European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*
COST Action TD1105

Odour Monitoring by Sensor Technologies
Cambridge, 18-20 December 2013

A-C Romain

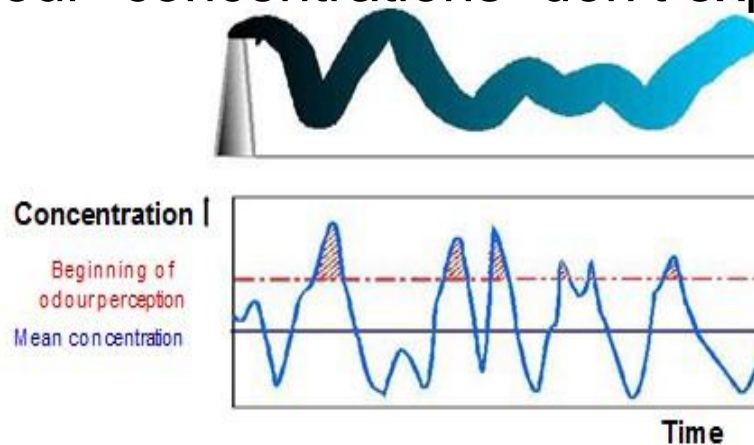WG 4 member, Sub-WG 4.2 Leader

ULg / Belgium

Context

Odour monitoring = continuous and real time measurements

Why ?

Mean values of odour "concentrations" don't explain the odour annoyance

Annoyance = FI**D**O (R) → need continuous recorded data

Interests

- Understanding and analysing
- Making correct decisions
- Improving policies
- Reducing management risk

For whom

- Industrial managers
- Neighbours
- Local authorities
- Governmental authorities
- Environmental companies

Odour definition

volatile emanation which cause sensations in humans due to the excitation of specialized organs
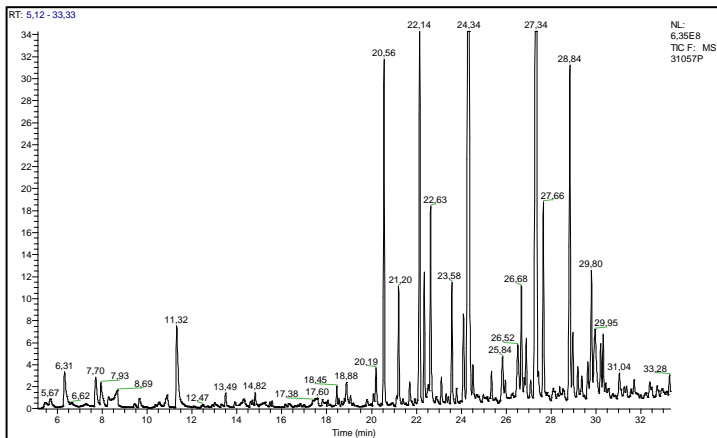
Chemistry

Complex mixture of hundred compounds
Single compounds (odorant eg H_2S)

2 dimensions
- ➢ Chemical concentration
- ➢ Compound name

Physiology
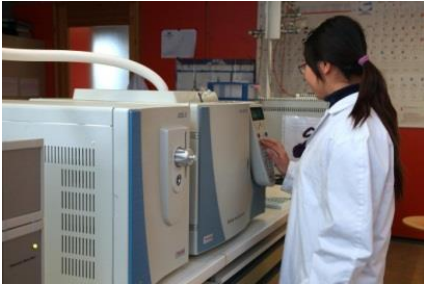

Perception → **Annoyance**

5 dimensions
- ➢ intensity
- ➢ odour concentration
- ➢ offensiveness
- ➢ quality (rotted egg; cabbages)
- ➢ time

Odour definition

volatile emanation which cause sensations in humans due to the excitation of specialized organs

