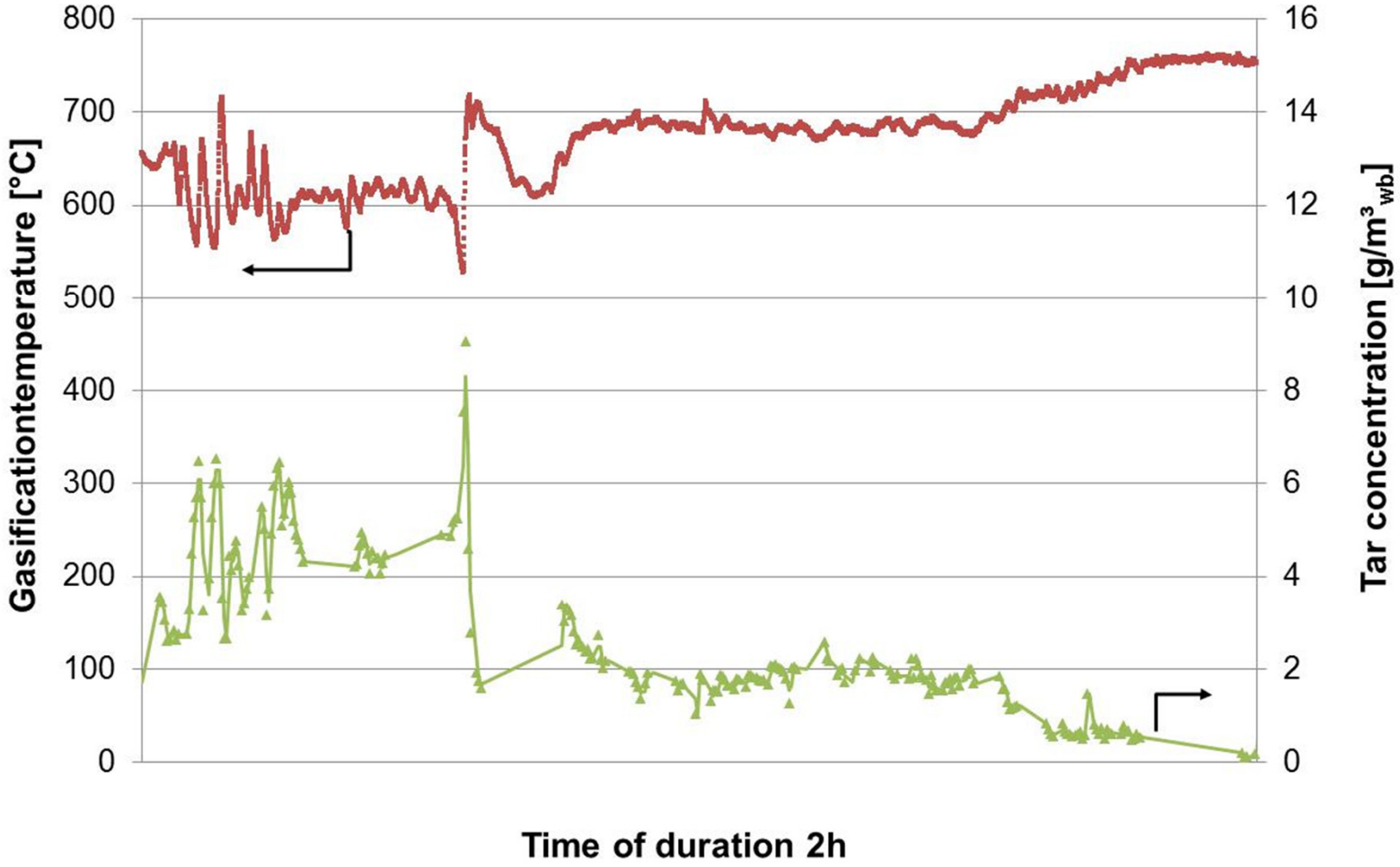
Results and operational experience

Tar monitoring at a 200kW DFB gasifier



Online measurement continuously over 2 days

Results and operational experience



Characteristics of the Tar Analyzer

- Measurement System is proven and tested
- Fast and easy quantification of the tar content
- Minimal measuring time is about 1 min
- No further analysis are needed
- Comparison of results are possible
- Online monitoring of the tar content is possible
- Commercially available

