Emission testing

- in western countries most of the time is spent indoors (e.g. Germany approx. 16 h/d [1])

- several investigations showed that building materials and furniture can emit harmful substances

  → indoor air containing product emissions can cause negative health issues [2]

  → need of emission testing of building products

  → emission test chambers as essential tool

- **actual trend of refurbishing houses for energy saving aspects lowers air exchange → possible enrichment of indoor air contaminats**

1 Brasche S. et al. (2005) *Int. J. Hyg. Environ.-Health 208*
2 Boeglin et al. (2006) *Environ. Res. 100*

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Emission test chambers I

→ emission testing under defined conditions regarding air exchange, humidity and temperature
→ reduces source/sink-effects of walls (glass, stainless steel)
→ ensures air sampling

Fig.: 24-l-chamber

Fig.: 1-m³-chamber

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Emission test chambers II

- MARKES int.
- Six single chambers
- constant volume
→ 44 ml
- constant flow
→ 30 ml/min technical air
- constant temperature
→ 25 °C for ambient temperature
→ 80 °C for simulation of long-term emission
- **No humidifaction!**

Fig.: Micro-Chamber/Thermal Extractor™ (µ-CTE, 44 ml)

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Reference materials in analytical chemistry

- comparative measurement between different laboratories needs reference samples (reference materials)
- requirements: traceability (composition) and homogeneity
- for emission testing of building products:

→ unknown sample composition

→ difficulties in traceability of emissions (equilibrium measurement)

→ heterogeneous samples complicate evaluation of round robin tests (40% to 300% deviation at different round robin tests [1])

→ **reference materials for emission testing of building products are commercially not available (only two approaches for toluene/formaldehyde are published)**

1 Howard-Reed et al. (2011) *Building and Environment 46*

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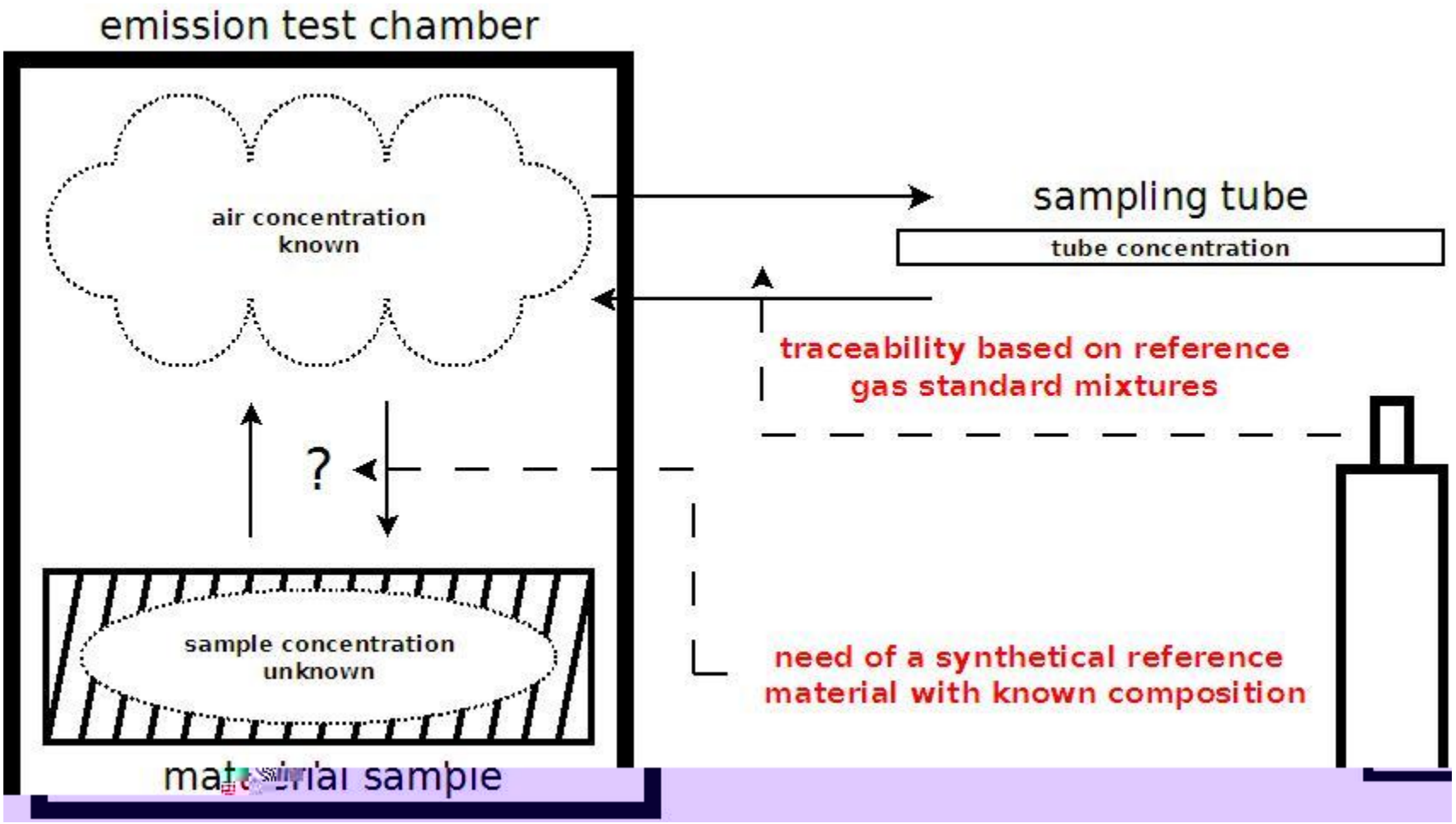
Why reference materials for emission testing ?



