



# The need of the standardisation of the emission measurements in show cases

Introduction

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Conclusions



**Exhibit cases** should protect **cultural objects** from **dust** as well as from **mechanical damage**.

*Vienna,  
museum for natural history*

- several building materials, including woods and coatings, are possible **sources of VOC** in the indoor environment
- a variety of different emission measurements clarify that many substances such as formaldehyde, acetic and formic acid have a **high hazardous potential**

**Is it necessary to establish limiting values?**

**What about risk potentials of substances such as siloxanes?**

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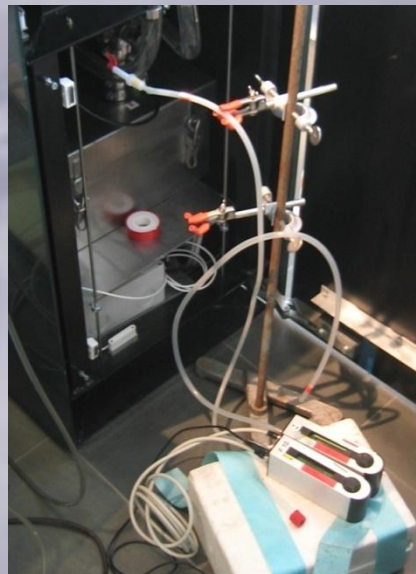
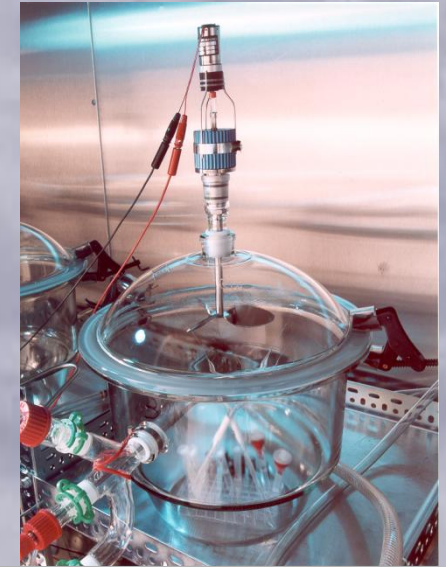
Conclusions



1) **Dynamic headspace method** (thermal extraction)

2) Emission measurements in **test chambers** (or test cells)

- investigation of **new materials / products**
- **long-term studies**



3) In-situ measurements are applied to **exhibition rooms, show cases** and **storage rooms**

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Materials	Emission
glass paint, air-dried	cyclohexanone, propylene glycolether derivate
glass paint, heat-dried	cyclohexanone, propylene glycolether derivate
powder varnish	no substances detected
polymer adhesive	alkanes, alkenes, butyl hydroxyl toluene, various aromatic compounds
1-component adhesive	methyl isobutyl ketone, oximes
2-component adhesive	cyclic siloxanes
silicon sealant	oximes, siloxanes, 1-methoxy-2-propyl acetate, acrylic acid ethylhexyl ester

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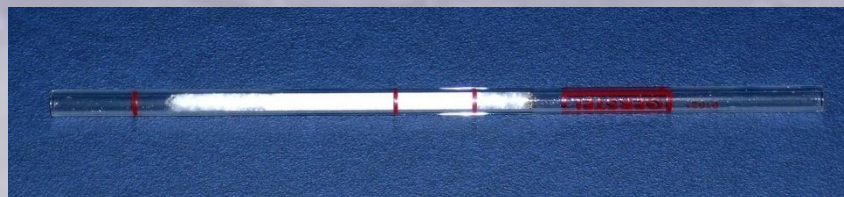
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- the results reflect actual conditions only to a **limited extend** and are therefore only moderately suitable for quantitative estimations
- provide essential information about **whether pollutants** could be **emitted from the materials at all**

- **VOC sampling** is accomplished using **Tenax TA** or activated **carbon filters** with a follow-up thermal desorption and **GC/MSD** analysis