Chemistry ≠ **Physiology**

H_2S: 2 µg/m³	→	Strong odour
CH_4: 30%	→	No odour
Ethanol: 5 mg/m³	→	Light odour

Sum of chemical concentrations ≠ Sum of odour concentrations
(synergetic and inhibition effects)

often confusion : odors = odorants

Odour definition→Metrology

Chemistry

Physiology

Analytical instruments
 chemical analysis
        (GC-MS; GC-MS-O, FTIR; …)

Sensor technologies
selective sensors (specific? ☺)
                optical or chemical
1 sensor, on chip or multi sensors array

Outputs
chemical concentration (µg/m³)
        ≠
odour information

Sensorial analysis
 dynamic olfactometry,
 complaints survey, panellists, …

Senso-instrumental technologies
 "electronic nose"
    (Artificial Olfactory System AOS)

Outputs
Odour concentration (ou/m³),
offensiveness, frequency, odour sources
(compost, biogas,…)

Sensor technologies in the world of odour

o **single odorants** (extremely rare)
  eg H_2S: selective sensors (electrochemical cells)

o **environmental off-odors** = complex mixture and…
 **"odour sensors"** don't exist…yet !!!!...excepted our nose

Mixture of hundred compounds
- various chemical families and compounds
- large range of concentrations

No need of specificity (some selectivity)
Do you know one hundred different chemical gas sensors?

o **key compounds** (if complex mixture)

sometimes enough to monitor fluctuation
if strong correlation odour and single compound (selective sensor enough)
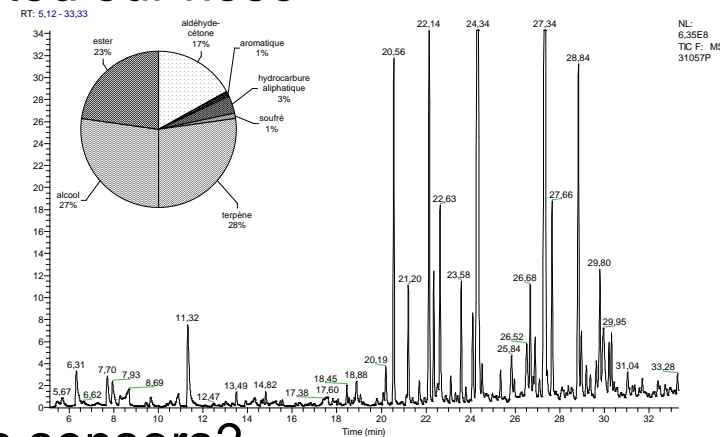
Sensor technologies in the world of odour

- Each day, the chemical sensors are
    more "accurate", smaller, cheaper and more "intelligent "

- BUT still **several limitations**

    o drift,
    o humidity,
    o high LOD,
    o short lifetime,…   *Example: if drift, frequent calibration of the devices*
                          calibration with odours?
                          No standards *of « compost odour» or « waste odour*
                          Which "mixture" to compensate the drift?

    Since 1995,
        our team have tested different chemical sensors
        for long time odour monitoring in the field

                → Best results with metal oxide sensors

Sensor technologies in the world of odour

✓ What we need

- **Low cost sensors**
  to install several devices around the plant – to catch the emissions in the different wind directions, network-real time mapping

- **Long life time**
  to avoid new costly development of classification and quantification models

- **Low drift and robustness**
  (sometimes) resistant to harsh environmental conditions

- **Lower LOD** (to avoid preconcentration devices)

- **Weak power** consumption/wireless sensors

- **Some selectivity** (sensor array, T Modulation) ; cross-sensitivities

✱ What we don't need

- Accurate output of chemical concentration

- High selectivity / specificity

Highlights

- Odour ≠ odorant

- The management of the odour pollution needs a real time monitoring of the "odour perception"

- Sensors technologies (ST) -as artificial olfactory system- have the best potentialities for this monitoring at low cost

- ST for odour monitoring no yet considered in the policies

- Currently limitations of the technology not hinder it's development

- High specificity not mandatory

- Collaboration of end-users (stakeholders) and scientists would have the power to merge the requests of each actor

