The CEN/TS 15439 tar standard - A useful tool but no answer for every question

Measurement, Analysis and Monitoring of Condensable Gas Components (especially Tar) in Product-Gases from Biomass Gasification and Pyrolysis

International Workshop

June 8th 2011 at 19th EU Biomass Conference and Exhibition, 10.00 – 16.00 , ICC Berlin

Christoph Unger

Fraunhofer Institute for Enviromental, Safety, and Energy Technology UMSICHT

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AGENDA

1. A short history
2. Use and limitations
3. Sampling & analysis
4. Analytical repeatability and reproducibility
   - For single tar components with GC/MS or GC/FID
   - For total GC detectable tars
   - For gravimetric tar
5. Analytical results after parallel sampling
   - Producer gas from updraft gasifier
   - Producer gas from CFB gasifier
6. What do we need further?

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A short history

- In 1998 some institutes dealing with gasification and producer gas cleaning start to compare their individual tar sampling
  - First Version of the tar protocol

- EU –fifth framework Project Tar-Guideline 2000-2002

- CEN BT/task force 143 „organic contaminants (tars) in biomass producer gases“2003-2005

  CEN Technical specification: Biomass gasification – Tar and Particles in Producer gas –Sampling and Analysis
  Technical report Technical background document: Rationale for setup of impinger train

- Danish energy agency founded Round robin Test program to proof accuracy and reproducibility coordinated by DTI

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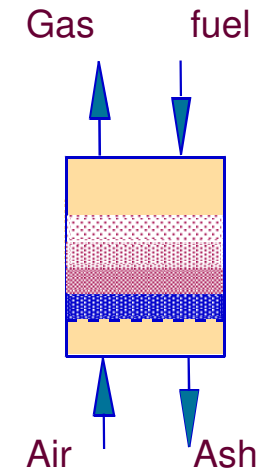
Use and limitations

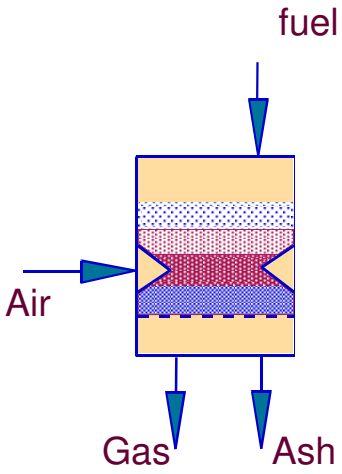
air or oxygen blown gasifiers
small and big scale
athmospheric and pressurized
usable for allothermal steam gasification

only partly

Makes gas qualities of different gasifiers comparable
help to define gas quality requirements at interfaces
along the process stream



countercurrent



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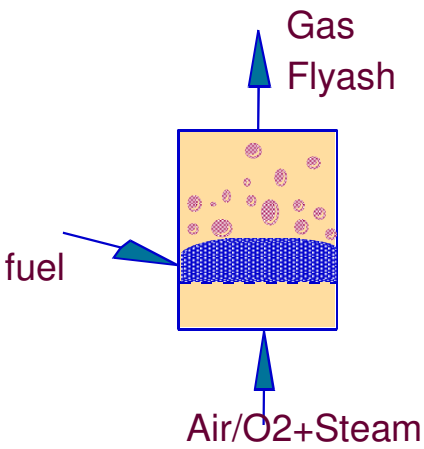
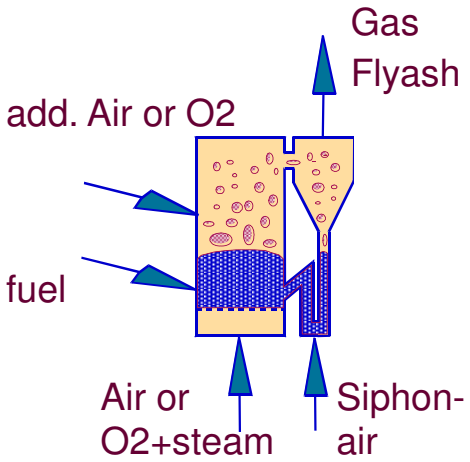


