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PERSNICKETY® CHEMICALS - ODOR PERCEPTION

PERSNICKETY® Chemicals
We offer two very effective odor control chemicals: Odor countervailants and odor neutralizers. Our chemicals can be used in wet scrubbers, ponds, sludges and as a topical spray.

PERCEPTION • QUALITIES • CHEMICAL CONTROL METHODS

PERCEPTION

Analysis of available data and experiments leads to the conclusion that there are two senses of odor detection. One is controlled by the olfactory nerves and is responsible for odor perception and recognition. Its performance is a function of molecular structure, configuration of odor receptor sites, signal generation at these sites as a result of a reaction between the odorant and an enzyme, and relative concentrations of the reactants. A change in any one of these factors can change the perception of the odor.

The process whereby we perceive odors follows these steps:

1. The odorant molecule travels along nasal air passages to the olfactory cleft where it fits into an odor receptor site;
2. A chemical reaction occurs between the resident enzyme (most probably ATP) and the odorant;
3. This reaction causes production of a specific coded electric signal which is transmitted to the brain where it causes perception and recognition of the odorant characterized by that particular signal.

Therefore, an odor can be perceived only if all of several criteria are available: There must be an available odor site. There must be sufficient enzyme to react with the odorant. There must be no interference with the pattern of the signal generated by the reaction, and the concentration of the odorant must be high enough to create a signal strong enough to be perceived.

The second odor perception system has nothing to do with odor recognition. It is controlled by the trigeminal nerve and serves primarily as a warning system against substances which could be harmful. This system does not recognize odors. It perceives them but does not define them.

QUALITIES

According to one classification, there are seven odor qualities: 1) ethereal, 2) camphoraceous, 3) floral, 4) musky, 5) minty, 6) pungent, 7) putrid. Odor problems occur in and control methods focus on the latter two qualities almost exclusively. Individual reaction to odors varies widely. Consequently, categorization and description of odors is necessarily subjective. The following tables list and describe odor characteristics in commonly accepted terms.

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PUNGENT MALODOROUS SUBSTANCES			
Substance	Formula	Characteristic Odor	Odor Threshold (ppm)
Allyl Mercaptan	$CH_2 \cdot CH \cdot CH_2 \cdot SH$	strong garlic, coffee	0.00005
Ammonia	NH_3	sharp, pungent	0.037
Benzyl Mercaptan	$C_6H_5 \cdot CH_2 \cdot SH$	unpleasant, strong	0.00019
Butylamine	$C_2H_5 \cdot CH_2 \cdot CH_2 \cdot NH_2$	sour, ammonia-like	-
Chlorine	Cl_2	pungent, suffocating	0.01
Chlorophenol	ClC_6H_5O	medicinal, phenolic	0.00018
Crotyl Mercaptan	$CH_3 \cdot CH : CH \cdot CH_2 \cdot SH$	skunk-like	0.000029
Dibutylamine	$(C_4H_9)_2$ NH	fishy	0.016
Diisopropylamine	$(C_3H_7)_2$ NH	fishy	0.0035
Dipheny Sulfide	$(C_6H_5)_2$ S	unpleasant	0.000048
Ethylamine	$C_2H_5 \cdot NH_2$	ammoniacal	0.83
Propyl Mercaptan	$CH_3 \cdot CH_2 \cdot CH_2 \cdot SH$	unpleasant	0.000075
Pyridine	C_6H_5 N	disagreeable, irritating	0.0037
Sulfur Dioxide	SO_2	pungent, irritating	0.009
Tert-Butyl Mercaptan	$(CH_3)_3C \cdot SH$	skunk, unpleasant	0.00008
Trietylamine	$(C_2H_5)_3$ N	ammoniacal, fishy	0.08
PUTRID MALODOROUS SUBSTANCES			
Substance	Formula	Characteristic Odor	Odor Threshold (ppm)
Amyl Mercaptan	$CH_3 \cdot (CH_2)_3 \cdot CH_2 \cdot SH$	unpleasant, putrid	0.0003
Cadaverine	$H_2N \cdot (CH_2)_5 \cdot NH_2$	putrid, decaying flesh	-
Dimethylamine	$(CH_3)_2$ NH	putrid, fishy	0.047
Dimethyl sulifide	$(CH_3)_2$ S	decayed vegetables	0.001
Ethyl Mercaptan	C_2H_5 align="middle" SH	decayed cabbage	0.00019
Hydrogen Sulfide	H_2S	rotten eggs	0.00047
Indole	C_2H_6 NH	fecal, nauseating	-
Methylamine	CH_3 NH_2	putrid, fishy	0.021
Methyl Mercaptan	CH_3 SH	decayed cabbage	0.0011
Putrescine	NH_2 $(CH_2)_4$ NH_2	putrid, nauseating	-
Skatole	C_9H_9 N	fecal, nauseating	0.0012
Thiocresol	$CH_3 \cdot C_6H_4 \cdot SH$	skunk, rancid	0.0001
Thiophenol	C_6H_5 SH	putrid, garlic-like	0.000062

(Tabular information courtesy of the Water Pollution Control Federation.)

