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# DEVELOPING ODOR CONTROL REGULATIONS: GUIDELINES AND CONSIDERATIONS

### William H. Prokop Vice Chairman, APCA TT-4 Odor Committee

The TT-4 Committee developed a position paper on odor control regulations. Present odor regulatory approaches are considered generally to be unsatisfactory. There are two basic needs: 1. develop sound administrative procedures for establishing the existence of a community odor nuisance, and 2. obtain reliable odor sensory data that can be related to community acceptance or annoyance of a particular odor. Specific issues regarding administrative procedures for odor regulations are presented. These include establishing the validity of odor complaints and the existence of a community odor nuisance, based upon a specified number of valid complaints being received within a fixed time period. The existence of a community odor nuisance should be established before a compliance program is applied to an odor source. Technological needs for odor regulations are discussed. These include the development and testing of improved odor sensory measurement techniques, critical evaluation of atmospheric dispersion models to predict ambient odor concentration and relating ambient odors to annoyance thresholds for different communities or zoned areas. A suggested approach to odor control regulations is detailed. Specific procedures are provided for validating complaints, for establishing the existence of a community odor nuisance, for locating the alleged source(s) causing the odor problem and applying a compliance program to the source.

The TT-4 Committee of APCA is primarily concerned with basic odor technology: its measurement, control, and regulation. Many of its members have contributed technical articles on odor regulations in recent years.<sup>1-4</sup>

At the APCA Annual Meeting held in June 1974, a *Critical Review of Regulations for the Control of Odors* was conducted in cooperation with the TT-4 Committee. As a result of the discussions of this critical review, the Committee decided it would be helpful to develop a position paper on odor control regulations that would provide guidelines to agencies desiring to adopt such regulations.

Initially, voluntary comments were solicited from the Committee members regarding two basic questions:

- 1. With the present state of the art in odor sensory measurement and other technology including odor control, what specific type of odor regulations would be the most feasible?
- 2. If the desired odor sensory measurement and other technology is available, what specific type of odor regulation would be the most feasible?

For both questions, the respondent was asked to cite specific examples of odor sensory measurement and other technology to support the choice of odor regulations. Many diverse comments were received and a variety of issues was raised. These comments were incorporated into a first draft of the position paper which was circulated among the Committee members for additional comment. A later draft resulted from these comments. Two special meetings of the Committee were held in early 1977 to review the later draft and possibly to reach a consensus on specific issues.

The total input toward the position paper was provided by comments recieved from 17 out of a total Committee of 26 members. This represents about two-thirds of the Committee and hopefully provides a reasonable consensus. Of the 17 member participants, two are from regulatory agencies, five are from academic or research oriented institutions, and ten are from industry. This distribution of participants is directly proportional to the actual makeup of the total Committee.

Due to the diverse comments received from the Committee members, it is difficult to portray an accurate consensus for the various controversial and relevant issues that influence the development and promulgation of specific odor control regulations. The author is well aware of the problem in attempting to achieve a proper balance between the pros and cons presented by others regarding such issues. As a result, this position paper is considered to be a "perceived consensus" of the Committee.

As an example, the Committee was about equally divided on the basic issue of selecting stack emission type standards as opposed to ambient odor type standards. Both approaches have strengths and weaknesses. The stack emission approach

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#### ODOR CONTROL REGULATIONS

has obvious advantages over an ambient odor type regulation regarding the relative ease and lower cost of sampling and analyzing odors. Also, the emission source of objectionable odors is more readily determined by using stack measurements. However, the stack emission type approach requires an additional technical step—the correlation of stack emission with ambient odor concentration, either by obtaining empirical data or by use of atmospheric dispersion models, in order to be able to judge whether or not the resulting ambient odor concentration is acceptable to the community.

On the other hand, if odor annoyance threshold data are available, an ambient odor limit can be related to a particular zoned area and specified to avoid an odor annoyance being experienced by the population that lives or works in a particular zoned area. Further, it should be recognized that odors do not discharge only from stacks or well defined enclosures but could originate from fugitive type emissions (i.e. anaerobic lagoons). As a result, it may be necessary in certain areas to have a combination of stack emission and ambient odor regulations available to control all significant sources of odor.

#### **Basic Issues**

The issues discussed in this paper are separated into those which are related to regulatory administrative procedures and those which have an essentially technical basis. For example, establishing the existence of a nuisance should usually follow a specific regulatory procedure whereas the choice of a method for measuring an odor emission from a stack involves a technical decision. It is the consensus of the Committee that the desired approach for odor regulation involves the use of reasonable administrative procedures for confirming the existence of an odor nuisance and the availability of an established technical base for measuring odor concentration and determining odor annoyance.