SFB or bubbling bed



CFB

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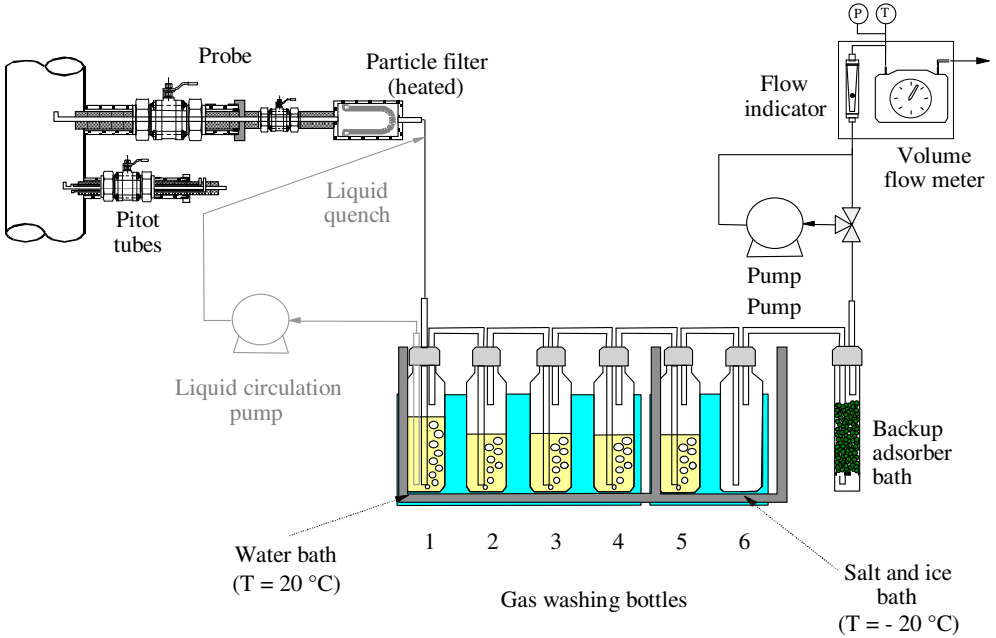
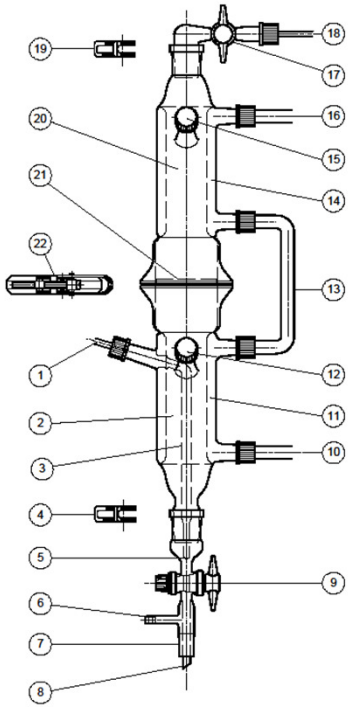
Sampling and Analysis I





Probe and Sampling train

Quasi isokinetic measurement is needed for dust and for tars below their due point (if unknown use 400°C as limit

For details on Impinger and fritts required see

CEN/TS 15439

Sampling alternativ:

Peterson column with internal two stage solvatisation (impinger an fritt in a cooling jacket at -20°C filled with precooled solvent

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Sampling and Analysis II

Solvent including all drain (from sampling train and dust capture) is combined and filled up to a well define volume at ambient conditions.

an aliquot is taken and mixed with internal standards

analysed by GCMS or GC/FID

Result: concentrations for each detectable tar

Total GC tar is made by GC/FID as integrated signals over the runtime above baseline with in or external Standard (Hydrocarbons around average tar molar mass)

For total tar a gravimetric measurement of the remaining tars after removing the solvent can be made, but keep in mind that you lose monoaromatics in total and a significant amound of 2 ring aromatic hydrocarbons from down draft or fluidized bed gasifiers. For updraft gasifier tars the gravimetric analysis does not lead to quantifiable results