*Tenax TA tube (200 mg, 60-80 mesh)*

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- thermal desorption (Gerstel TDS-2) combined with
- gas chromatography (Agilent Technologies 6890N)
- mass spectrometer (Agilent Technologies 5973N)
- analytical column: HP1, 60 m 0.25  $\mu$ m 0.25 mm or DB624, 30 m 0.25  $\mu$ m 1.4 mm
- quantification with **internal standards** (cyclodecane, toluene-d8 in methanol) or external quantification

- characterisation of aldehydes and ketones by use of derivatisation with **dinitrophenyl-hydrazine (DNPH)** followed by solvent extraction with acetonitrile and HPLC analysis



*DNPH cartridge (LpDNPH S10)*

- elution with acetonitrile
- HPLC with coupled UV-detection at **365 nm**
- analytical column (ULTRASEP ES ALD, 125 × 2.5 mm × 3 μm)
- pre-column (3 × 10 mm)
- solvent A: acetonitrile / solvent B: water; gradient programme
- **external calibration**

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- **SVOCs** are collected on **polyurethane foams**. After solvent extraction the analyses are also carried out with **GC/MSD**



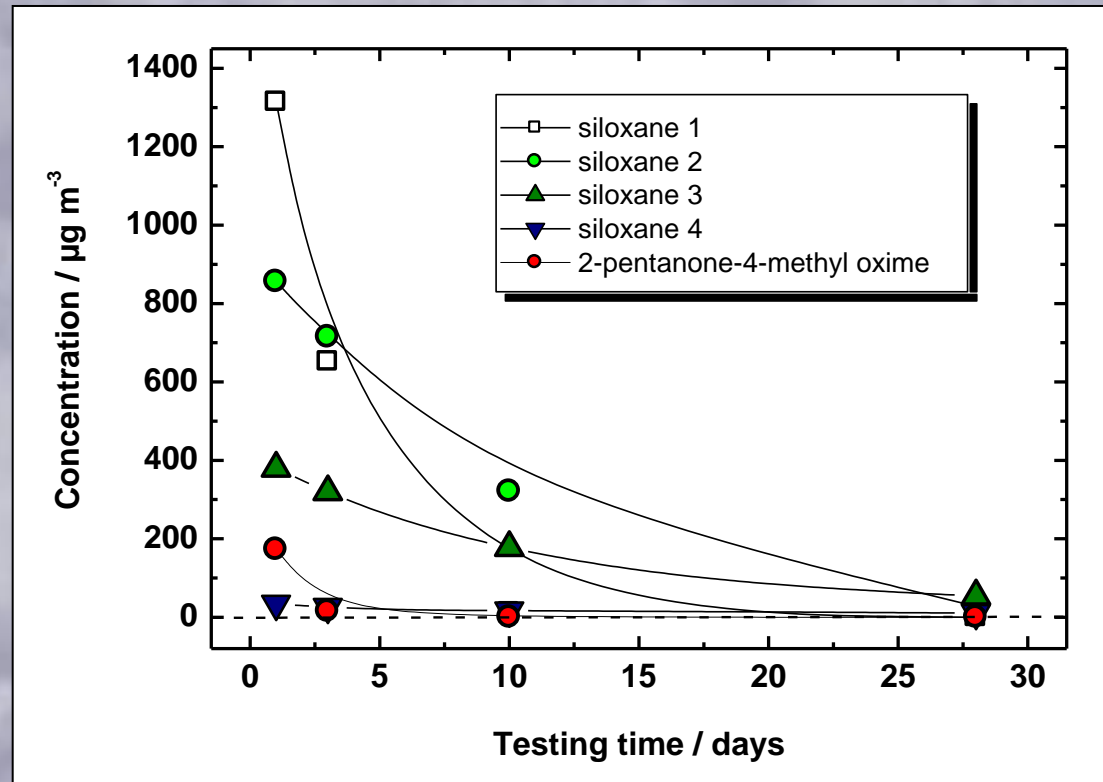
- liquid injection combined with
- gas chromatography (Agilent Technologies 6890N)
- mass spectrometer (Agilent Technologies 5973N)
- analytical column (HP1, 30 m 0.25  $\mu$ m 0.25 mm)
- **external quantification**