- Maximum operating temperature of 300°C
- No composition of the tars can be determined

Current status of the online Tar analyzer

- Online Tar analyzer is currently used for tar research at IFK
- Update of the 10 years old operating software is still in process
- InnoEnergy Project: „Development and market implementation of PID and FID tar analyzers” Project partner KTH will start within 2011

  Goals for this project: Design and built a viable and fully commercialized 2nd generation of the semi-continuous tar analyzer based on the FID detection system.

Thank you for your attention!

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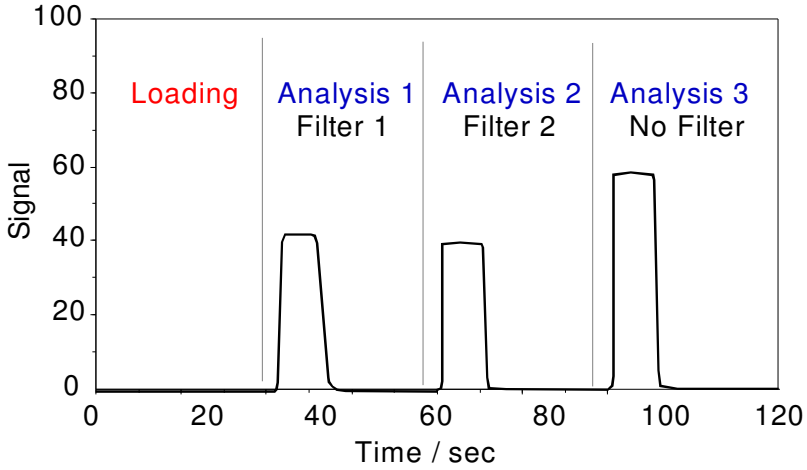
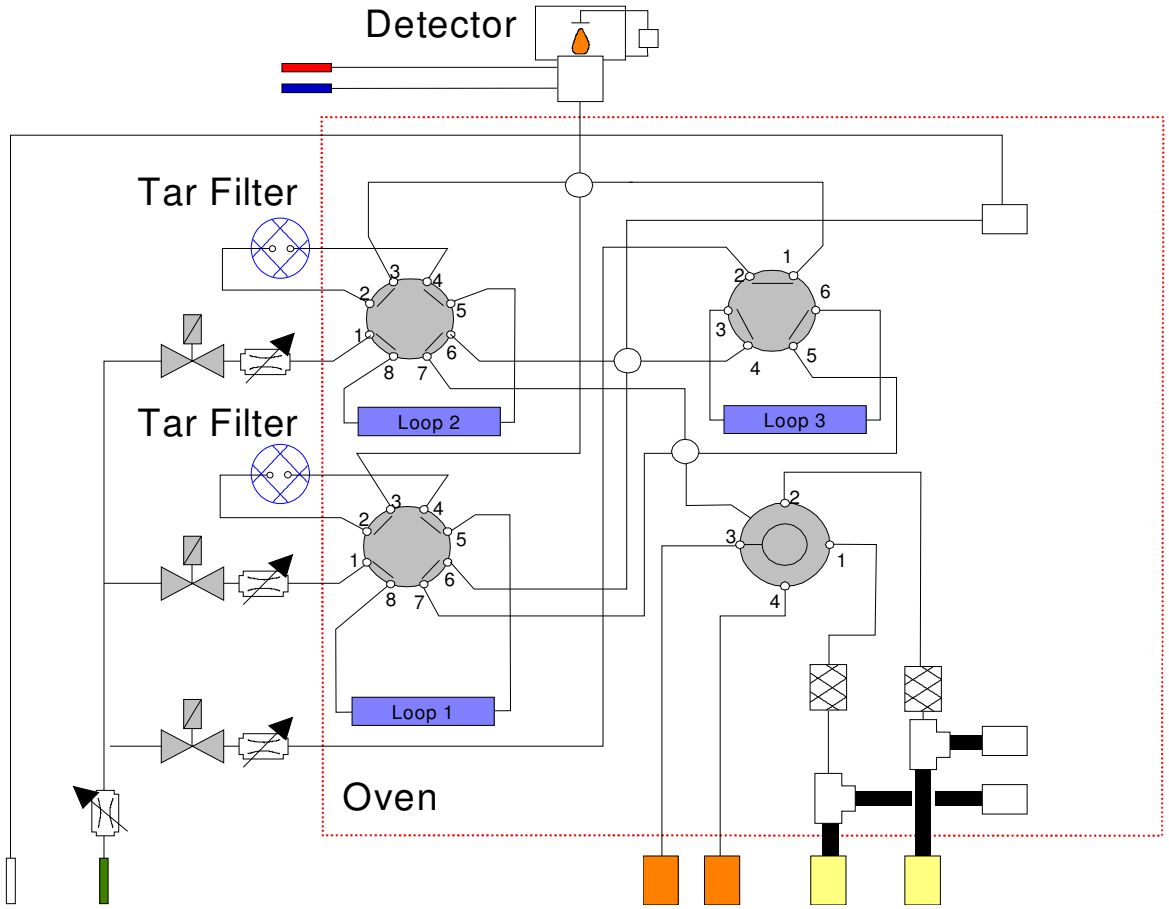
Signal Output and Measurable Values



