Background Information Concerning Odors

Most odiferous material, whether discharged into the atmosphere from an industrial or agricultural source or from a natural source such as a marsh or from an improperly operated sewage treatment plant or even from a pleasant source such as a cup of coffee is composed of complex mixtures of many components. According to the National Academy of Science's 1979 publication on "Odors from Stationary and Mobile Sources", sensory responses to the separated components of these mixtures can be very different from component to component and also from person to person.

Although compounds such as hydrogen sulfide are both odiferous and dangerous, odor is not necessarily associated with hazard to health with some odorless compounds such as carbon monoxide ranking among the most deadly of those commonly encountered.

Unquestionably some compounds possess stronger odors than others. The assessment of this property is called the olfactory threshold and is defined as the lowest concentration of an odorant beyond which fewer than half of a trained panel can detect the odor. Tests of this type were originally developed in the food and fragrance industries and have now been applied to a wide variety of materials

It is therefore possible to compare analytical results with published odor threshold data and determine which compounds among the many typically identified are likely to be the cause of the complaint. In this way, sources can be identified and appropriate corrective actions taken.

Table 1 contains odor threshold data for many of the compounds detected in the course of this study. These are to be compared with the analytical detection limits provided in the table.

The analytical detection limit, in turn, is defined as the minimum level below which a given compound cannot be distinguished from background noise. This value is therefore dependent upon the nature of the sample as well as the analytical methodology applied. Thus the most sensitive method is only the best method if it is also free from the kinds of background noises likely to be encountered.

Odors perceived by the human nose are reported to not be additive although data gathered in connection with insect attractants have documented some examples of synergism. While odor detection may not be additive and may even exhibit a cancelling effect, the effect of mixing odiferous compounds at levels above their threshold often produces an odor which is quite different from either of the original odors. Table 2 provides an example of such changes in odor characteristics as documented by the National Academy of Sciences.

TABLE 1

Comparison of Detection Limits and Odor Detection Threshold

All Values in ppbv

COMPOUNDS	ANALYTICAL DETECTION LIMIT *	ODOR THRESHOLD
Hydrogen Sulfide	0.03	4.7
Carbonyl Sulfide	0.2	50.
1-Butene	0.2	1300.
Butane	1.0	not available
Methyl Mercaptan	0.02	2.1
Branched Pentane	0.5	not available
1-Pentane	0.2	190.
Pentane	0.5	5000000.
Ethyl Mercaptan	0.04	3.
Dimethyl Sulfide	0.03	1.
Carbon Disulfide	0.5	210.
i-Propyl Mercaptan	0.03	not available
Branched Hexane	0.1	not available
1-Hexene	0.2	not available
Hexane	0.1	not available
n-Propyl Mercaptan	0.03	1.6
Benzene	0.05	3000.
Cyclohexane	0.2	9500.
Methylcyclohexane	0.2	not available
i-Butyl Mercaptan	0.03	not available
n-Butyl Mercaptan	0.03	6.
Toluene	0.05	170.
Ethylbenzene	0.1	not available
Xylene	0.1	80.
Dichlorodifluoromethane	0.2	not available
Trichlorofluoromethane	0.2	5000.
Freon 113	0.2	45000.
1,1,1-Trichloroethane	0.3	<500000.
Trichloroethylene	0.3	210.
Tetrachloroethylene	0.3	4680.
Methylcyclopentane	0.2	not available
Heptane Isomers	0.2	220000.
C-7 Unsaturated Hydrocarbon	0.2	not available
C-7 Alicyclic Hydrocarbon	0.2	not available
Ethylcyclopentane	0.2	not available
C-8 Unsaturated Hydrocarbon	0.2	not available
C-8 Alicyclic Hydrocarbon	0.2	not available
Octane Isomers	0.2	not available
C-9 Unsaturated Hydrocarbon	0.2	not available
C-9 Alicyclic Hydrocarbon	0.2	not available
Nonane Isomers	0.2	not available
Styrene	0.1	50.
C-3 Alkylbenzenes	0.1	8.

Most of the data in this table were extracted from the ASTM publication entitled "Compilation of Odor and Taste Threshold Values Data" edited by F. Fazzalari, 1978 edition. Several values were taken from the National Academy of Science's publication on "Odors from Stationary and Mobile Sources" (1979) and "Industrial Odor Technology Assessment" by Cheremisinoff and Young (1975).

TABLE 2

Reported Odor Characteristics of Some Sulfur Gases Detected in this Study

Components	Level in PPBV	Odor Quality
Hydrogen Sulfide	20	Rotten Eggs
Carbon Disulfide	670	Medicine, Iodine, burnt
Carbon Disulfide	450	Sweet, mild, rotten eggs
Carbonyl Sulfide	50	Burnt Rubber, carbamate
Carbonyl Sulfide	120	Rotten Eggs, burnt rubber
71% Hydrogen Sulfide plus 29% Carbon Disulfide	10	Rotten Eggs
28% Hydrogen Sulfide plus 72% Carbon Disulfide	50	Rotten Eggs
9% Hydrogen Sulfide plus 91% Carbon Disulfide	130	Rotten Eggs
Carbonyl Sulfide/Carbon Disulfide, 1/1000	230	Medicine, Iodine
Hydrogen Sulfide/Carbonyl Sulfide/Carbon Disulfide 1/3.5/1,250 sulfur	150	Burnt rubber, shoe wax,

The information presented in this table was extracted from a similar table in "Odors from Stationary and Mobile Sources" published by the National Academy of Sciences in 1979, p. 175.