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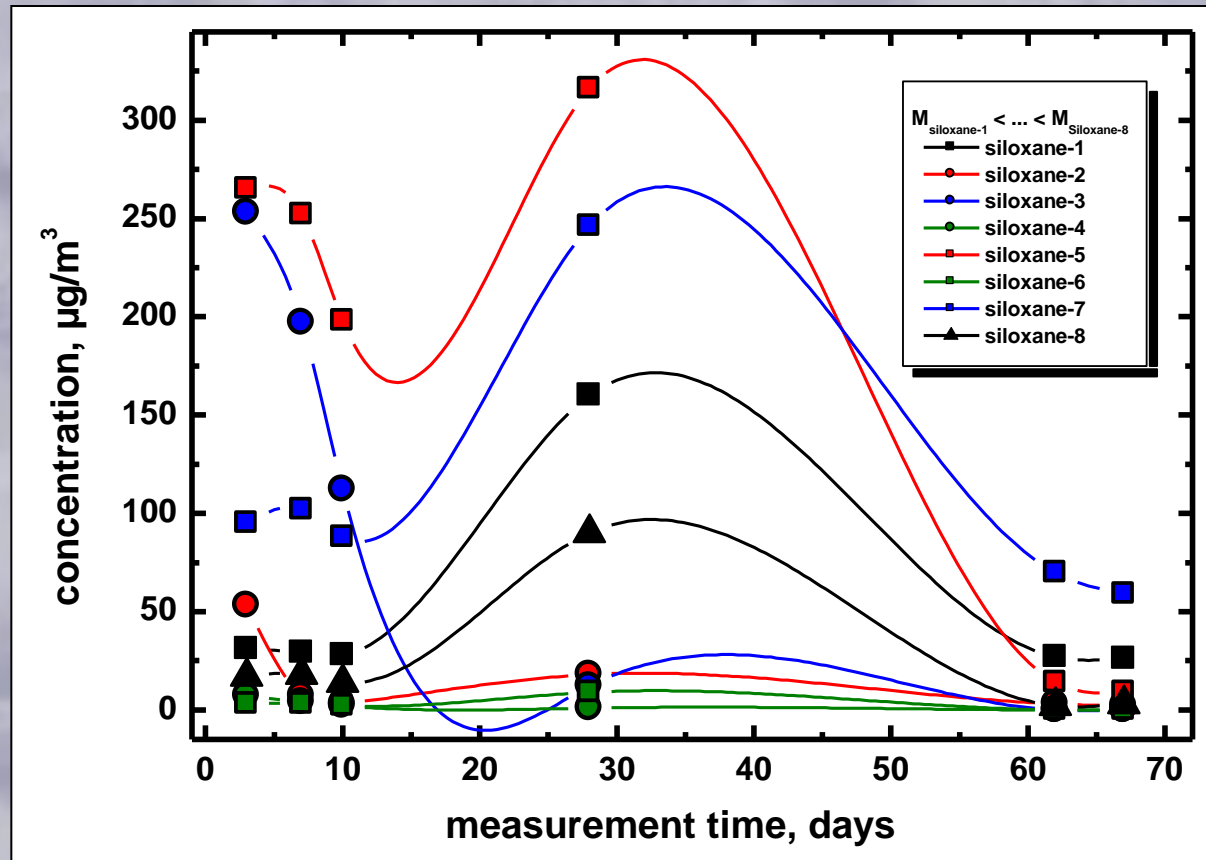
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- concentration profiles of siloxanes and pentanone-methyl-oxime as a function of testing time
- characterisation by means of TENAX sampling
- **clear decrease** in concentration over 28 days
- siloxane compounds as well as pentanone-methyloxime **do not present any damage potential after 4 weeks**



after 20 days: significant increase of siloxane concentration

new formation of different siloxanes:

- polymerization process?
- ageing process?