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Problem-solving approach

1. lacquers act as substrate
2. lacquers are mixed with substances of interest (analytes)
3. emission testing of the cured lacquer

→ **advantages:**

- agitation ensures homogenisation of the analytes in the lacquer
- sample preparation easy to handle
- sample composition is known → measured concentrations are traceable to the weighed analyte amount in the lacquer

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Optimisation step 1 - selected substances (analyte)

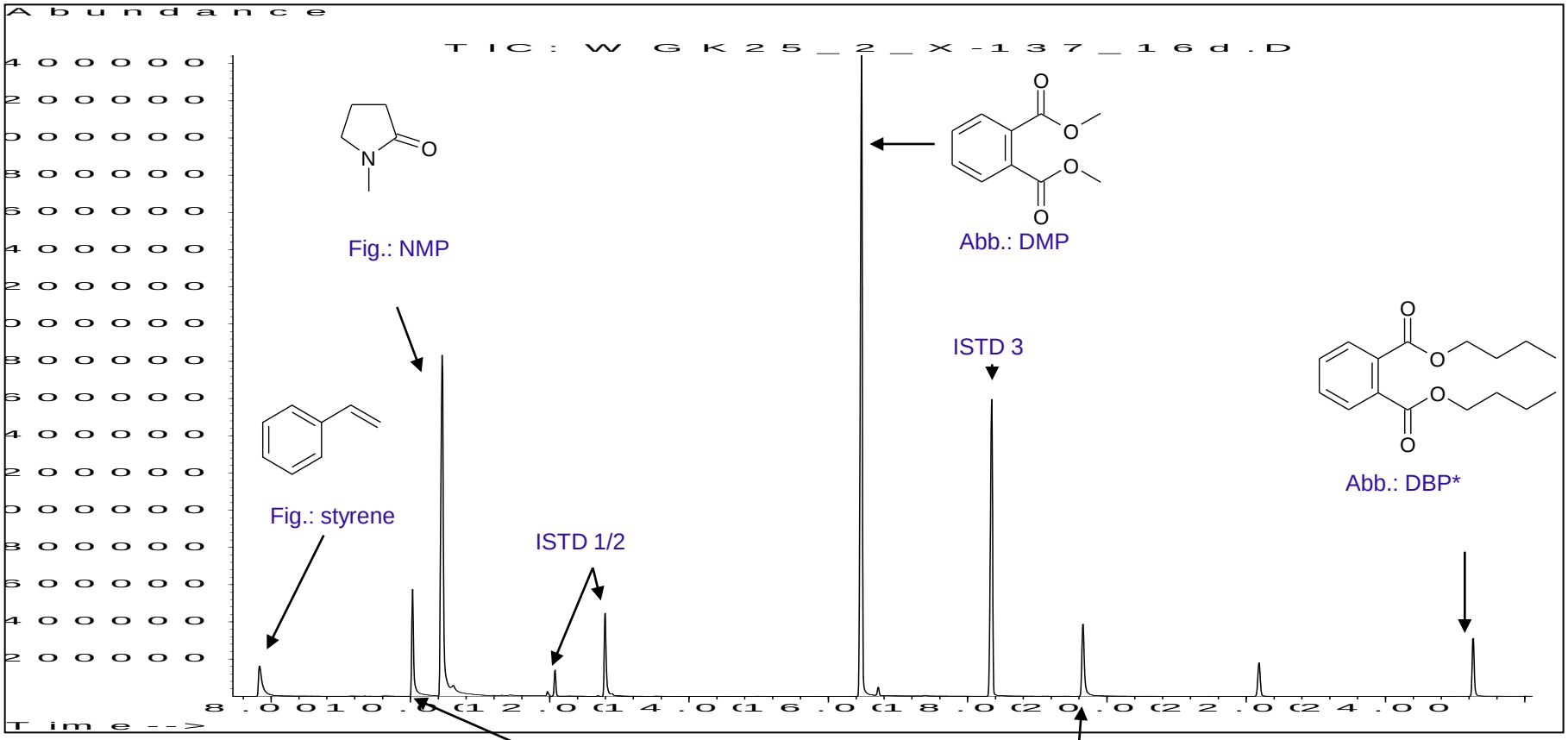

Fig.: SIM-chromatogramm of the investigated substances

