

A Glance at Odor Measurement Techniques

Odor is the sense that is felt by the olfactory perception and created by the chemicals which are usually found dissolved and in very small concentrations in the air. Odors can be roughly perceived as stinking or pleasant. Although most of the odors are created by organic compounds, inorganic materials such as hydrogen sulfide and ammonia can also smell. Be it stinking or pleasant, every smell is picked up by our nose. However, even the most powerful scents become unperceivable after being smelled for a long time. Having a less developed sense of smell compared to many animals, humans can start perceiving scent molecules starting from the concentration of one in 400 million.

Due to practical reasons, scents are gas molecules in the air which stay above the level of perception. The olfactory signals reach the brain, by the stimulation of the special cells inside the nose. Just as our tongues have private taste receptors, our nose also sends different signals depending on the stimulated olfactory receptors. As mentioned above, depending on their vital importance, scent molecules can be effectively perceived even though they stay in the air with very little concentrations. Concentration examples that can be accepted as the perceivable threshold for some scent molecules are given below:

- Hydrogen Sulfide: 0,00047 ppm
- Ethyl Mercaptan: 0,001 ppm
- Pyridine: 0,021 ppm

Usually being big molecules, only a certain part of scent molecules are made of a structure that is able to stimulate olfactory receptors. This structure is usually similar molecule to aldehyde, amine, diamine, sulfide, lactone, carboxylic acid, ester, carbamides, and ketone. A common trait of these odor-causing molecules is the reactive structure which is caused by their odd numbered amount of electrons in their final orbitals.

Odor sources

The following list can be used as examples of odor sources:

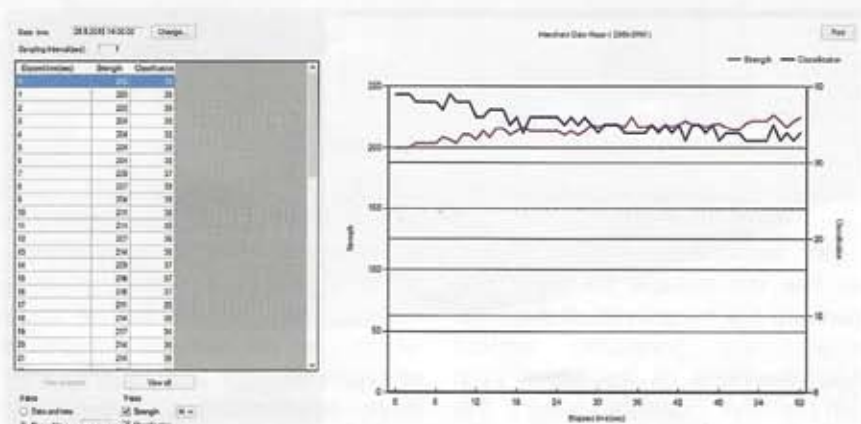
Wastewater treatment plants; Lac-Varnish-Paint factories; Dye-works, Food production facilities; Forage factories; Animal reproducing ranch; Refinery and petrochemistry facilities; and Fertilizer factories.

Odor measurement methods

With the recent regulations, odor pollution is now being accepted as a parameter that needs to be kept under control. This condition mandates accepting the

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Figure 1: Electronic odor magnitude measurement graphic



waste gasses and particles which create the odor as a pollutant and measuring them as well as the measuring the odor itself and keeping it under control. Being the main accepted method of odor measurement, Olfactometric method can generally be explained as given below:

1. Olfactometry

It is basically a method of exposing smelly gas to human nose in certain concentrations and measuring the effects which it causes in the sense of smell.

“With the recent regulations, odor pollution is now being accepted as a parameter that needs to be kept under control”

Olfactometry is based on 2 main principles: exposing a certain known smell to human nose and calibrating the nose's ability to smell by measuring the created effect; and using human nose as a detector to determine the magnitude of any unknown smell's concentration. Measuring the odor concentrations by using Olfactometry is called "Olfactometer." Since it is difficult to mobilize, this method's usage in field operations is limited. Even though olfactometry is the approved method of

odor measurement in the valid regulations, methods given below are also being used in odor measurement and recognition.

2. Gas chromatography

Gas chromatography is a method used to separate and identify the gasses in gas mixtures. The composition of the gas mixture can be identified this way. In the situations where very accurate qualitative and quantitative analyses are required, gas chromatography is followed by the mass spectrometer. Initial investment and measurement costs are really high. Analysis periods take a long time. That's why more mobile and affordable devices were developed. Even though this method cannot measure the

magnitude of the odor correctly, it can identify the odor through measuring the combination and concentration of the gasses which created the odor.