⇒ up to now only few data available

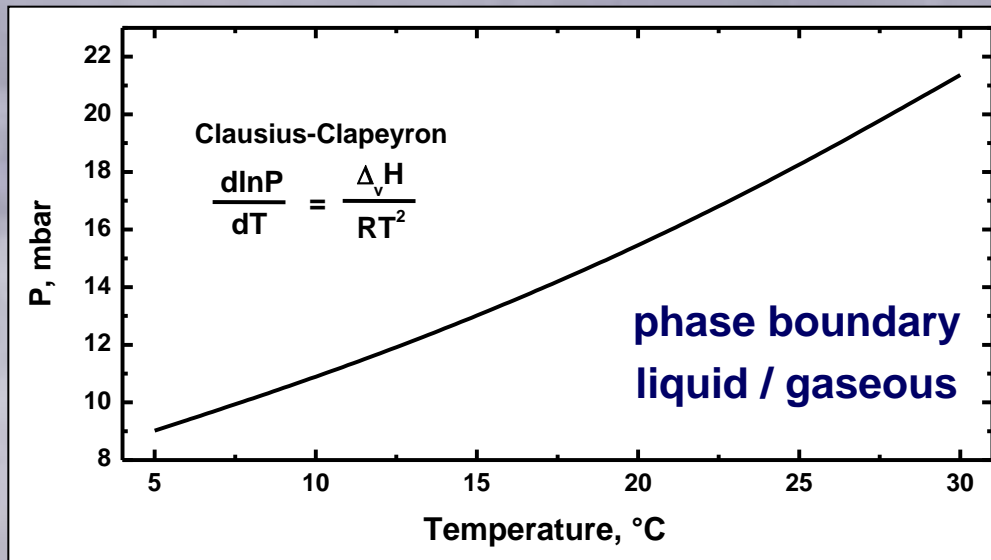
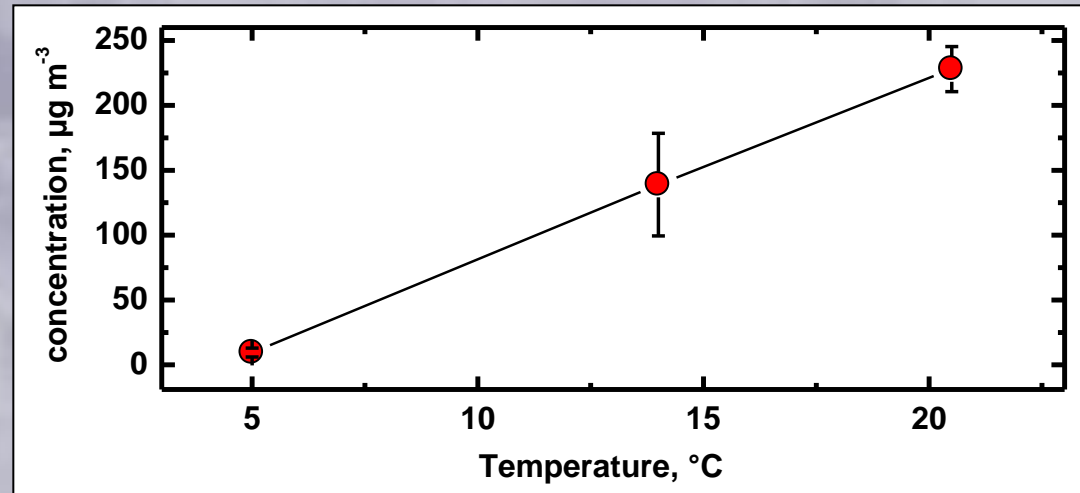
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Emission of **acetic acid** as a function of temperature