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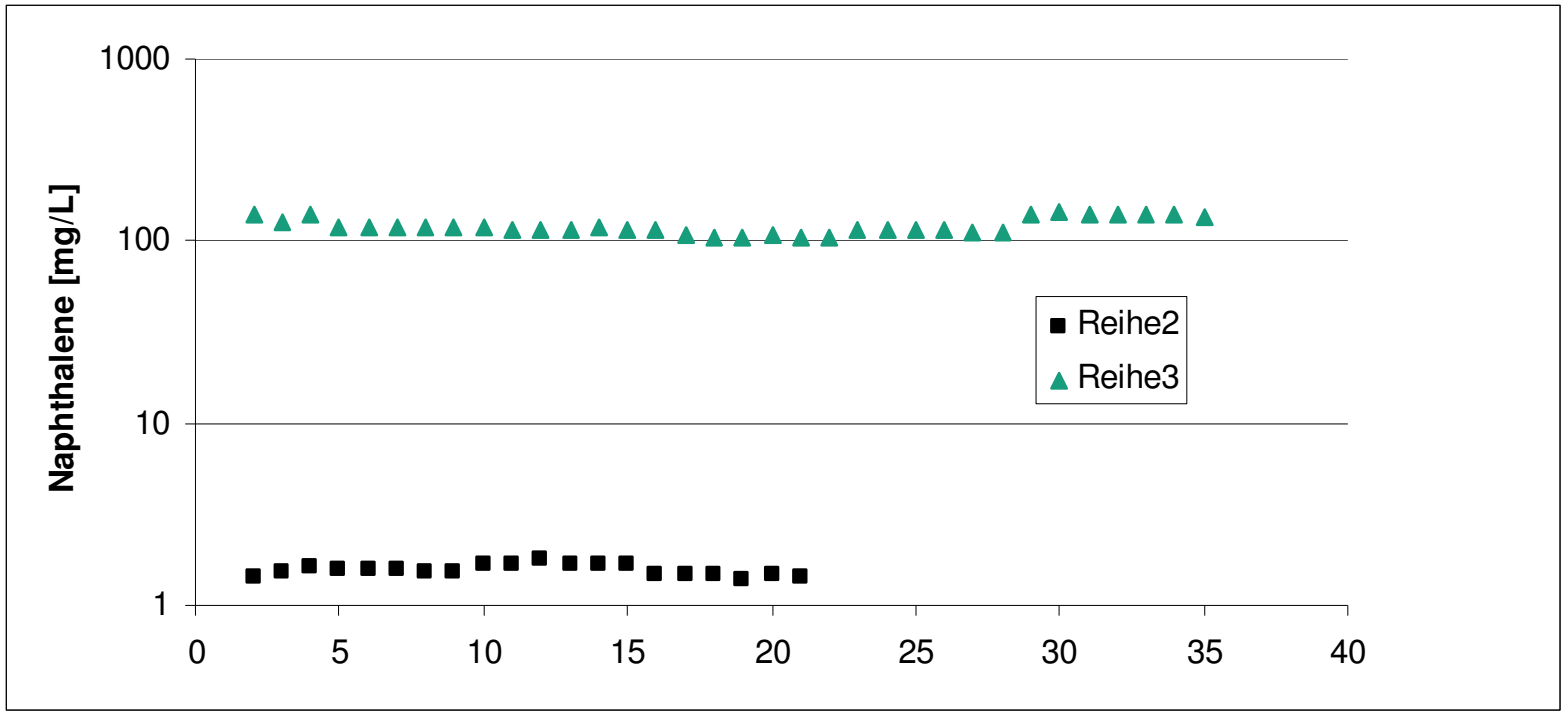
Analytical repeatability and reproducibility

- For single tar components with GC/MS or GC/FID [I]



Measured by 6 different labs

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Analytical repeatability and reproducibility

- For single tar components with GC/MS or GC/FID [II]

		r [%]	R [%]
updraft tars	low content 0.25-10 mg/l	**16.8**	**56.8**
	high content < 600mg/L	**13.6**	**54.4**
CFB tars	low content 0.5-10 mg/L	**23.4**	**44.7**
	high content <150 mg/L	**7**	**20.2**

r =repeatibility (single lab) R = Reproducibility (between labs) low numbers
mean good correlation

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Analytical repeatability and reproducibility

- For total GC detectable tars

		r [%]	R [%]
updraft tars	low content 4000mg /l	**17.5**	**56.8**
	high content 6200mg/L	**11.8**	**33**
CFB tars	low content 25 mg/L	**73.7**	**206**
	high content 300 mg/L	**9.9**	**27.7**

r =repeatibility (single lab) R = Reproducibility (between labs)

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Analytical repeatability and reproducibility

- For gavimetric tars

R and r were in similar ranges to total GC tars but results show only a ruff correlation to the composition of the tar sample

Proper sampling is a waste of time when only analysied as gravimetric tar !

r =repeatibility (single lab) R = Reproducibility (between labs)

