Gas Analysis Workshop 2017 Berlin
test gas generators

Why do we need test gases?

- *Test on-line tools under known and stable conditions*
- *Calibrate on-line tools*
- *Test adsorbers and (catalytic) reformers*

Journal of Chromatogr, 300 (1984) 79–108
Chromatographic Revi
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

CHREV. 171

GENERATION OF STANDARD GASEOUS MIXTURES

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(Received April 7th, 1983)

CONTENTS

Sources:

J. Namieśnik, “Generation of standard gaseous mixtures,” Journal of Chromatography A, vol. 300, pp. 79–108, 1984

See also:

Yue Li, Tim Täffner, Michael Bischoff, and Bernd Niemeyer, “Test Gas Generation from Pure Liquids: An Application-Oriented Overview of Methods in a Nutshell,” International Journal of Chemical Engineering, vol. 2012, Article ID 417029, 6 pages, 2012. doi:10.1155/2012/417029

Gas Analysis Webinars

test gas generators

March 21st 2014

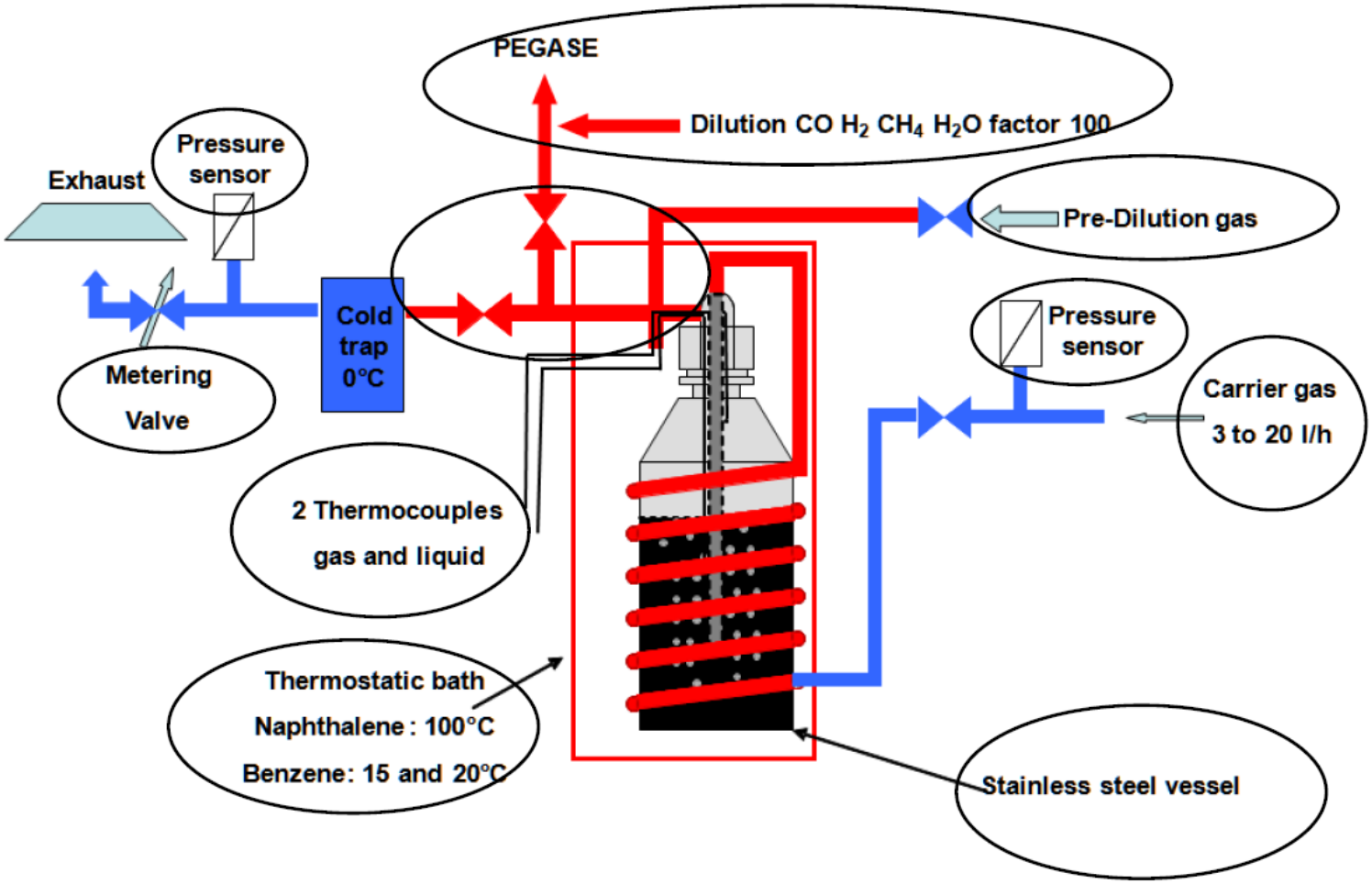
- *Y. Neubauer, TU Berlin, Germany*
  Brief introduction and scope of this webinar

- F. Defoort, cea, Grenoble, France
  Two types of test gas generator systems based on entrainment of saturated gas and on syringe into vacuum vessel

- M. Reinikainen, vtt, Espoo, Finland
  Tar generation by ethene pyrolysis

- C. Hamel, C. Unger, Fraunhofer UMSICHT, Oberhausen, Germany
  Model gas made by Fraunhofer UMSICHT –
  Test gas for catalyst examinations including steam and tar compounds