Measurable Values

- Total Hydrocarbon Content
- Total Condensable Hydrocarbons
- Total Aliphatic Hydrocarbons
- Total Aromatic Hydrocarbons

Detailed Flow Scheme of the Analyzer



- Fuel
- Combustion Air
- Carrier
- Compressed Air
- Sample
  2 Sample Lines
- Calibration
  2 Calibration Lines

Specifications

- Effective Range: 3 decates up to max. 120 gC/m^3
- Measurement Limit: < 0,02 % of the total hydrocarbon content
- Reproducibility: 0,1 % of the measured value
- Time for one Analysis: minimum of 60 seconds
- Sample Gas Flow Rate: up to 100 l/h
- Ambient Temperature: +5 to + 35 °C
- Heating Time: about 60 minutes
- Sample Pressure: - 30 to 50 mbar

How to calculate the tar concentration ?

Goal: Measure the content of condensables carbon (tars)

$$C_{cond} = Peak_3 \cdot R_3 - Peak_{1/2\ ave} \cdot R_{1/2\ ave}$$

$Peak_{3,1,2}$: FID Signal

$R_{3,1,2}$: Response factor

Calculate the response factor => calibration with Methane (5 Vol-%)

R^* = C-concentration of the calibration gas [mg/Nm³] / Peak

C-concentration of the calibration gas [mg/Nm³]:

5 Vol-% · density [kg/m³] · C-content [kg C/kg] · 10^6 [mg/kg]

C-concentration of the calibration gas = 26925 [mg/Nm³]

Calibration

Signal of an FID is almost directly proportional to the amount of organically bound carbon.

Substance	Response relative to propane
Propane	1.00
Benzene	0.99
Toluene	1.00
Ethylbenzene	0.92
o-Xylene	0.97
Trimethylbenzene	0.96
Phenol	1.00
Indene	0.92
Naphthalene	1.00

Response is close to one for all compounds

- Error is small when an average response factor determined with propane is used
- For all peaks a separate calibration factor is determined to compensate small differences in volume or temperature of the sample loops.

Tar monitoring at a 200kW DFB Gasifier