* SVHC – substances of very high concern

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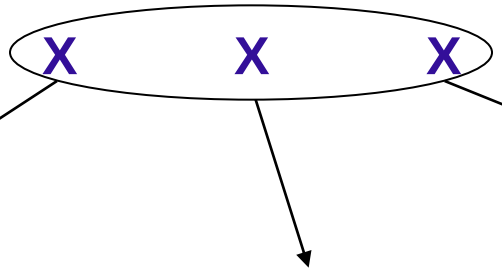
Optimisation step 2 - lacquer selection

nomenclature:



solvent		surface		color	
W	… water	M	… matt	R	… red
O	… organic	G	… glossy	W	… white
				C	… clear
				I	… light-ivory

tested lacquer types:

WGC	WMC	LGC	LMC
WGI	WMW	LGW	LMW
WGR	WMR	LGR	LMR

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Optimisation step 3 - chamber selection

Fig.: size comparison µ-CTE (front) vs 1-m³-chamber (back)

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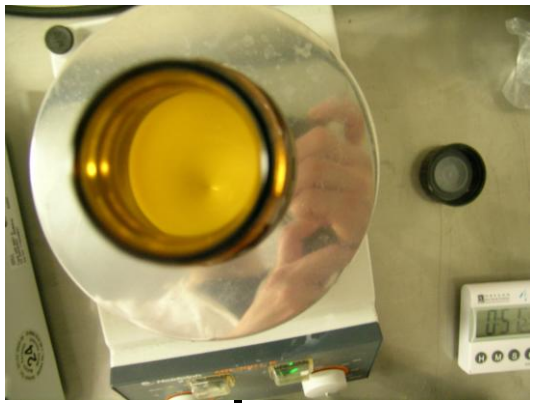
Optimisation step 4 - lacquer preparation