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CONTROL

Deodorizing by odor fatigue: If a voracious consumer of the signal producing enzyme is introduced into the environment it can prevent the chemical reaction that produces the code signal characteristic of the malodor. It will consume the enzyme leaving none available for reaction with the malodor. It may also cause a secondary signal to be generated thereby altering the overall odor perception and recognition. These compounds are generally non-specific. They block all perception. Ionones, some ketones and aldehydes have been used for this purpose.

Deodorizing by blocking: This can be accomplished either by closing of the receptor sites via mechanical means such as masks, filters or nostril plugs, or by chemically blocking or damaging the sites. While the former technique is cumbersome, transitory and uncomfortable it is preferable to the latter which could be dangerous. The result of harsh chemicals such as formaldehyde can be more than transitory. Substances powerful enough to cause a radical physiological change can have severe and harmful long range effects upon the body.

Masking by reodorizing: Perfumes and fragrances function in this manner. Products of this type do little to alter either the basic perception of the odor character or the intensity of the malodor. The intent of their use is to cause so many signals to be sent to the brain, most of which are pleasant, that the impact of the malodor is relatively weak in relation to the overall impact. This approach can be effective with low levels of malodor. Effectiveness is debatable with high levels of malodor. Most often both fragrance and malodor are perceived, and the potential for exacerbating a problem exists.

Deodorizing by chemical reaction: If a malodor can be made to react chemically with an introduced substance, it will become something else and will smell differently. This reaction is primarily oxidation-reduction. Oxidation involves a donation of electrons by one molecule, and reduction involves acceptance of electrons by another. Both oxidation and reduction occur simultaneously and in equivalent amounts during any reaction involving either process.

Oxidizing agents include chlorine, (chlorine/caustic) sodium and calcium hypochlorite, chlorine dioxide, potassium permanganate and hydrogen peroxide. All are effective, but non-specific. Thus, they react with non-malodorous organics and nitrogen-based compounds which increases the cost of their use. As a group, these products generally pose safety problems — toxicity, the production of toxic by-products, inherent corrosive and explosive characteristics. Temperature and pH influence the effectiveness of most. Stabilized chlorine dioxide is an exception. Unwanted reaction with nitrogen-based compounds can not occur, it is much safer to handle and does not form chlorinated by-products.

Metal salts are also used for deodorizing. They bind and precipitate. Their effectiveness is restricted to addressing sulfides in solution. They do not react with malodorous organics such as amines and mercaptans. Those most commonly in use are ferrous and ferric chloride; ferrous and

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ferric sulfate.

Deodorizing by counteraction/neutralization: Defined as the mutual diminution of two odors, counteraction or neutralization is achieved by the application of a second odorous substance to the original malodor so that the combination of odors becomes inoffensive. The simultaneous reaction at receptor sites in the olfactory cleft causes the generation of a signal other than that characteristic of the malodor. The combined signal may either overpower the malodor signal or cause the brain to recognize a different pattern which results in perception and recognition of a pleasant odor or no odor at all.

In order to achieve practical success with this approach, a balance must be achieved between the relative concentration of the malodor and odor neutralizer, and their respective rates of reaction with stoichiometric concentrations of enzymes at receptor sites. This technology represents a clear advancement in odor control.

Deodorizing with odor Countervailant products: Nuisance odors are rarely single-dimensional. Rather, they are a combination of malodors. As such, any product which is to be successfully used against them must provide multi-interventional capabilities.

The chemistry of odor Countervailant products is specialized and complex, and provides the most advanced and broadly useful technology currently available. It incorporates the principles of counteraction and neutralization technology, but expands considerably beyond it. Polymeric adsorption is a facet of Countervailant product technology. This involves the building up of malodor molecules via electrostatic attractions and Van der Waals forces to form macro-molecules. The resulting macromolecules become unrecognizable at receptor sites, thus a signal code is not produced.

The process of esterification is also incorporated. Esters are the product of intermolecular dehydration involving an alcohol and an acid. Literally thousands of esters can be formed because of the extraordinarily large numbers of acids and alcohols available for reaction in waste substrates. This reaction ability is particularly useful in dealing with food processing odors — such as fatty acid and butyric acid odors. Signal codes for the resulting esters are normally recognized and described as odors of natural herbs, fruit and nuts. Essential oils are used sparingly as well. They are of plant origin, and principal constituents are terpenes. In diluted form, essential oils are only faintly perceived, and are included largely as olfactory guides for application rates.

Odor Countervailant products are effective for both gaseous malodors via spray atomization and malodorous liquids via direct addition. They function in a broad range of pH and temperature. Very importantly, they are safe to use for operators, equipment and the environment.