



Odour - Frequently Asked Questions

What is an odour?

Odour is a chemical property perceived by our brains giving rise to what we describe as a 'smell'. Olfaction is the term used to describe our sense of smell, the process where odorous chemicals excite receptor cells in the nose and trigger sensations in the brain. Not all chemicals are odorous and therefore do not trigger olfaction.

What are odorants?

'Odorants' are individual chemical compounds, entities in the atmosphere which are capable of being transposed by our nervous systems into what we term 'odours'. 'Odours' are the subjective products of neural stimulation in the brain and therefore have the potential to be modulated by individual influences. The memory and emotional areas of the brain are often stimulated during olfaction resulting in psychological responses to the odour. Some odours are caused by single odorant species however most odours are a mixture of many chemicals that interact to produce what we perceive as an odour. For example the smell of coffee is made up of over 300 different odorants which combined give a distinctive smell.

How do we respond to odours?

Humans have a sensitive sense of smell and can detect odorous chemicals in very low concentrations. We can also detect odours in a matter of seconds after exposure i.e. when we inhale and air travels up the nose stimulating a response. Odours are able to trigger strong and quick responses for good reason. Pleasant odours prompt our appetite i.e. when we are putting food to our mouths whereas unpleasant odours are often, but not always, indicators of harm e.g. the smell of rotten food warning us not to eat.

Can odours have toxic effects?

Odorous chemicals can have toxic properties i.e. cause direct physiological effects such as eye, nose and throat irritation. However concentrations capable of causing acute toxic effects are much greater than those levels found in the normal environment. In addition for the vast majority of odorous chemicals, sensory effects occur well before the onset of health effects, i.e. the odour threshold lies below the irritant threshold, therefore smelling the substance acts as a warning trigger.

Can odour perception cause health effects?

The relationship between exposure to odour and health is not completely understood. A number of studies have demonstrated that odorous chemicals, present at levels which are not considered to be toxic or irritant, can still lead to health symptoms being reported in the exposed population (Schiffman et al., 2004, Shusterman, 2001). Symptoms reported from environmental exposures to odours can include headache, nausea, shortness of breath and sore throats.

Can odours be measured?

The characterisation of what chemicals are present in the air can be achieved analytically i.e. what chemical species are present and in what quantities. However this often does not relate to what people 'smell' or describe when they perceive the odour. This is due to the subjective nature of perception. The best way to determine

odour characteristics is by the use of human sensory perception i.e. what the population smells and where.

What are the characteristic attributes of an odour?

Odours possess four interlinked sensory characteristics and it is often these parameters which are used to describe odours when they occur in the environment. These parameters are: concentration, intensity, quality/character and hedonic tone. The only objective dimension of odour is detection i.e. whether one can smell the odour or not.

Concentration

This defines the amount of an odorous substance in a particular volume of air. Usually the concentration is measured in volume units e.g. parts per million (ppm), parts per billion (ppb) or as mass units e.g. mg m^{-3} of air, for single compounds. For mixtures of odorous compounds the concentration is usually expressed as odour units per cubic metre (OU/m^3) or European odour units (OU_E/m^3) when the European Standard is employed (CEN, 2003). Odour units are determined by presenting samples of successively diluted odorous gas to a panel of assessors until 50% of the panel can no longer smell the odour. At this level the gas mixture is equivalent to 1 odour unit (1OU). The concentration of the original gas sample can then be expressed in terms of the number of dilutions or in the equivalent odour units. As a very approximate guide, $1 \text{OU}_E/\text{m}^3$ is the point of detection of a particular odour; at $1-5 \text{OU}_E/\text{m}^3$ the odour is recognisable; at $5 \text{OU}_E/\text{m}^3$ there is a faint odour and at $10 \text{OU}_E/\text{m}^3$ the odour is said to be distinct odour. The values for normal background odours such as traffic, grass cutting and plants, amount to anything from 5 to $40 \text{OU}_E/\text{m}^3$.

Intensity

Intensity refers to the strength or magnitude of odour sensation as perceived and is therefore a subjective measurement. Odour intensity scores are obtained by human assessors in a laboratory. Firstly, the odour concentration is determined, and then a range of odour dilutions are presented to the panelists who indicate their perception of the intensity of each dilution following the scale in Table 1.

Table 1: Odour intensity scales

Intensity Score	Intensity
0	No odour
1	Very faint odour
2	Faint odour
3	Distinct odour
4	Strong odour
5	Very strong odour
6	Extremely strong odour

Odour concentration and intensity are related with perceived intensity increasing with increased concentration; however two important points should be noted. Firstly, odours having the same concentration will not necessarily have the same intensity (Sarkar and Hobbs, 2002). Secondly the relationship between concentration and intensity is logarithmic therefore an increase or decrease in concentration will not always produce an equivalent relative change in the perceived intensity.

Quality/character

This is a qualitative characteristic that is articulated in terms of a description of the odour by analogy with a generally recognised smell e.g. 'sweet', 'pungent', 'solvent' or 'fishy'. The character of an odour may change with dilution. Odour descriptions are useful for indicating an odour source character and/or in pointing to likely key chemical compounds contained in an odour.

Hedonic tone

The hedonic tone of an odour is the subjective judgment made by a person of the relative pleasantness or unpleasantness of its smell. The determination of this odour characteristic is therefore open to variation between perceiving individuals and is strongly influenced by previous experience of the odour and emotions at the time of perception. Determination of hedonic tone is usually undertaken in a laboratory setting. Positive scores are the more pleasant odours (a score of +4, e.g. a bakery smell) and negative scores (a score of -4 e.g. a sewer odour) are for unpleasant odours.

How is odour controlled?

Odour 'pollution' is controlled primarily under the Environmental Permitting Regulations (EPR) and the Environmental Protection Act (EPA) 1990.

Industries producing odorous emissions are regulated under the EPR in order to prevent pollution of the environment and harm to human health. The regulatory authorities are the Environment Agency (EA) and Local Authorities (LA). Permits to operate odorous industries are issued either by the EA or the LA, depending on the scale of the operation, and will have conditions relating to odour control. A breach of these conditions will be dealt with by the relevant organisation.

Table 2: Examples of permitted activities and the relevant regulator

Regulator	Examples of permitted activities
Environment Agency	Landfills, intensive farming, refining gas
Local Authority	Animal rendering, textile treatment, sewage treatment works

Odours arising from industrial or commercial properties which are not subject to the EP Regulations are dealt with by LA's under the EPA.

If odours are considered to be a nuisance or prejudicial to health then the LA must investigate any complaints reported to them.

Odour as a nuisance issue is determined by the impact of the odour being 'substantial and unreasonable'. In deciding whether odours are a nuisance, LA inspectors will take into account the FIDOL factors.

Table 3: Relating odour to statutory nuisance (Adapted from (Defra, 2010))

FIDOL factors	Factors determining statutory nuisance
Frequency	Frequency of the odour occurrence – how often an individual is exposed
Intensity	Intensity of the odour
Duration	The length of time of the odour event or exposure
Offensiveness	Offensiveness (a mixture of the concentration, character and hedonic tone of the odour)
Location	The tolerance of the receptor, the characteristics of the neighbourhood

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