rough estimation  
possible

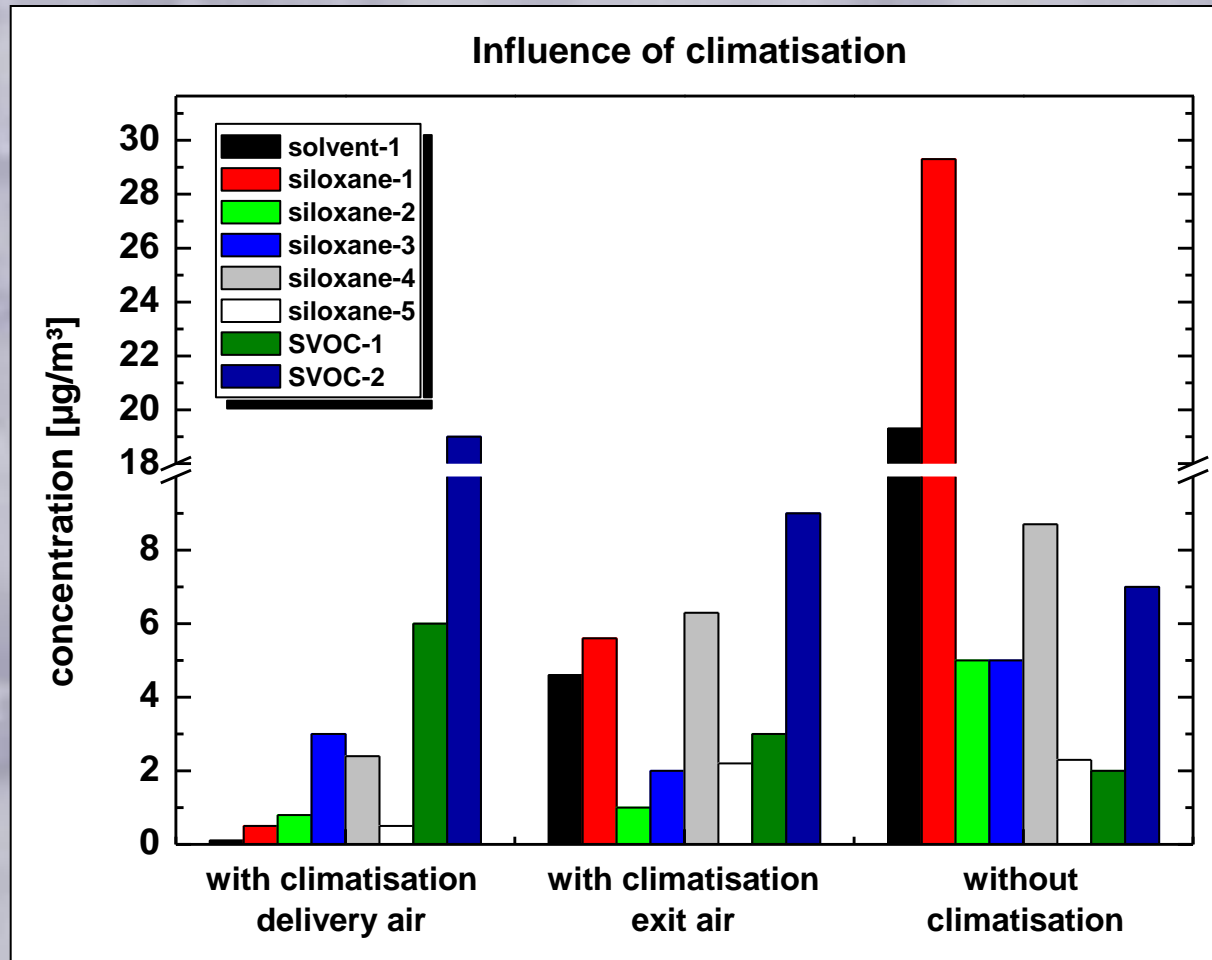
- migration
- diffusion
- adsorption

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investigation of exhibition case with internal climatisation:

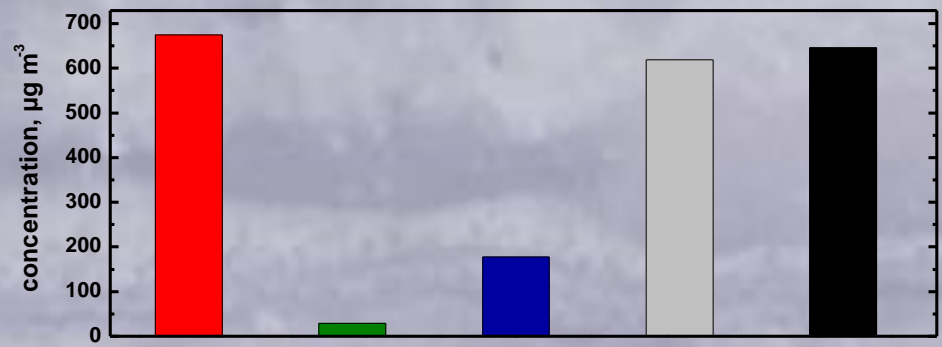
**⇒ ventilation decreases emission**

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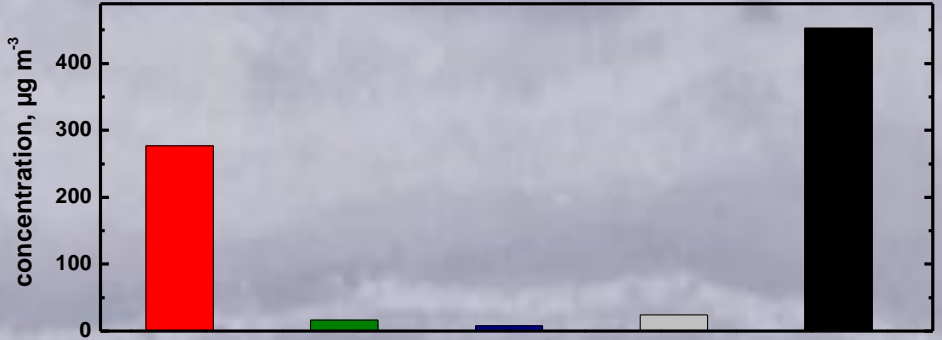
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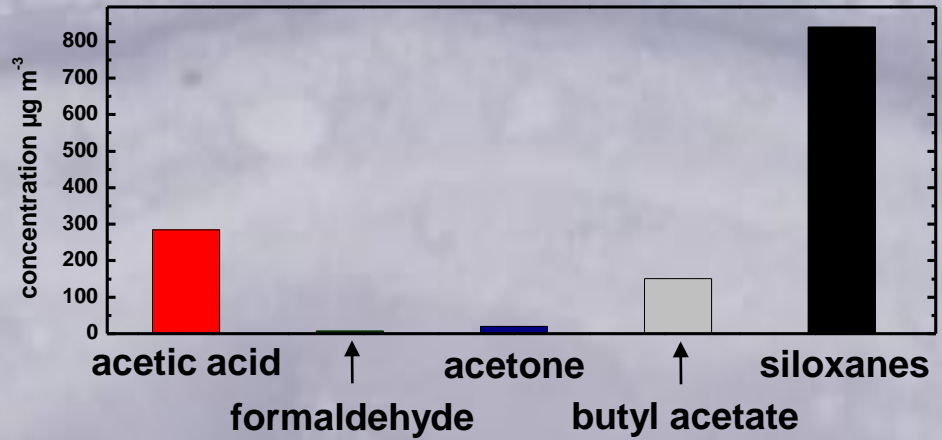
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exhibition case  
**with fixtures**  
(wood, textiles)



exhibition case  
**with fixtures and  
adsorber/filter  
material**



exhibition case  
**without fixtures**

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**scientists**  
**improvement of  
measuring techniques**

- reliability
- reproducibility
- round robin tests
- detection limits

**manufacturers**  
**consideration of further „quality  
demands“**

- closeness of exhibition cases
- adherency of sealants
- processability of building materials

**restorers / conservators**  
**protection of cultural heritage**

- avoidance of hazardous materials
- optimal storage

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emission measurements in **emission test chambers** / test cells

- investigation of **new materials / products**
- **long-term studies**
- **standard conditions**

in-situ measurements applied to **exhibition rooms, show cases**  
and **storage rooms**

- **under working conditions**

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**Is it necessary to establish limiting values?**

**What about risk potentials of substances such as siloxanes?**



glass corrosion

pigment degradation

lead corrosion

fading

- many corrosion processes are characterised
- risk potential of acetic acid, formic acid, formaldehyde, insecticides is well known
- for many substances it is not possible to establish limiting values!
- we have to estimate the impact of different compounds (such as siloxanes) on a variety of different materials

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**Thank you for your attention!**