#### Objectives

Primary objectives of this position paper on odor control regulations:

- 1. Determine effectiveness of agency enforcement of current odor regulations.
- 2. Review and evaluate current administrative procedures for odor regulations.
- 3. Determine odor measurement and control technology needs for odor regulations.
- 4. Develop a suggested approach to odor control regulations.
- 5. Determine specific technical gaps to be plugged.

At the APCA Specialty Conference: State of the Art of Odor Control Technology II held in Pittsburgh during March 1977, Jim Franz of the TT-4 Committee presented a paper on the subject of standardizing odor terminology. The odor terms defined at the Pittsburgh Conference are incorporated into this position paper.

#### Agency Enforcement of Current Odor Control Regulations

A number of agencies specify either the use of the Scentometer<sup>5</sup> for measuring the odor concentration in the ambient air or the ASTM syringe dilution technique for measuring the odor concentration or odor dilution ratio of a stack type emission. The basic static syringe method is described by ASTM<sup>6</sup> and has been modified by others<sup>7,8</sup> to eliminate the trial and error feature of the original method.

Six state agencies and the District of Columbia specify the use of the Scentometer for ambient odor measurement. It appears that most of these regulations were enacted without the agencies having the benefit of field experience with the Scentometer. Specific problems were discussed<sup>3</sup> regarding its application to ambient air measurement. A major difficulty concerns its use by an individual who is surrounded by the odorous environment that is to be measured. Since the nose is easily desensitized under these conditions, it is most difficult accurately to detect differences in odor concentration in the ambient air.

Three state agencies designate the use of the ASTM syringe method with sensory panel procedures specified by either Mills<sup>7</sup> or Benforado<sup>8</sup> for establishing whether or not compliance is achieved with a stack type odor limit. Although Friedrich<sup>9</sup> reported reliable results with the ASTM syringe method, it was emphasized that training of the odor sensory panel is particularly important and following consistent procedures is essential. Further, monitoring of the odor panel results is critical to establish the reliability of each panelist's response.

The basic ASTM method lacks a defined procedure for odor stimulus presentation since the various odor dilutions are to be presented randomly to the panel by mixing the order of strong and weak odor stimuli. Sometimes, a blank or odor-free sample is substituted to check the panel's reaction which tends to produce confusing results. As a result, no satisfactory provision is available to check the reliability of positive-negative responses of the panel other than through experience.

In an attempt to overcome this one basic shortcoming of the ASTM method, the syringe dilution technique has been modified<sup>10</sup> to provide for an ascending order of odor concentration in presenting the odor stimuli to the panel, and at each dilution level two syringes are submitted to each panelist. One syringe contains the odor stimulus and the other is a blank containing odor-free air. However, the amount of data obtained using this technique is limited.

Discussions with various regulatory agencies that currently specify or use the ASTM syringe method for monitoring stack emissions indicates a desire to have available improved odor sensory methods. In fact, one agency contracted with a research firm to conduct a comparison study<sup>11</sup> which evaluated three dynamic olfactometer methods and the ASTM syringe method. The study concluded "the ASTM syringe static dilution technique should not be used if a dynamic dilution method is available." Presently, only one agency in the U.S. specifies the use of a dynamic olfactometer method in odor control regulations.<sup>12</sup>

There has been a definite reluctance expressed by some state and local agencies considering new regulations to incorporate the use of the ASTM syringe method or Scentometer. Instead, they prefer to retain the nuisance concept to regulate odors. Further, those agencies which do specify either of these two odor measurement methods still have an odor nuisance regulation or various criteria for determining an odor to be objectionable. However, the agencies recognize the limitations of the odor nuisance concept and Feldstein<sup>2</sup> indicated "the enforcement of such a statute (nuisance) is at best difficult."

It must be concluded that present odor regulatory approaches are generally unsatisfactory. There are two basic needs: (1) develop sound administrative procedures for confirming the existence of a community odor nuisance, and (2) obtain reliable odor sensory data that can be related to community acceptance or annoyance of a particular odor.

#### **Administrative Procedures for Odor Regulations**

Regulatory administrative procedures are the essence of any odor regulation. The procedure is inherently related to what is the *intent* or *objective* of the regulation, for example, to resolve and eliminate valid complaints. However, technical issues can be strongly influenced by the choice of procedure presented in the regulation. For example, if the odor regulation states that *no* odor is to be detected beyond the property line of any source, this degree of odor control may not be achievable either technically or economically. Administrative procedures should take into consideration the interests and concerns of the public, the source(s) and the agency. The public usually reacts to objectionable odors by registering complaints with either the agency or source. An effective regulatory procedure provides the mechanism for resolving odor complaints in a fair and timely manner (informally, if possible) with reasonable administrative effort and without judicial intervention unless required.