3. Electronic odor magnitude measurement device

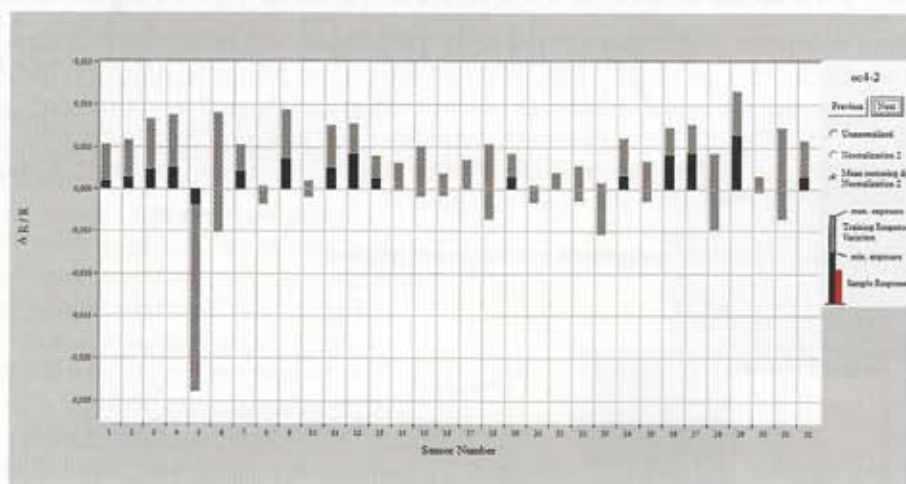
Odor magnitude measurement devices are the devices which are able to measure the magnitude of the odor numerically and classify them via their attributes in order to analyze the odor.

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Figure 2: Smellprint results of electronic nose



With the sensors they have, basic models that are suitable for hand use can measure the magnitude of the odor numerically and constantly without identifying the type of the smell. With their simple and practical design, this types of devices help odor neutralization studies by their ability to be used in the field and displaying the momentary changes in odor magnitude. The yield of the odor removal can be measured by the decrease in the momentary data, after the study. There are hand-held odor magnitude measurement devices available for the characteristic products such as hydrogen sulfide, methyl mercaptan, ammonia, toluene, etc. These devices manufactured for specific products can take precise measurements for businesses such as wastewater treatment plants, hospitals, food production and fertilizer industry. Results can be displayed on the computer as numerical data

or graphics upon request. Relatively more economical, these devices do not possess the number of receivers which can provide measurements on all types of odor (that is why they are more economical) and even though they can be carried at hand, it may be required to use other types of devices in certain situations. With proper software, measurements taken by more advanced and stationary devices

“Electronic copies of the human smelling system are trying to be replicated in various research and development centers of the world”

which operate with the same logic, are able to produce results in odor units which are approved by legislations. The technology's advancement at this point may just as well be taught as olfactometric method's application through a fully electronic nose.

4. Odor identifying electronic nose devices

Electronic copies of the human smelling system are trying to be replicated in various research and development centers of the world. The devices which are developed with this pattern in mind are called "electronic nose." Instead of the receptors which are made of proteins in the human nose, electronic counterparts use series of chemical sensors. With specifically developed software, the data processed by these sensors in terms of magnitude and odor characteristics are interpreted the same way as the same effects are perceived by the nose. As a result, with the cooperation of a developed hardware and software, this emerging system is a fully integrated hand-held detection device which can be used to identify special smells, aromas, formulations, odors that were created by spilling and leaking, complex chemical compositions and even cancerous cells. Alongside these measurements, it can also be used for simple compositions and to identify chemical compounds one by one. The electronic nose can be used in various sectors which can be odor sources such as petrochemistry, chemistry, food and beverage, packing materials, plastic, pet food, paper, medical research and many others. Measurements taken by an electronic nose, odor perception can be visualized as a set of numerical values or graphical results. ■

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الرائحة هي الشعور الذي ندركه من خلال حاسة الشم، وتأتي الرائحة من خلال المواد الكيميائية التي عادة ما تذوب بمركبات ضئيلة جداً في الهواء. وتكون الروائح إما كريهة أو عطرية. وعلى الرغم من أن معظم الروائح تنشأ بفعل المركبات العضوية، فللمواد غير العضوية مثل كبريتيد الهيدروجين والأمونيا أيضاً رائحة. ولأسباب عملية، إن الروائح هي جزيئات الغاز في الهواء وهي تبقى فوق مستوى البصر. تصل إشارات الشم إلى المخ من خلال تحفيز خلايا خاصة داخل الأنف. وكما تمتلك السنننا مستقبلات ذوق خاصة، يرسل الأنف أيضاً إشارات مختلفة اعتماداً على المستقبلات الشمية المحفزة. وتعتبر الآن رائحة التلوث كمياري يحتاج إلى أن يبقى تحت السيطرة. ويقتضي هذا الشرط اعتبار غازات النفايات والجزيئات التي تخلق الرائحة كملوث وقياسها كقياس الرائحة نفسها وإبقائها تحت السيطرة. كونه طريقة رئيسة مقبولة لقياس الرائحة، يعدّ مقياسُ السَّمّ وسيلة يشم من خلالها الأنف البشري غازات كريهة موجودة في تركيزات معينة وعليها يمكن قياس الآثار التي تتسبب بها في حاسة الشم. الغاز اللوني هو طريقة تستخدم لفصل الغازات وتحديد الغازات في خليط الغاز. ويمكن التعرف على تكوين خليط الغاز بهذه الطريقة. أما الاستشراقُ الغازي فهو طريقة أخرى تستخدم لفصل الغازات وتحديدتها في خليط الغاز. وبذلك يمكن تحديد تركيبة خليط الغاز. وفي الحالات التي تتطلب تحليلات كمية ونوعية دقيقة للغاية يجب أن يتبع مقياسُ الطيفِ الكتليّ الاستشراقُ الغازي.