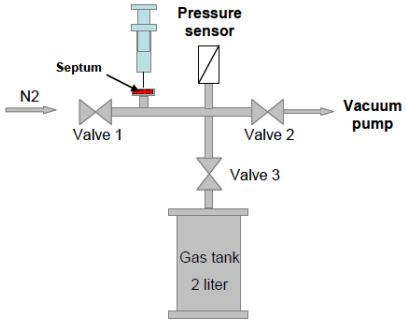
2-System based on entrainment of saturated gas

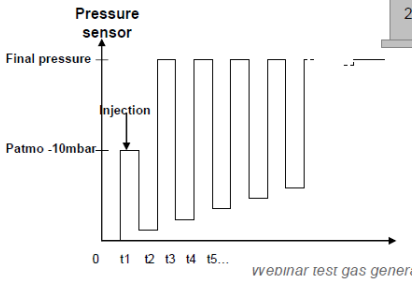


3- System based on syringe into vacuum vessel

- **Need a gas generator**
  - For pure component (gas not polluted by solvent)
  - With about 6 liters of calibrated gas

Filling the Gas Tank





1_ t=0 : V2, V3 open, vacuum is done

2_ t1 : close V2, V3 and open V1 ur slightly below atmospheric pressu

3_ injection of the liquid by the syr

4_ t2 : open V3 and then close

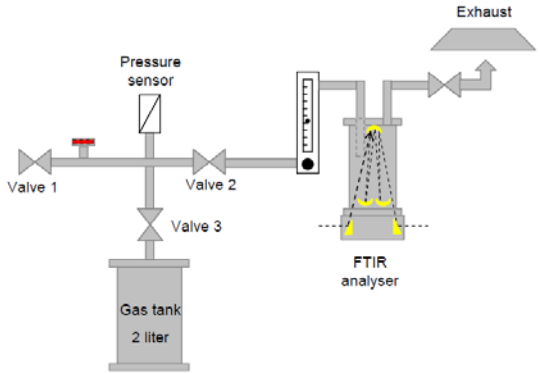
5_ t3 : open V1 for N2 injection to t and then close V1

6_ t4 : open V3 and then close

And repeat steps 5 and 6... until yc pressure

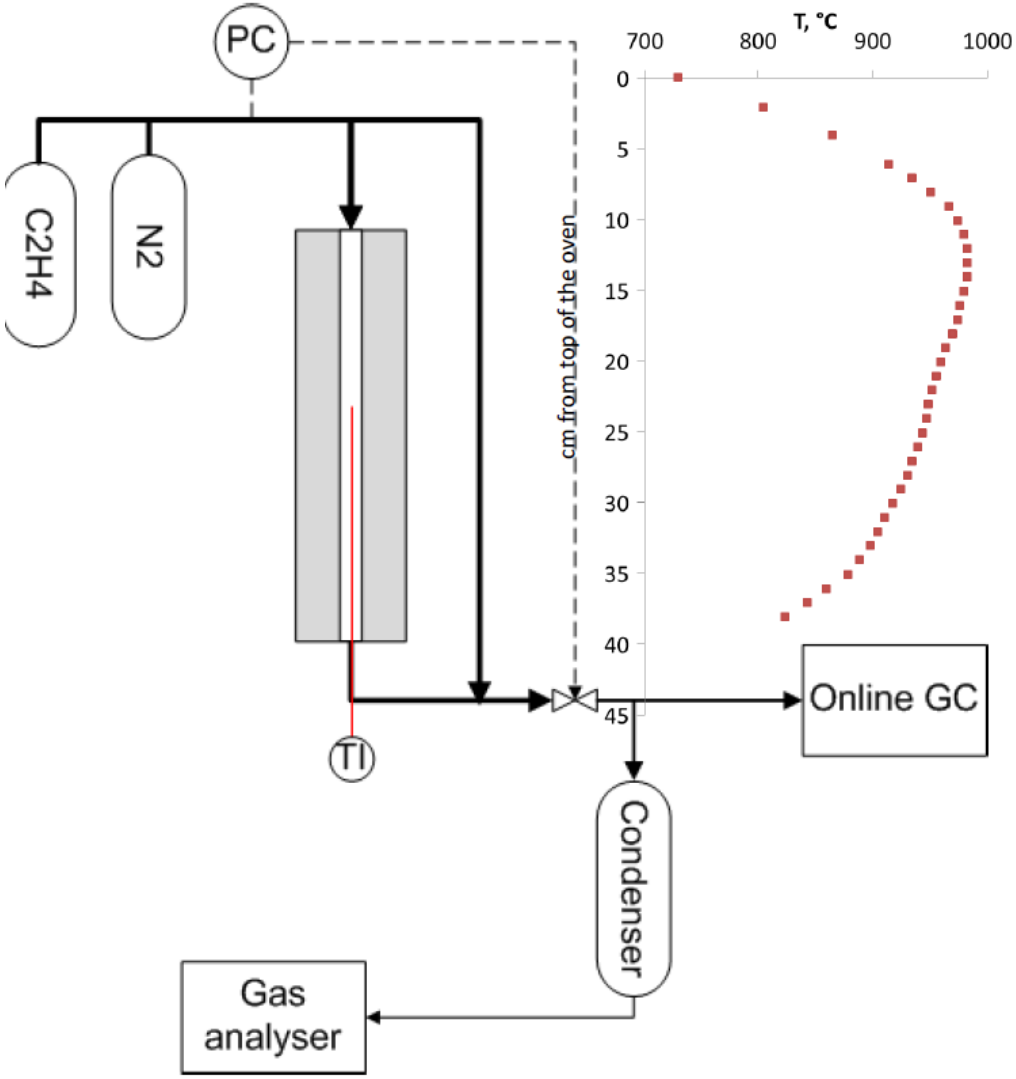
3- System based on syringe into vacuum vessel