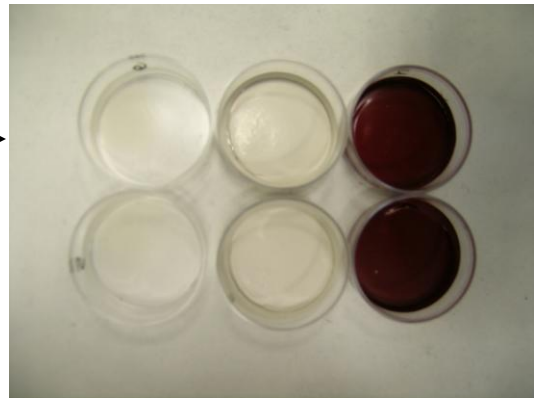
opening of lacquer-can and stirring with glass rod

filling 55 g of lacquer into 100 ml screw cap bottles and adding of a magnetic stirrer

analyte-addition into the magnetic stirred lacquer at (750-1250) 1/min

stirring for 1 h at (750-1250) 1/min with closed cap

decanting of the lacquer into diverse Petri dishes:
µ-CTE: 2 g in 35-mm-dishes
desiccator: 16 g in 94-mm-dishes



loading into emission test chambers

Fig.: sample preparation for the lacquer mixture

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Optimisation step 5 - curing process I

Fig.: surfaces of various lacquers after curing

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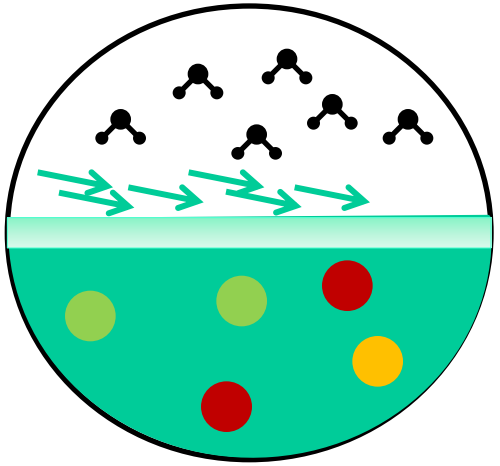
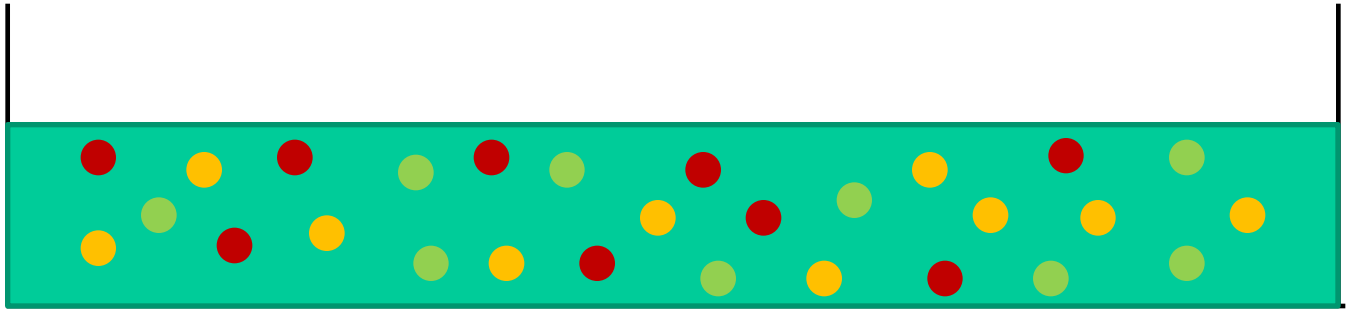
Optimisation step 5 - curing process II

Relative Humidity

Air velocity





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Optimisation step 6 - transferring to conventional (larger) chambers

