Olfactometry

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Odor determination

Several parameters are available to describe an odor with regard to its undesirable effect:

- odor concentration (dilution factor at odor threshold)
- (perceived) odor intensity
- hedonic tone of odor (pleasant/unpleasant)
- type of odor (it smells of…)
- frequency and duration of occurrence
- fluctuation (temporal variation of concentration)

In practice, only the determination of odor concentration is of relevance. As is also the case with e.g. noise measurement, olfactometry is an impact-oriented measurement method that determines the effect an odor has on humans. Ultimately, the goal of odor measurements is to estimate the degree of nuisance caused by the odor impact. The following figure shows the various effects of odors on the well-being of humans. Three cases can be distinguished (see Fig. 1):

1. **Case A**: no odor sensation as there are no odorous substances
2. **Case B**: With increasing odor concentration odor sensation increases and discomfort grows to the point of health risk.
3. **Case C**: With increasing odor concentration the intensity of odor sensation increases and then decreases again. The health risk increases nevertheless.

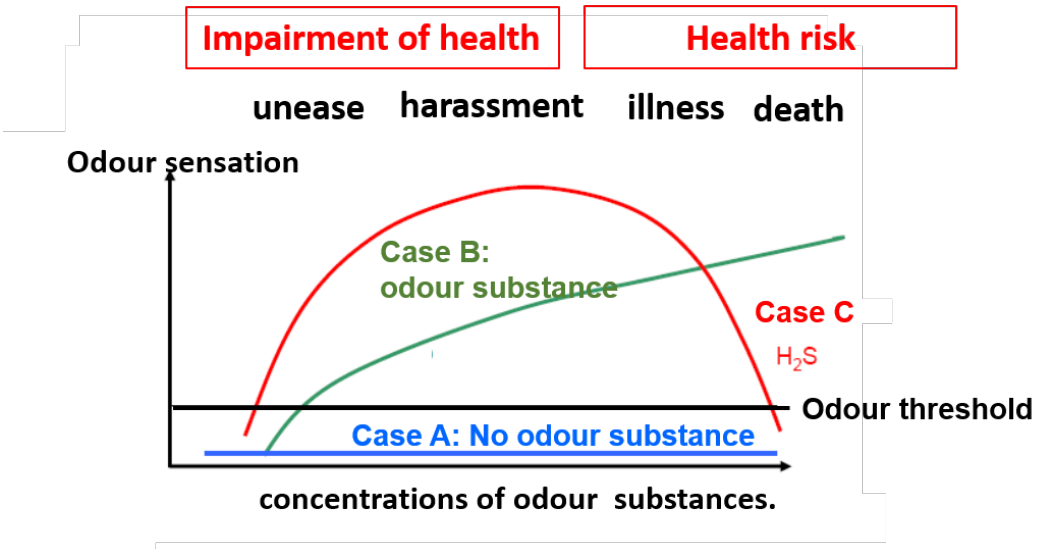

Fig. 1: Odor sensation depending on odor concentration

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The olfactory sense reacts very sensitively and differently to a variety of chemical substances. It even reacts to concentrations of individual odorous substances that are below the metrological detectability threshold.

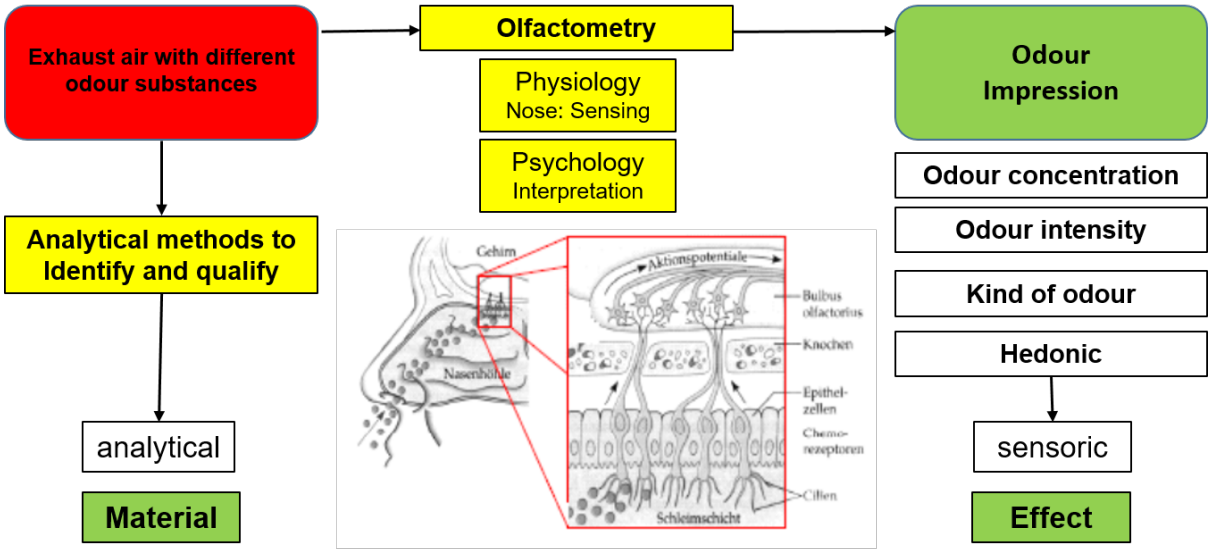

Fig.: 2: Odor perception

The odor impression can be described as

1. odor concentration
2. odor intensity
3. odor type and
4. hedonics.

All parameters are to be determined exclusively by organoleptic methods. Thus, odor measurement will depend on the human nose as sensor also in the foreseeable future.

Today the most important parameter is odor concentration. It is the basis of all emission examinations and immission calculations. It is measured by **olfactometry**.

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Here, the human nose serves as assessment criterion. The odor sample is mixed with non-smelling clean air and is presented to several human subjects. This is done in defined dilution levels. The human subject makes a statement on when and/or how strong s/he perceives the odor.

An olfactometer basically consists of a pump, a mixing device, a pre-diluting device, hose lines and pipes and one or several smell tubes. The pump delivers an odor sample diluted with neutral air from the mixing device to the smell tubes. N-butanol serves as reference substance. (See Fig. 3).

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The odour concentration c_{od} of an analyzed sample meets in numbers the relation of dilution from the odour free air and the sample which is necessary to reach the odour threshold.

The 50-percentile odor threshold Z 50 is calculated by means of the geometric mean of all the odor threshold values of a sample identified individually by all participants. Odor threshold value Z 50 is used in determining the emission mass flow (odor flow).

Odor concentration is given in **odor units [ou / m³]** and describes the dilution of the odor sample that is set at the olfactometer according to

$$\frac{V_{Geruch} + V_{Synth.\,Luft}}{V_{Geruch}} = Geruchseinheit$$

with:
V_{odour} = flow rate of odor-carrying air delivered to nose
$V_{synth.\,air}$= flow rate of odor-neutral air delivered to nose

Derived units are

- ou / (m² * h) describing the emission from e.g. windrow surfaces
- ou / h used in immission calculation

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Fig. 3: Diagram of olfactometric measurement and photograph of device