FTIR calibration



- **Syringe + vacuum system validated by comparing with:**
  - Other gas generator (bubbling) for steam, acetaldhehyde, methanol
  - FTIR integrated values with cold trap residue + GC-MS
- **Problem with formaldehyde (adsorption on the surface of the vessel in stainless steel)**

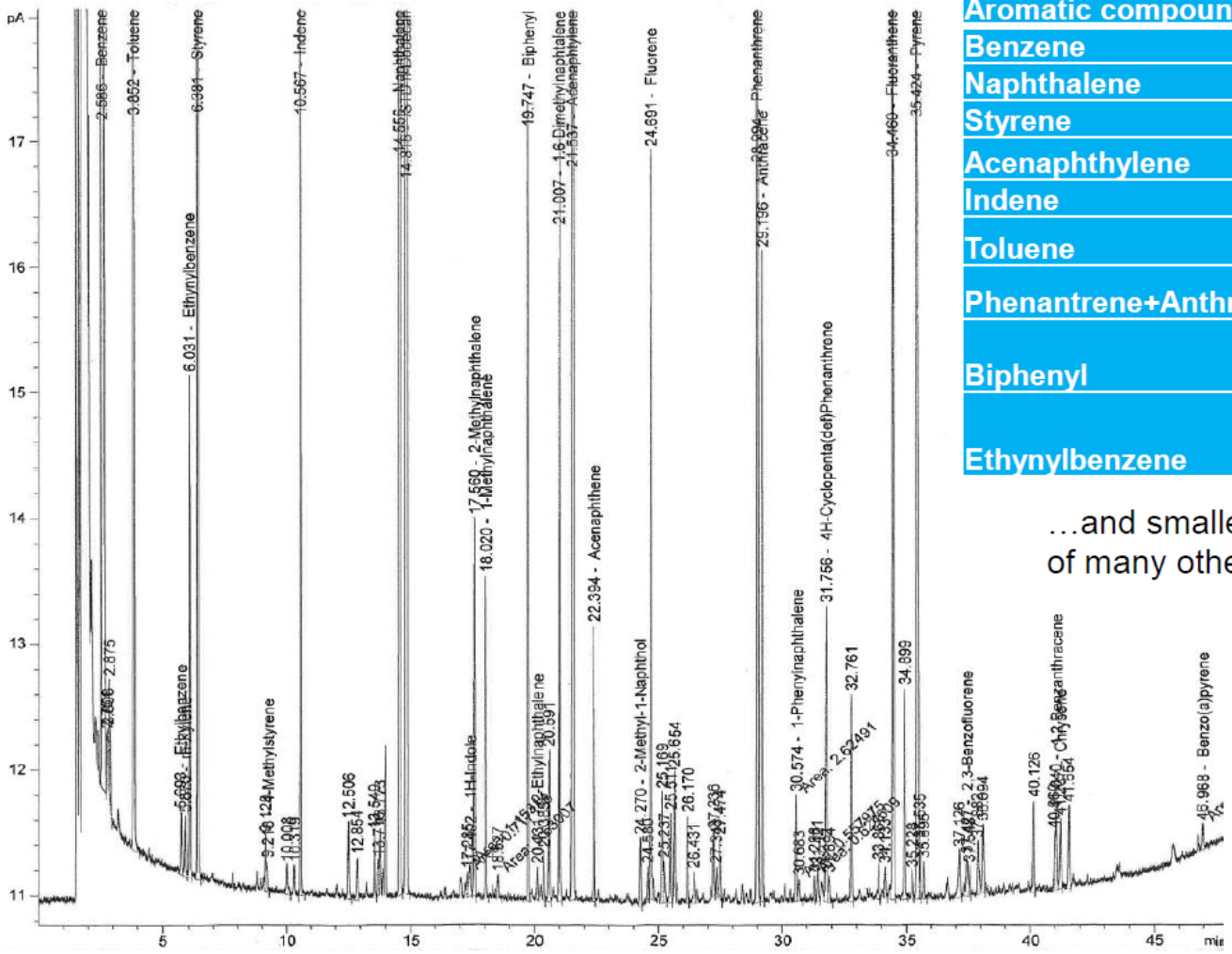
Laboratory set-up and conditions



- Feed: 5 vol-% ethene in N2
- Conditions tested
  - Pressure: 1-6 bar(a)
  - Temperature: 800 – 975 °C
  - Residence time: 0.09-3.34 s (calculated for the whole reactor length)