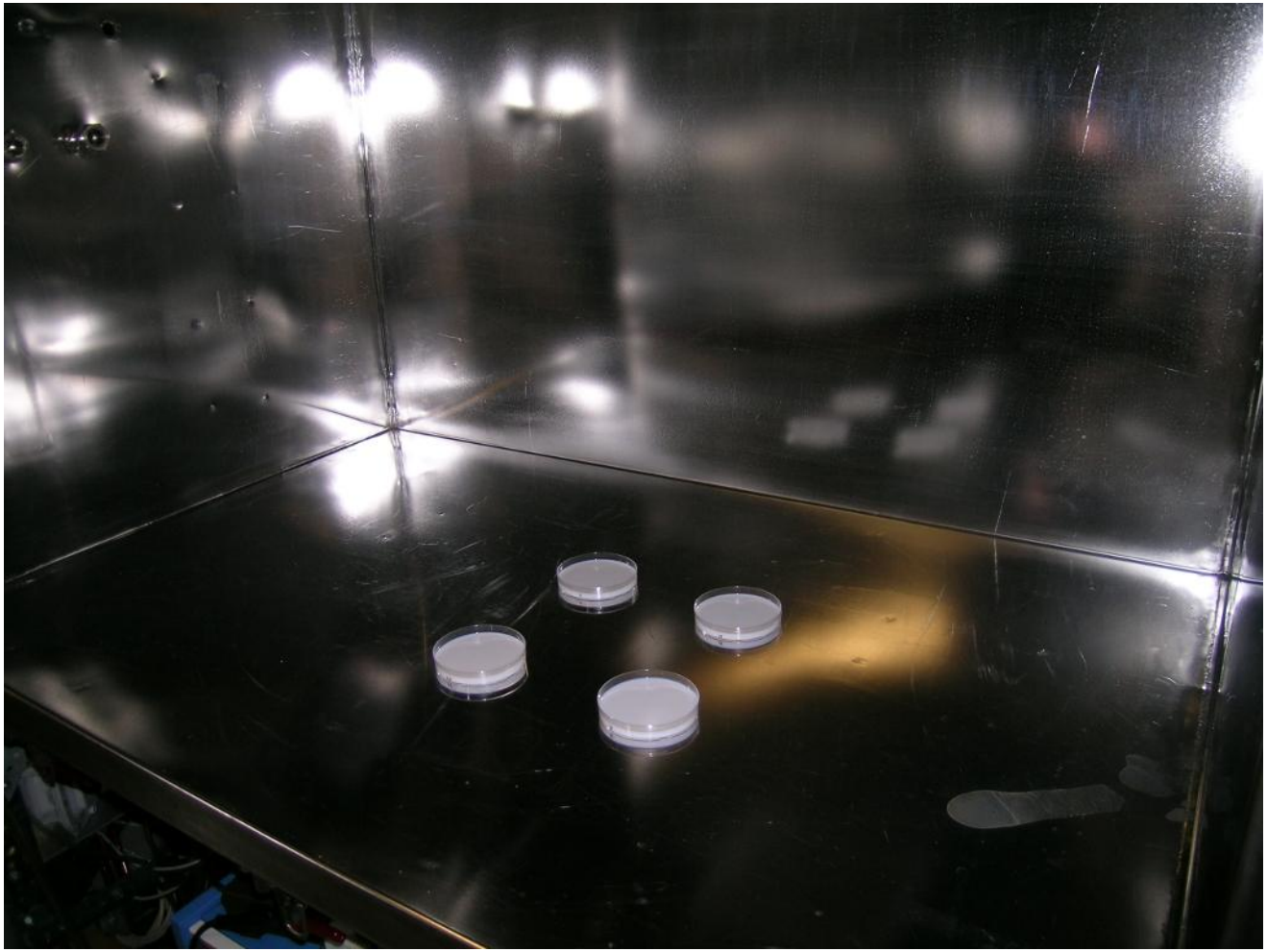

Fig.: prepared lacquer mixtures inside a 1-m³-steel-chamber

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Interim conclusion I

- emission profiles (emitted amounts over time) for the investigated substances comparable to “real” building products
- emitted amounts can be adjusted by the added analyte amount
- easy sample preparation
- emission of the investigated substances is reproducible mostly with variations of less than 10 % inside the micro chamber
- curing process influence the reproducibility of the emission

→ Statements according traceability and homogenity only possible after further testing

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Interim conclusion II

coming soon:

Michael Nohr, Wolfgang Horn, Katharina Wiegner, Matthias Richter, Wilhelm Lorenz

„Development of a material with reproducible emission of selected volatile organic compounds - µ-Chamber study”

submitted to CHEMOSPHERE

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