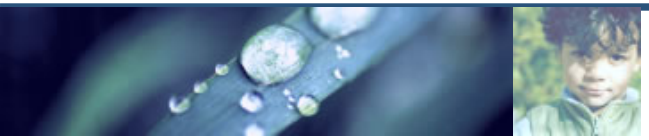


Emission Testing

-

Some principles

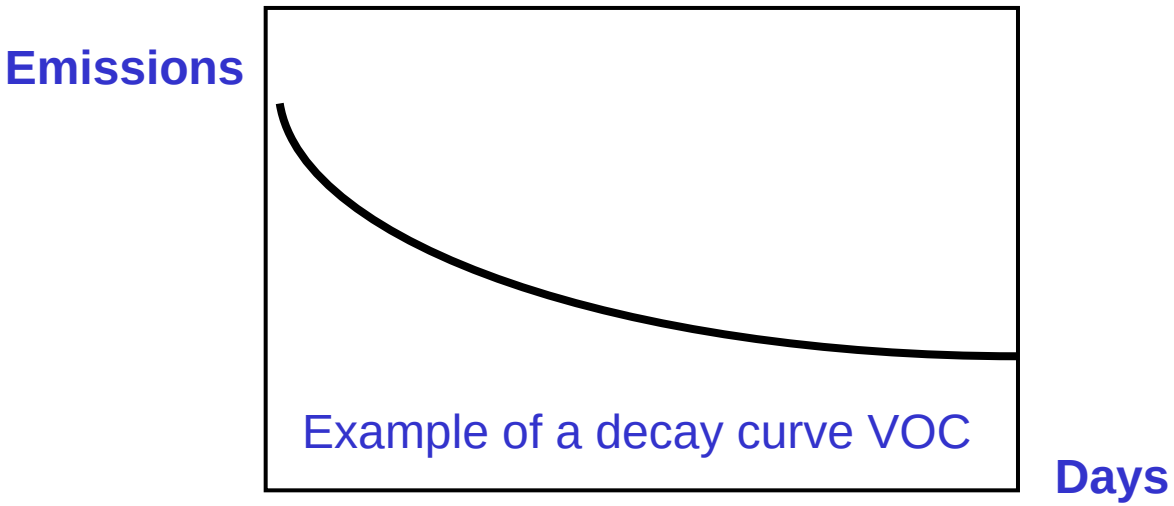
Reinhard Oppl, Eurofins Product Testing

Experience with emission testing

- Europe:
  - Formaldehyde E1 (wood-based panels)
  - DIBt (floor coverings)
  - Blue Angel (furniture, floorings, adhesives, sealants, …)
  - M1 (construction products, cleaners)
  - GUT (textile floorings)
  - EMICODE (adhesives, mortars, sealants, floor coatings)
  - France (solid construction products)
  - Denmark (construction products, furniture)
  - CertiPUR (PUR foam for furniture)
- USA:
  - Section 1350 / LEED / CHPS (construction products, furniture)
  - FloorScore / CRI (textile / resilient floorings, adhesives)
  - BIFMA (office furniture)
  - Greenguard (construction products, furniture)

Emission over Time

- **Evaluation, e.g. by emissions test, standard schedule:**
  - **after 3 days (early exposure, renovation) and**
  - **after 28 days (long-term exposure)**
    (or 3 days, GUT, or 10 days, EMICODE,
    or 7 days, BIFMA, or 14 days, Section 1350 / LEED / CRI)
- **Equilibrium concentration: only relevant for urea-formaldehyde binders**



Emission test and reality

- **Test chamber and real room**
  - Adsorption on walls reduces effective emission in real room
  - Other sources will contribute to real room air quality
  - **What you get is the emission rate,**
    and the maximum contribution of emitting material
    to room air concentration
- **Ageing - how to be considered?**
  (airing out and oxidation processes during storage, transport, construction process, use life cycle)
- **Coverage - how to be considered?**
  (e.g. adhesive by carpet, or wall by paint)

Significance of test result

- **What you get from chamber testing is:**
  Chamber air concentration at given time mg/m³,
  then calculate from that:
  - **Emission rate hour mg/h**
  - **Specific emission rate (emission factor)**
    - **per area mg/m²h**
    - **or per mass, per device, per unit**
  - **Contribution to air concentration mg/m³**
    in reference room or in real room (source strength)
    after a specified time

Intended use and exposure scenario

- Reference room - not a test room, but just a model
  - In Europe:
    - Floor area 7 or 12 m², Height 2.5 m
    - 1 window, 1 door
    - From that calculate wall area, sealant area 0.2 m²
      - From that calculate loading factors (m²/m³)
    - 1/2 air exchange per hour (1/h in EN 717-1, 0,6/h - 0,9/h in USA),
    - 23 °C (Asia: 25°C/28°C; 25°C for CARB regulation)
    - 50% relative humidity (45% in EN 717-1)
- Testing shall simulate that room more or less
  - Some deviation possible, if result is re-calculated to reference conditions
    - … as long as air velocity over test specimen surface is sufficient for transfer of emitted VOC into surrounding air
    - … and no surface drying occurs during testing

Correlations

- **Specific emission rate, e.g. mg/(m² x h) :**
  - is the key parameter as it allows all other calculations
  - *Instead of area specific emission rate as here, also mass specific, volume specific or unit specific emission rate may be used*
- **Reference room air concentration (mg/m³):**

  Can be re-calculated from whatever test chamber (within certain limits)
  - from emission rate mg/(m² x h), or
  - with loading factor m²/m³ and with ventilation rate per h
    - even if these in test chamber differ from reference room
- **Real or other room air concentration (mg/m³) :**

  Can be re-calculated freely
  - from emission rate mg/(m² x h), or
  - with reference room air concentration (mg/m³)
  - with loading factor m²/m³ and with ventilation rate per h

Calculations

- **Test chamber air concentration at given time**
  - C_{CH} = mg/m³ = µg on sampling tube / litres air sampling volume
- **Emission rate**
  - ER = mg/h = C_{CH} (mg/m³) x chamber volume (m³) x air exchange (/h)
- **Area specific emission rate or emission factor**
  - SER_a = mg/(m²xh) = ER (mg/h) / emitting surface (m²)
- **Reference room air concentration - used as reference**
  - C_{MR} mg/m³ = SER_a mg/(m²xh) x loading factor L (m²/m³) / air exchange rate (/h)
- **Other room air concentration - different loading factor L (m²/m³) in room**
  - C_{OR-L} mg/m³ = SER_a mg/(m²xh) x other loading L_x (m²/m³) / air exchange rate (/h)
- **Other room air concentration - different air change rate n (1/h) in room**
  - C_{OR-V} mg/m³ = SER_a mg/(m²xh) x loading factor L (m²/m³) / other air exchange (/h)
- *Instead of area specific emission rate,*
  also mass specific, volume specific or unit specific emission rate may be used