Example of most abundant tar compounds

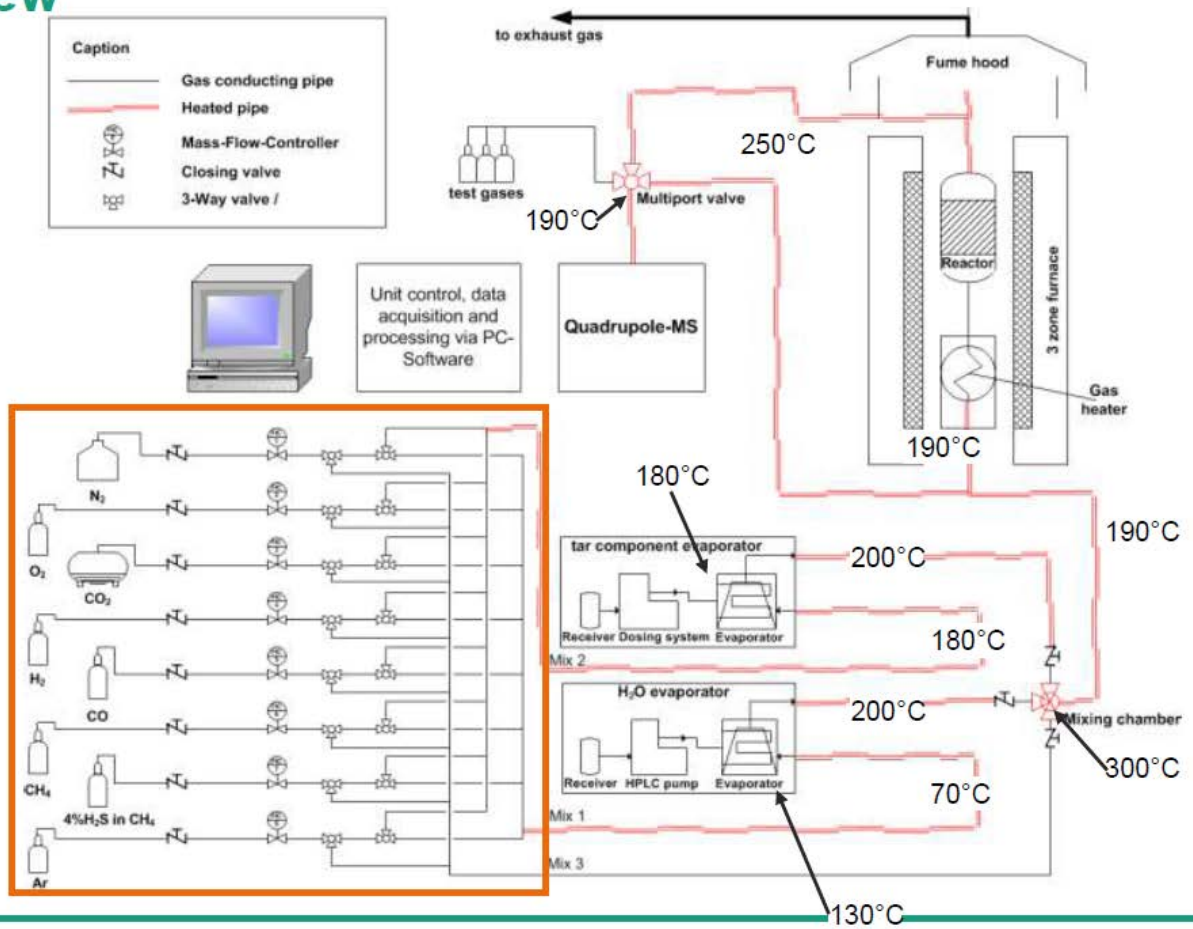
C_2H_4, 961 °C, 6 bar, 3.34 s



Aromatic compound	Amount, ppm
Benzene	2362
Naphthalene	535
Styrene	129
Acenaphthylene	91
Indene	60
Toluene	42
Phenantrene+Anthracene	29
Biphenyl	19
Ethynylbenzene	18

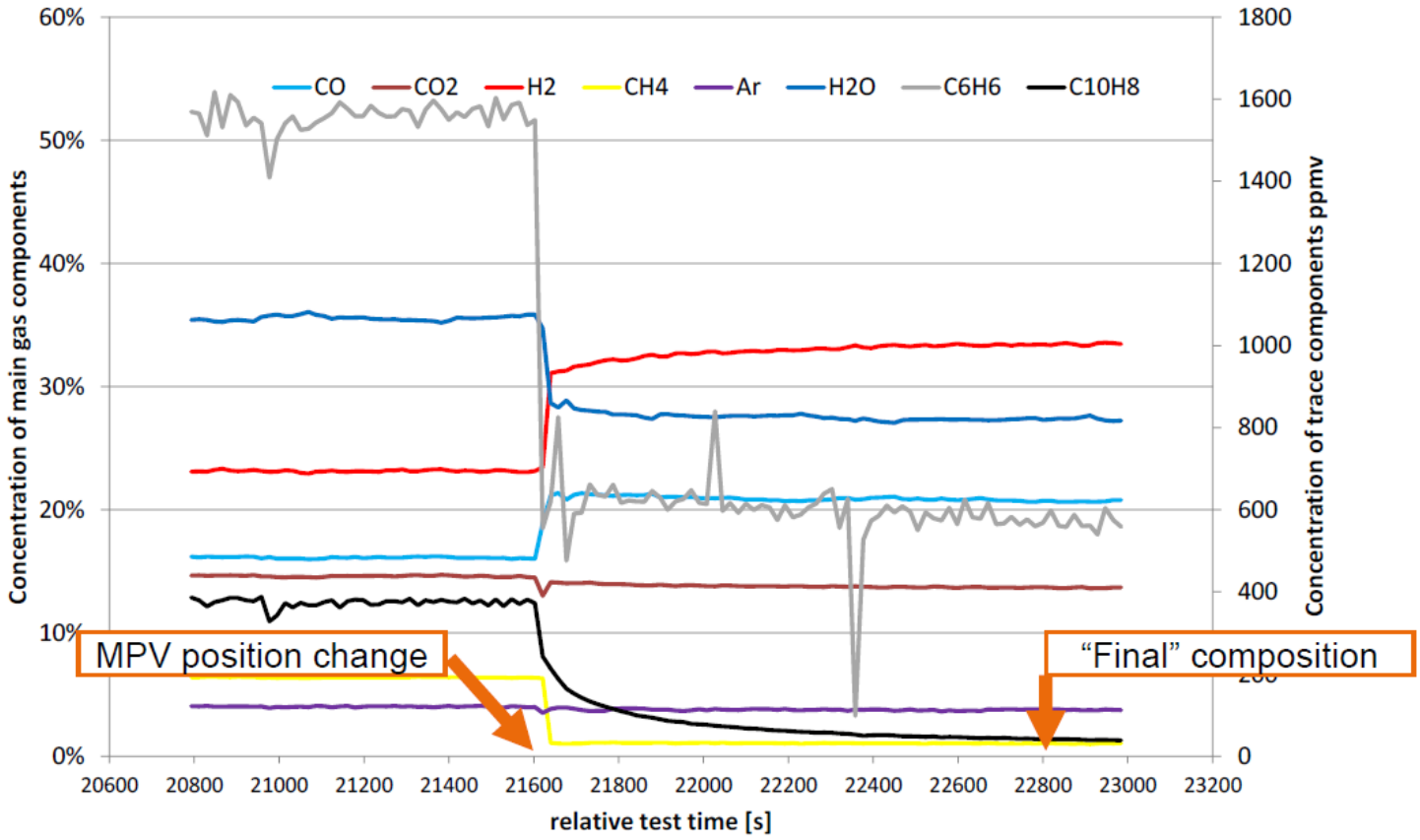
…and smaller amounts
of many other compounds