The TT-4 Committee in its various comments on odor regulations raised specific issues regarding administrative procedures. An attempt is made below to clarify these issues and bring them into sharper focus:

1. Odor control regulations usually are concerned with objectionable type odors which are not harmful to health. Hazardous or toxic odorous vapors and gases require a separate type of regulation. In this case, measurement and control of a specific chemical compound is required to maintain its concentration in the ambient air below an established physiological danger level.

The Federal EPA considered the application of performance standards for new stationary sources to rendering plant odors. However, its analysis established these odors to be a noncriteria pollutant affecting only public welfare but not health. As a result, the Federal EPA has left the regulation of odors to the state and local agencies. The Committee agreed that odor problems are basically related to the local community and should be regulated by the appropriate local agency.

2. Classification of odors and odor sources could be useful in developing meaningful odor regulations. It should be clear what specific types of odors and/or sources are to be excluded from the regulations.

In certain instances, an odor source may be intimately connected with the socioeconomic use of an area. For example, certain state agencies<sup>13</sup> recognize the necessity of agricultural operations and these are specifically exempted from odor regulations. Likewise, agencies acknowledge that certain materials must be odorized for safety purposes (i.e. mercaptan in natural gas) and these are exempted from regulation.

- 3. Chemical identification and measurement by continuous instrumentation for the monitoring and control of a single odorant or similar groups of odorants is a more convenient approach to controlling odors than odor sensory testing. For example, one agency<sup>12</sup> currently has specified total reduced sulfur (TRS) limits for the kraft pulp mill industry. However, it may be desirable to correlate odor sensory data with the concentration of chemical constituents for certain applications, particularly if a judgment is to be made regarding these emissions being the cause of odor complaints.
- 4. Odor complaints are indicators that a *potential* odor problem may exist in the community. It is essential that a regulatory agency has established procedures for receiving and investigating odor complaints. These procedures should clearly establish whether or not a complaint is valid. The use of a printed form to record the complaint received and the findings of the agency inspector would be desirable.
- 5. There should be specific procedures and guidelines provided to establish the existence of a community odor nuisance which take into account the community's characteristics: population distribution, socioeconomic activity, and land use zoning. The use of validated odor complaints to establish the existence of a community odor nuisance provides a measure of the basic odor problem—the annoyance expressed by the community and not merely the detection of odors. Copley International Corporation<sup>14</sup> in their Phase III study for the EPA, concluded that "technological controls on the annoyance



threshold rather than the odor threshold ... would promote more efficient solutions ...."

Certain agencies<sup>15</sup> employ a procedure where an objectionable odor is defined to exist "upon (the) decision resulting from investigation by the department based upon the nature, intensity, frequency, and duration of the odor . . . ." Subjective judgments by the agency inspector should be avoided. There is a definite need to develop objective criteria that can be quantified regarding the quality, intensity, frequency and duration of an odor that relate directly to the annoyance experienced by the community.

- 6. The TT-4 Committee arrived at an essentially unanimous consensus that the existence of a community odor nuisance should be established first before regulatory limits are applied to a specific odor source to obtain compliance. The procedure for establishing a community odor nuisance would require a specific number of valid complaints being received from separate households during a fixed time period. One agency<sup>12</sup> requires the receipt of odor complaints from ten or more people within a 90 day period before specific odor limits are applied to an alleged source of objectionable odors.
- 7. As a concept of odor regulation, the issue was raised whether or not stack emission or ambient odor standards should be set with the intention that odors *not* be detected beyond the property line of the source. This type of standard confuses the perception of an odor with the existence of a problem. The Committee unamimously agreed that this approach is unreasonable and places an undue restraint upon a particular source where the best available technology may not be capable of achieving this ultimate degree of control.
- 8. As an administrative procedure in regulating odors, the Committee was essentially unanimous in their comment that a regulatory agency should consider the investment and operating costs of odor control techniques in applying a compliance program to an odor source. This approach requires knowledge of the incremental cost for a specified odor removal or reduction in complaints. For a significant increment of odor control investment, there should result a demonstrated reduction in the *community odor problem* instead of merely reducing the odor level of emission.
- 9. An effective odor regulation specifies the criteria to be complied with but *not* the method of odor control required to achieve compliance. The choice of a control method should be up to the individual source but with agency approval, because this choice usually is dependent upon a combination of economic and technical factors directly related to the source.