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Analytical results after parallel sampling

- Producer gas from updraft gasifier
- Total GC-detectable tars

Only 3 labs involved with cross analytic

	r [%]	R [%]
semi raw gas 5400 mg/Nm³	**31.7**	**56.3**
raw gas 24700 mg/Nm³	**31.1**	**84**

r =repeatibility (single lab) R = Reproducibility (between labs)

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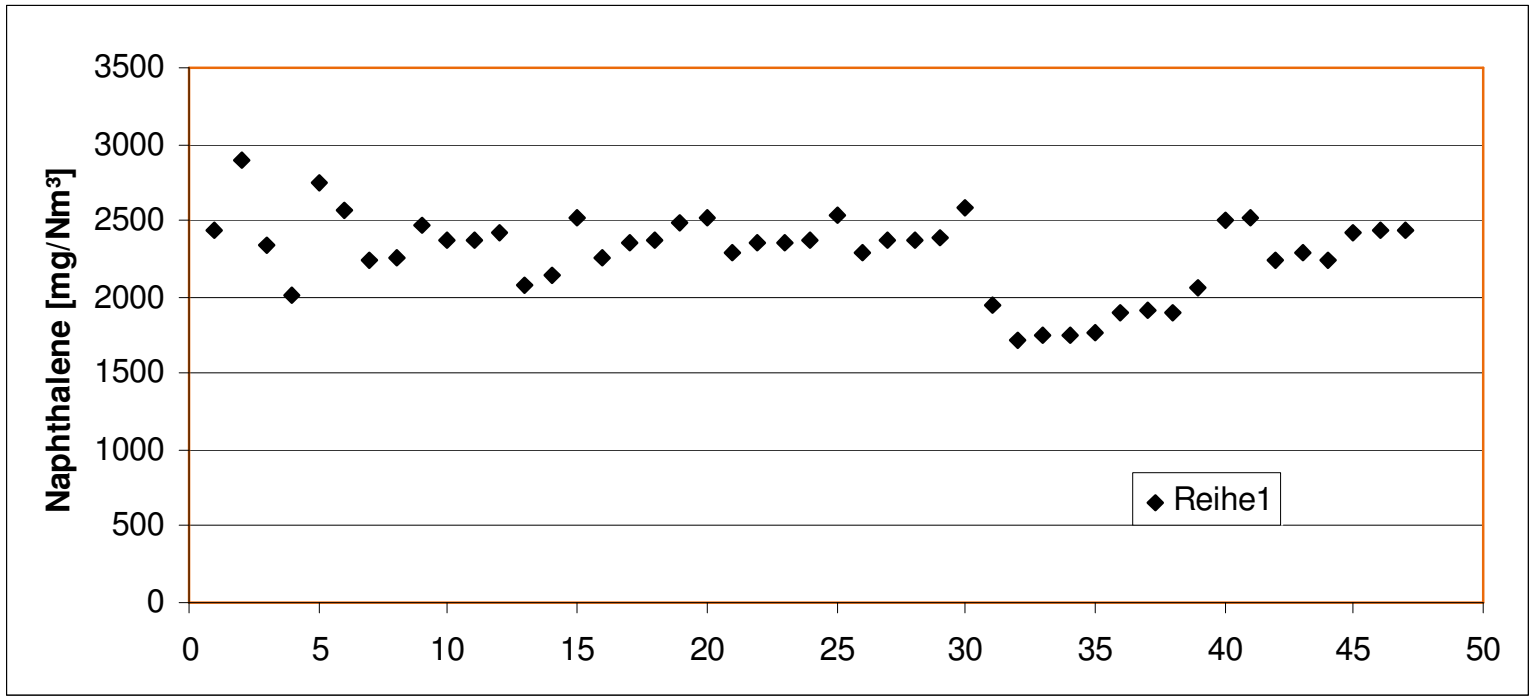
Analytical results after parallel sampling

- Producer gas from CFB gasifier



5 paralell samplings by different labs 5 samples each over 5 h of operation under constant gasifier operation conditions

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What do we need further?

- Quasi online marker for increasing tar amounts to protect down-stream equipment qualitatively ? For example continuous online benzene measurement
- Sampling with lower operator influence (to make mistakes without realizing it)
- Analysis with lower operator influence by sending the samples to labs with high experience in tar analysis (more cost effective too)
- Online measurement for process control? Far far away!

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