Test system
Overview



Fraunhofer UMSICHT

Gas composition
Example for results



Fraunhofer UMSICHT

GAW Hamburg 2014;
http://www.gas-analysis-webinars.org/?q=node/14

	V. Dragan O. Akpolat	Des Plaines, USA
Concept of round robins and host site activities	M. Kleinhappl	Bioenergy2020+ Graz, Austria
Method comparison for sampling and analysing syngas pollutants	E. Basset	GDF-Suez Paris, France
Comparison of different methods for tar analysis based on SPA and wet-chemical tar sampling for thermochemical gasification of biomass	S. Reil J. Karl H. Stork S. Beer	Fraunhofer UMSICHT Sulzbach-Rosenberg, FAU Erlangen-Nürnberg, OTH Amberg-Weiden, Germany
Method catalogue	M. Kleinhappl	Bioenergy2020+ Graz, Austria
A Test gas generation system from Bioenergy 2020+	M. Kleinhappl	Bioenergy2020+ Graz, Austria
Supplementary tools for gasification gas analysis	M. Reinikainen N. Kaisalo S. Tuomi P. Simell	VTT Technical Research Centre of Finland Espoo, Finland
Optical absorption spectroscopy for gas analysis in biomass gasification	H. Grosch A. Fateev S. Clausen K. L. Nielsen	DTU Technical University of Denmark Roskilde, Denmark
Continuous tar monitoring via FID –Actual status of the further development of an online tar measurement device	A. Gredinger	University of Stuttgart - IFK Stuttgart, Germany
Recent work on on-line tar analysis at TU Berlin	Y. Neubauer	TU Berlin Berlin, Germany

GAW Hamburg 2014;
http://www.gas-analysis-webinars.org/?q=node/14

Barbara system for test gases in cell- based toxicology: reality

MEDIZINISCHE UNIVERSITÄT INNSBRUCK

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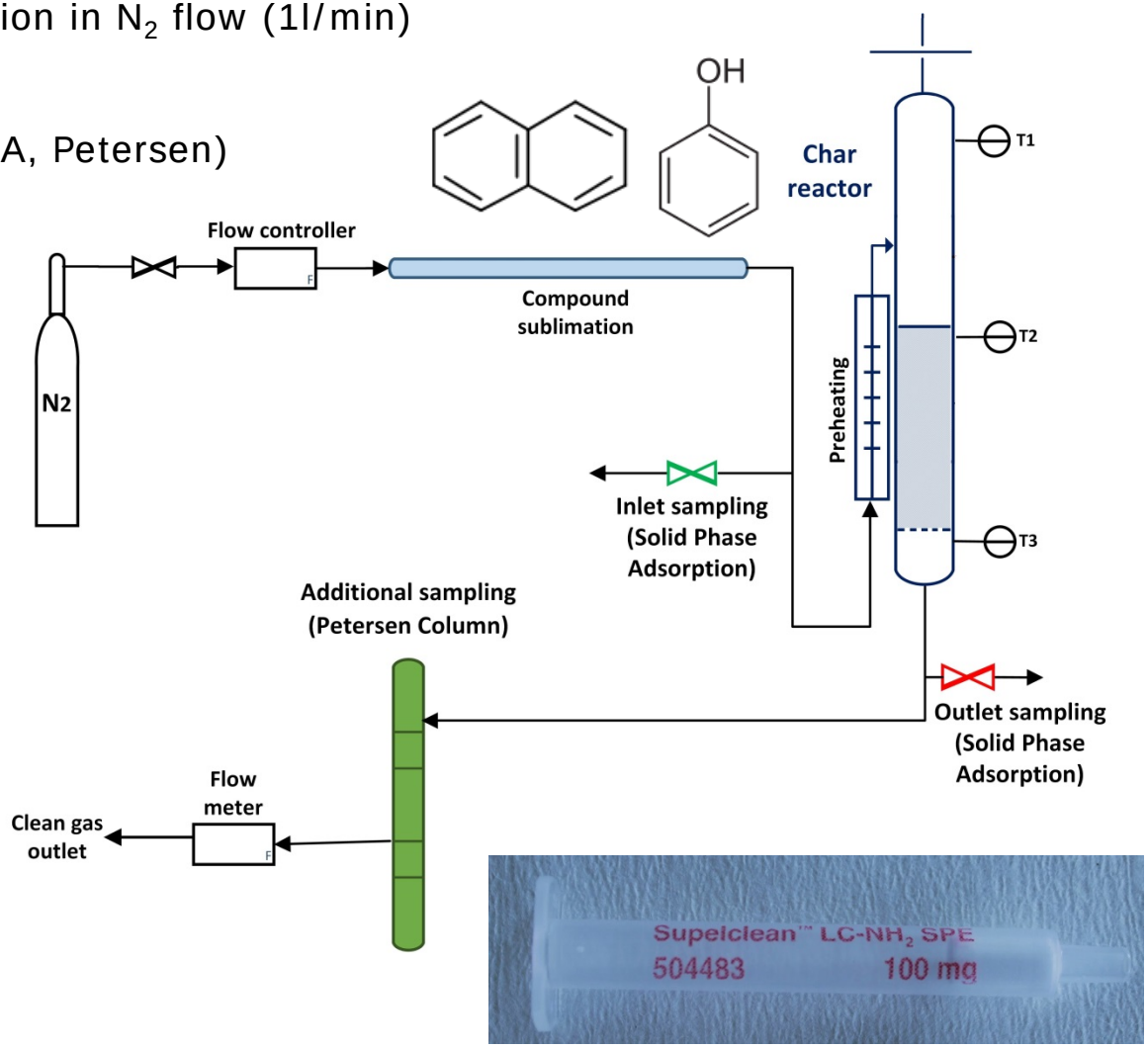
Information already given in this workshop