Odour Monitoring by Sensor Technologies ?
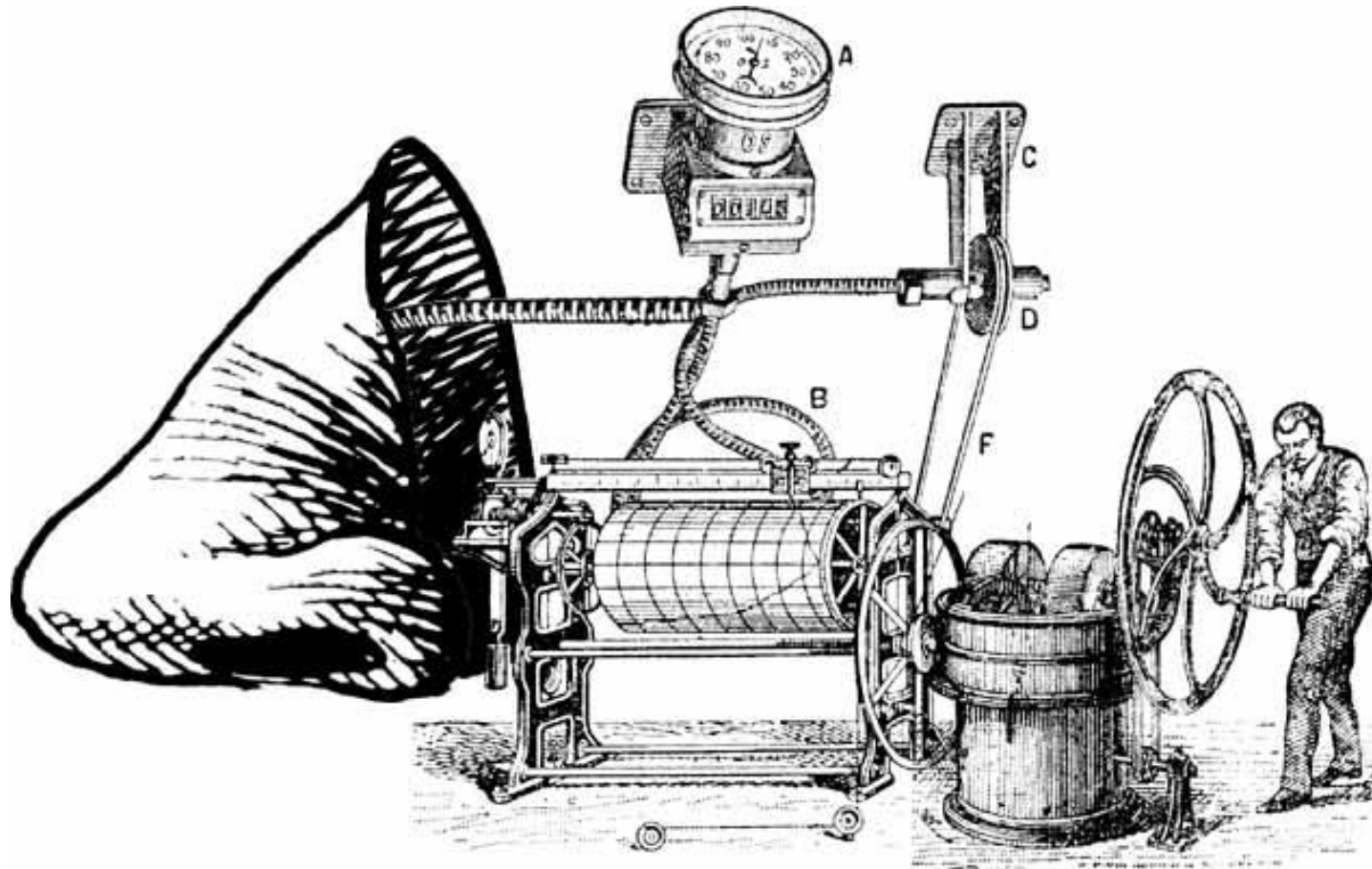
Thanks for your attention

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