Odors

Discover more about one of the most unpleasant pollutants:odours!

Certain smells awaken very pleasing memories: think of the smell of your favorite meal! It is also true that while some odor awaken pleasant memories, others are unpleasant and not very popular, making us exclaim, “it stinks.”

The goal of this article is to provide you information on odorous molecules. In particular, we will analyze:

- The definition of odor. What are the smells, and what are the processes that govern the perception?
- The chemical nature of the odors. What are the main categories of molecules that distinguish the odor emissions? From which industries originate?
- How they are quantitatively determined. What are the procedures used to determine the concentrations and the possible effects of odor molecules?

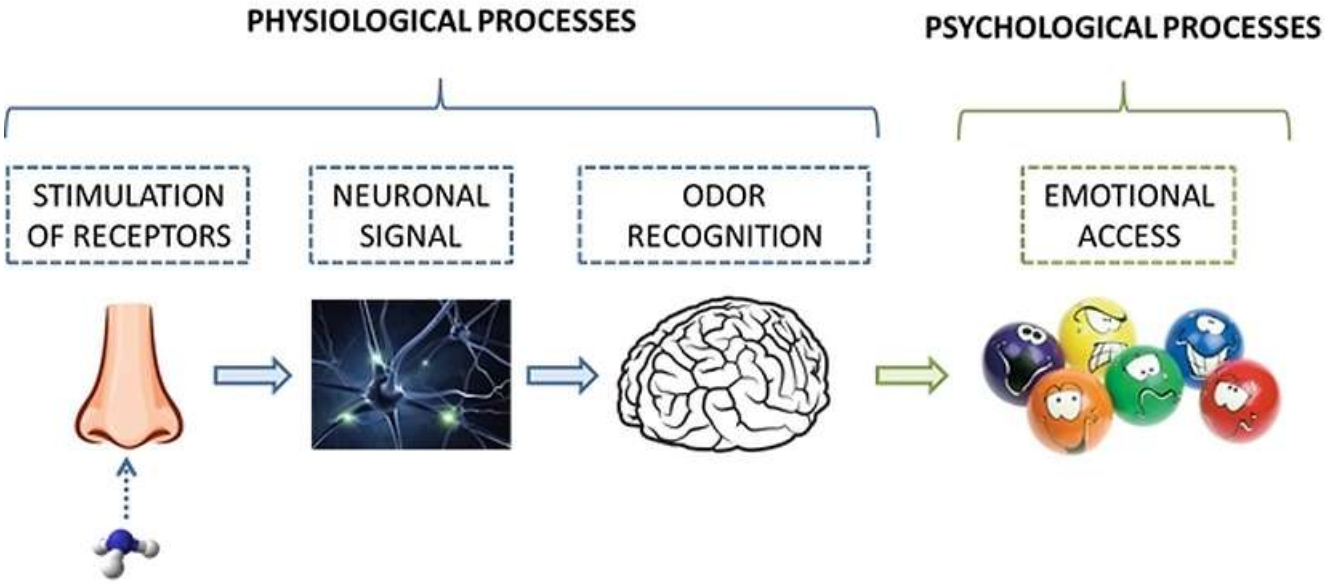
We start with the analysis of the first of three points: the definition of odor.

What are the smells?

The perception of smell is linked to one of the five senses: the olfaction.

The steps leading to the awareness of the presence of odorous molecules in the air are very fascinating. It must first be noted that the processes can be distinguished in two categories:

- Physiological Processes: the receptors inside the nose are stimulated by odor molecules in the air. This stimulus results in an electrical signal, which is sent through the nerve pathways to a specific area of the brain. The brain, then, decodes the signal and associates it to the signals of the various substances have already been recorded.
- Psychological Processes: basically our personal reaction to the odor that was perceived at the neuronal level. It is important to note that this component is highly subjective: While a person has perhaps associated sensations of pleasant smell in question, another person may have associated with the same odor, unpleasant sensations. This subjective component is also deeply influenced by the context (time and space) in which the odor is perceived: smell of your favorite meal around lunch time or six in the morning has two different effects!



We now understood one thing: the odor perception is profoundly influenced by psychological processes. It is also true that, statistically, there are odor considered unpleasant by most of the population. Living close to a production processes that emit significant amounts of odorous molecules can be problematic. Therefore, we analyze together the different classes of compounds that are part of odorous molecules.

The chemical nature of the odors

In a previous article we examined the VOC (Volatile Organic Compounds). The odorous molecules typically belong to this category of compounds, as they are mainly organic molecules with a marked tendency to be present in the vapor phase. However, not all VOCs have a distinctive odor, methane, for example, it is odorless. The pungent smell that we feel when we turn on the gas stove is associated with some sulfur molecules called mercaptans.

So what are those classes of compounds which typically have an odor? Here they are:

- sulfur compounds: as just pointed out, the sulfur molecules tend to have a characteristic pungent odor. They tend to be issued in anaerobic processes: H2S (hydrogen sulfide), for example, has a smell of rotten eggs. Other sulfur compounds, called mercaptans, have a characteristic smell of rotting cabbage.
- oxygenated compounds: within this category are many types of molecules. There are for example alcohols, having the characteristic odor of alcohol. Then there are the aldehydes, which typically have a strong odor (and stinging strokes) of fruit. The ketone, in a similar way, have a strong and sweetish odor, tend unpleasant. This category also ethers and esters.
- volatile fatty acids: are typically generated by incomplete oxidation of lipids, and have a pungent, rancid odor.
- terpenes: this class of molecules, including for example, limonene and α-pinene, mainly due to the plant world. In particular, it derived from processes of bio-degradation of ligno-cellulosic materials. They are molecules that give the feeling of that characteristic smell of “nature”.
- nitrogen compounds: Also in this category are different types of molecules (ammonia, amines …), which have pungent and unpleasant odors.