Experimental set up

- Phenol, naphthalene: sublimation in N_2 flow (1l/min)
- Contact with hot biochar bed
- Inlet - outlet gas sampling (SPA, Petersen)



PAH test-gas generator

Figure 3.9: Photo of solid PAH substances reservoir

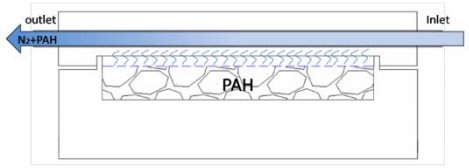
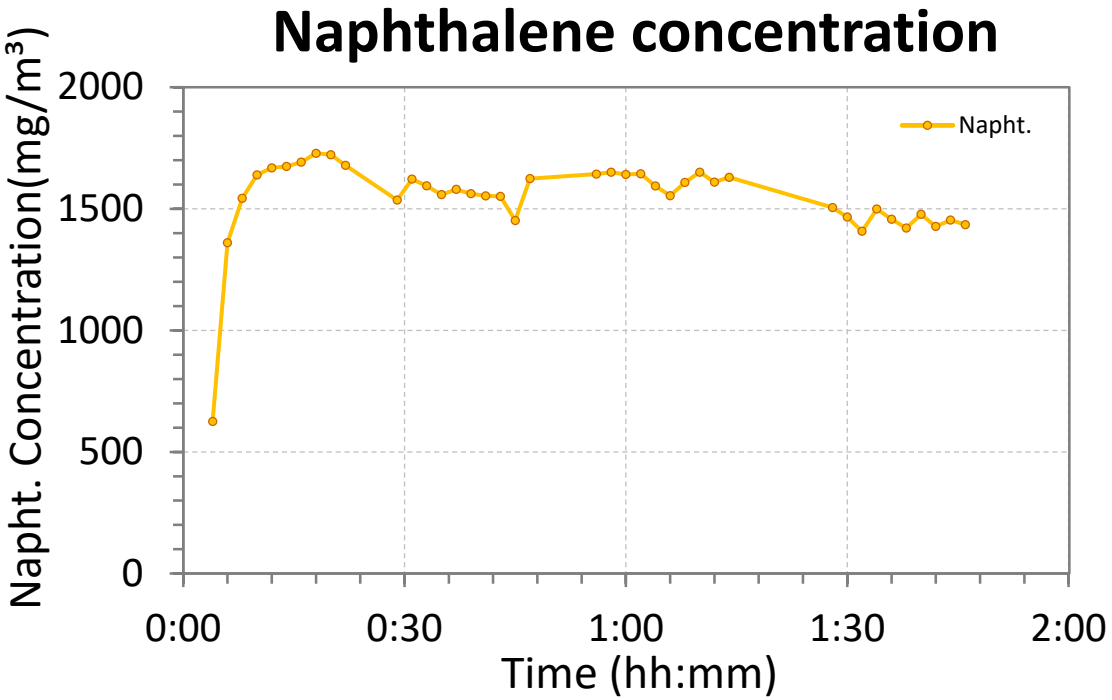
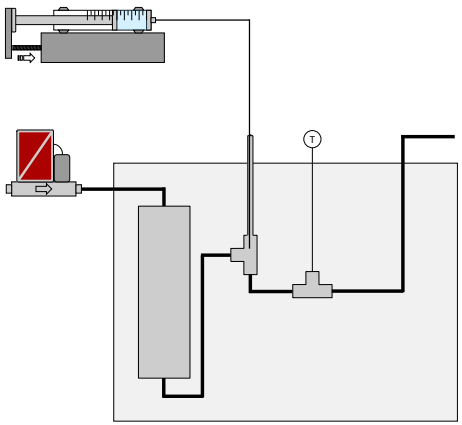


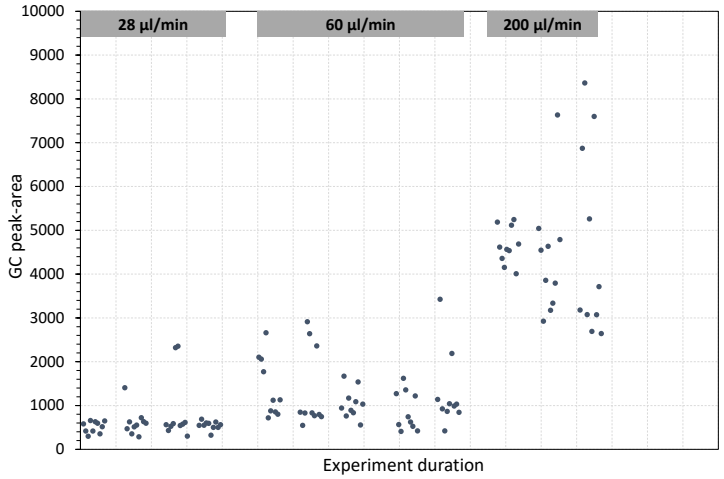
Figure 3.10: Schematic diagram of solid PAH substances reservoir



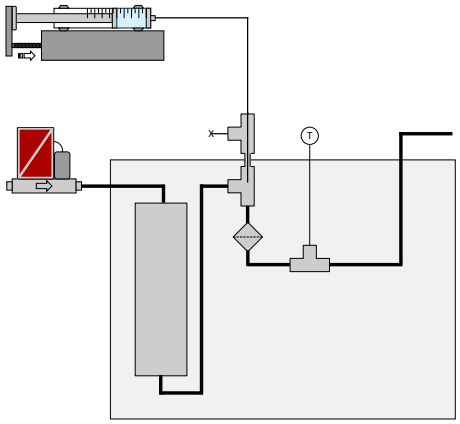
PAH test-gas generator

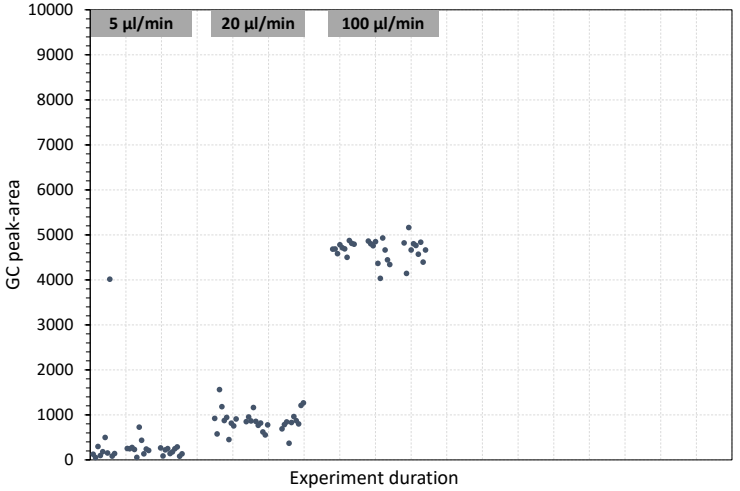
- Version 1





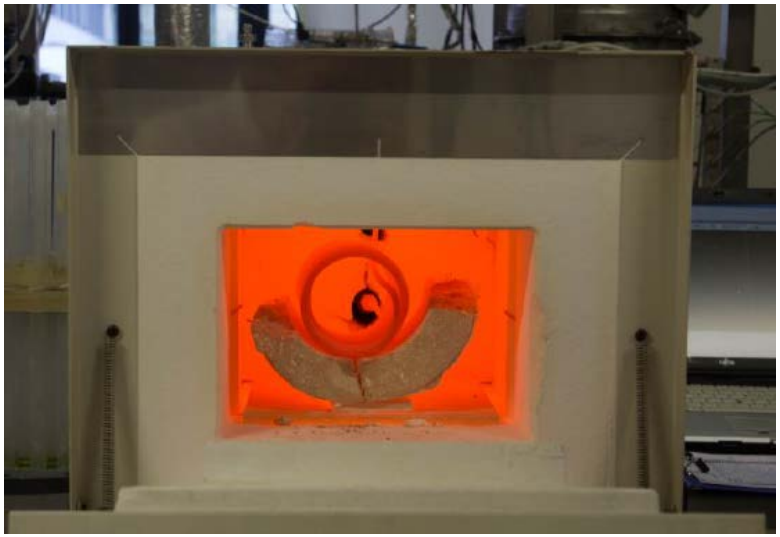
- Version 2

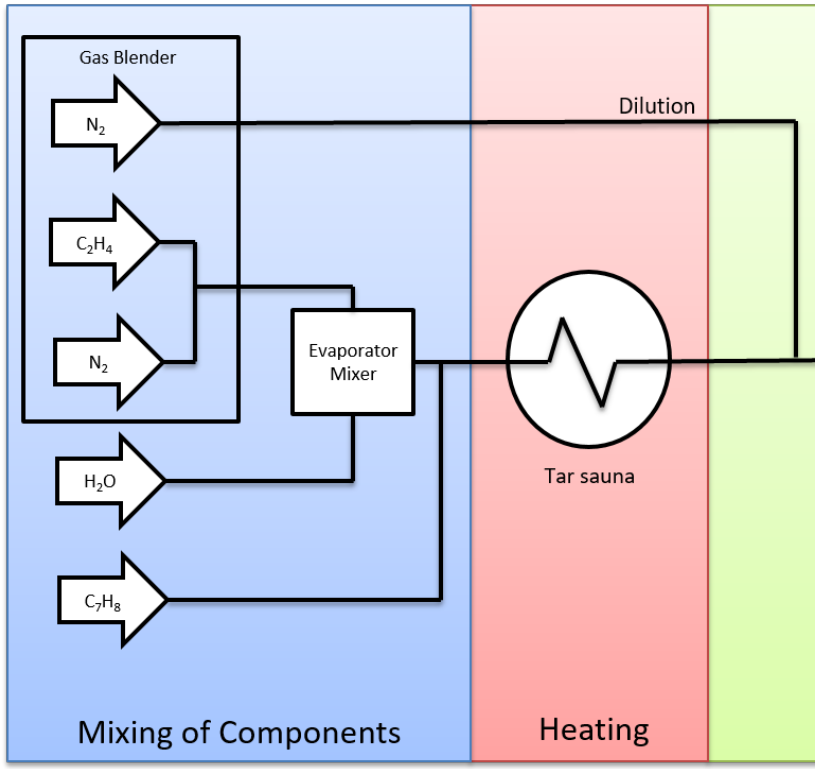




Test gas generation with the Finnish ‚tar sauna'