At the industrial level, in which processes are issued these categories of molecules? Those most relevant from the point of view of odor emissions are:

- treatment and disposal of waste a salso wastewater treatment
- livestock and agricultural equipment
- industrial production (chemical, petrochemical, pharmaceutical, food, tanning …)

Well, we saw the dynamics that govern the perception of odor and the various categories of odorous molecules. The description given is Qualitative. Let us now analyze the quantitative aspects; how are measured the concentrations of odors and what methodologies are used?

How do you “measure” odors?

In dealing with this topic it is appropriate to introduce a distinction between three categories of techniques.

Analytical techniques

They are based on the chemical analysis methodologies, which allow to carry out a determination of the molecules present in a gas stream. The advantage of these techniques is that they allow to determine the exact nature of the chemical species involved and their concentration. On the other hand, the disadvantages are data from the instrument detection limits (often less sensitive than the human nose) and lack of ability to estimate the possible synergies between odors. In fact, it may be that the combined effect of two odors simultaneously present in a gas stream is higher than physiologically respect to the sum of the individual effects; if this is sensed at a physiological level, that is not the same from an analytical point of view.

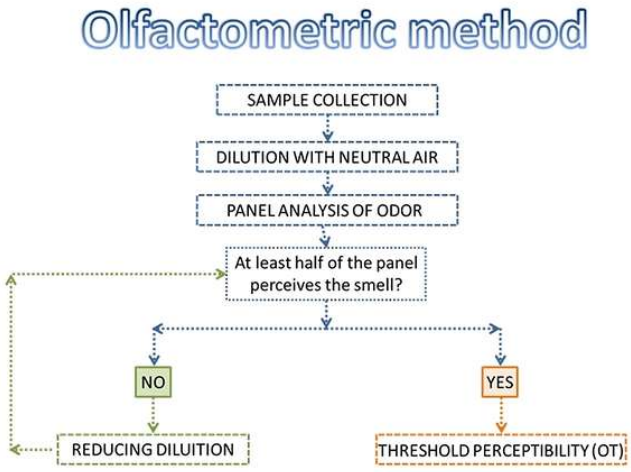
Sensory-instrumental techniques

They are based on the special equipment that aim to experimentally emulate the functions of smell (for example, the electronic nose). This category of techniques is used widely in the food industry, while it appears to be less developed in other fields.

Sensory techniques

Using the human nose as a reference point. Among these, the most used technique is the dynamic olfactometry, structured as follows:

- A group of people trained for the purpose is selected, this is called panel.
- The panel is subjected to olfactory stimulus of a gaseous sample, consisting of the sample you want to study diluted in relationships defined with odorless air.



The panel provides information on the perception or lack of odor perception.

- The procedure is repeated with a series of decreasing dilutions, till up to 50% of the panel perceives the ointment stimulus.

The odor concentration which corresponds to this condition (perceptual response from the 50% of the panel) corresponds by definition to a unit of odor (or odorimetric unit) of the test sample (1 OU / m3), and defines the threshold perceptibility (odor threshold – OT).

After establishing this base unit, the concentrations of odor molecules are expressed as a multiple of single odorimetric units.

The analysis carried out was mainly focused on the olfactory intensity determination of the sample methodologies. The question we now ask is: which correlation exist between the sample olfactory intensity with the potential health risks?

It is important to note that the presence of airborne malodorous compounds is not necessarily related to potential toxic effects to the health. It is also true that may arise certain issues related to the annoying perception of odor, such as upset stomach, headaches, loss of appetite and sleep disturbances.

The two parameters that is useful to compare for this analysis are the OT (odor threshold, defined above) and the TLV (Threshold Limit Value), which is the maximum concentration of the pollutant that statistically enables an exposure for the entire working life without causing damage to health. If the OT is higher than the TLV, it means that the substance can cause damage to health also without his presence is perceived by the nose. If, however, the TLV is higher than the OT, the substance is perceived at olfactory level, but has no direct effect on the health of the person (although the perception may be disturbing).

So, there are a number of goverment regulations that manage maximum permissible concentrations, whose analysis is not focus of this article. The question that now we begin to ask ourselves and that will deepen in another article, is: which technologies we have to break down the odor molecules? Tecnosida® has developed interesting solutions, including:

- DEODORY, a system based on the use of deodorizing molecules of biological origin (enzymes)
- BIOCLEAN, the biofilter that uses the action of microorganisms that develop themselves on a special wooden substrate
- CHEMSORB, an adsorption system made by specific activated carbon, especially designed for the application, in which the odorous molecules are adsorbed by the active pores and keeping them trapped inside the coal
- WET CLEAN, a special wet scrubber in which chemical reactions take place so that the odorous molecules are transformed into salts or other molecules with a lower odor impact
- OXITHER, a special thermal oxidizer that thermally destroys odorous substances transforming them into simple and common substances

See our Case History, and discover the applications of these technologies!

See you soon with new interesting items!