Principal idea for this approach from VTT

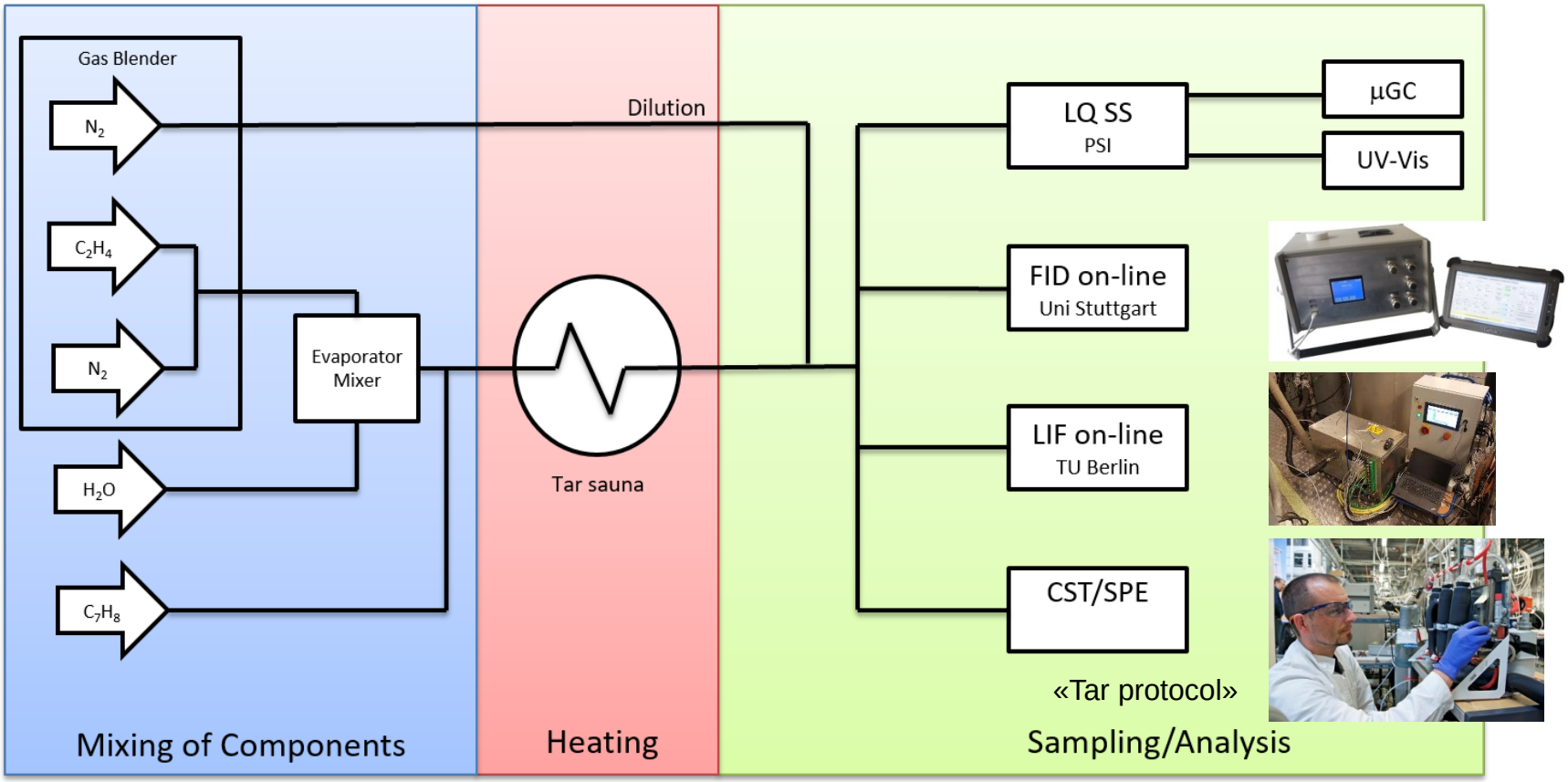




Reinikainen, M., Kaisalo, N., Tuomi, S., Simell, P.: Tar generation by ethene pyrolysis. Gas Analysis Webinar 21.03.2014 - http://www.gas-analysis-webinars.org/?q=node/2

Kaisalo, N. K., Koskinen-Soivia, M.-L., Simell, P. A., Lehtonen, J.: Effect of process conditions on tar formation from thermal reactions of ethylene. Fuel, 153 (2015) 118–127 DOI: 10.1016/j.fuel.2015.02.085

Measurement setup - combination of test-gas generator with analytical tools



Further updates:

- New System @ Fraunhofer UMSICHT built in 2016/17
- Reactive system @ PSI used also with Sulphur addition
- „Unshown“ presentation from PSI from webinar 2014

- New Webinar with further updates and needs ?

Note:

Reactive systems suitable for delivering larger PAH with low vapour pressure and high boiling points- species hard to evaporate without changing chemical structure

In General: Little information published - just tools !

Thank you for your interest!