Incineration standards have been promulgated<sup>16</sup> for rendering plants and for fifteen other industrial categories. This is an example of a type of regulation that specifies a control method. Unfortunately, the application of this type of regulation often ignores the availability of other proven technology. In the case of incineration, the unavailability of natural gas and rising fuel costs are key issues affecting the choice of this method for odor control.

#### **Determine Technology Needs for Odor Regulations**

The choice of technology for monitoring and evaluating odor emissions regarding their annoyance or acceptance by the community is no less important than the administrative procedures which are selected to implement a specific odor control regulation. The Scentometer and ASTM syringe methods currently used by state and local agencies are considered by the Committee to be inadequate for regulatory purposes. There is a basic need for odor sensory methods which are capable of measuring odors objectively and reliably. Unless such methods are available, odor regulatory problems will continue to be resolved by a court's interpretation as to the existence of an odor nuisance being based on evaluating the subjective testimony of opposite parties.

Our Committee considered two categories of technical issues: (1) the current technology available for application to odor regulations, and (2) the new technology needed to provide for more effective odor regulations. These technical issues are discussed below:

- 1. Based on odor technology currently available for measurement and control, limiting the odor dilution ratio of the stack emission is preferred as a method of correcting an odor problem. However, applying rigid limits to stack emissions should be avoided. Flexibility should be provided with some allowance being made to take into account local conditions and type of zoning. Monitoring the stack emission to reduce the odor intensity to a level that avoids a nuisance problem together with a reasonable compliance schedule would accomplish more than the blind application of rigid single-number type limits.
- 2. One state agency<sup>17</sup> currently has in effect a limit on total odor emission rate of one million odor units per minute. This limit is obtained by multiplying the volumetric emission rate in cubic feet per minute by the odor dilution ratio measured at the emission source and expressed in odor units per cubic foot. This limit can also be expressed in terms of metric volumetric units. It is interesting to note that this state agency relies basically upon the stack emission limits, expressed in odor units per cubic foot, for enforcement of their odor regulations.

The Committee was equally divided regarding their approval of or opposition to a total odor emission rate being applied for regulatory purposes. Those in favor considered this concept to be useful since another dimension other than odor concentration is available for evaluating an odor nuisance. In particular, it provides the means for totalizing a multiple number of odor emissions from a single source.

Those opposed to this concept recognize it has a certain validity when applied to small volume emissions. However, they question this concept when applied to large volume emissions, for example, from plant ventilating air scrubbers. Based on the previously cited total odor emission limit of one million odor units per minute, a 100,000 cfm scrubber would be allowed a stack emission odor concentration of only 10 odor units. This clearly is unrealistic and it is doubtful whether the specified syringe dilution technique is sufficiently sensitive at this low odor level to establish compliance reliably. The basic objective for an odor regulation should be to limit the ambient odor concentration at ground level,  $C_{\max}$ , rather than the total odor emission rate, Q, where both terms relate to atmospheric dispersion models.

It appears that the concept of total odor emission rate could be useful as a guideline for evaluating an odor nuisance but it should be applied judiciously for regulatory purposes.

3. Odor sensory measurement for stack emissions currently include both the static ASTM syringe method (Mills modification) and a number of different dynamic olfactometers. There is a consensus of the Committee in favor of the dynamic olfactometer and phasing out of the ASTM syringe method for regulatory enforcement. The dynamic olfactometer methods, compared to the static ASTM syringe method, can provide results which are obtained more quickly, with better reproducibility, with training of the odor panel being a less critical factor, with more consistent procedures in presenting the odor stimuli to panel members, and results which are related to statistically significant confidence levels.

It has been experimentally proven<sup>18</sup> that a significant difference in odor sensory value exists when detecting the same odor stimulus with the ASTM syringe method as compared to dynamic sensory methods and potentially large variations can exist between different dynamic methods. For example, when comparing various dynamic olfactometers with the ASTM syringe method at a level of 100 odor units (ASTM), two dynamic methods experienced an estimated threefold increase in odor unit values whereas a third dynamic method produced an estimated twentyfold increase. As a result, odor sensory data should always be identified with the particular odor sensory method that is used.

Basic criteria should be established for dynamic olfactometers that are used for odor control regulations. Adequate technical documentation is necessary to establish the sensitivity and reliability of the dynamic method as well as to describe it accurately in order that others can check and compare results.

- 4. Ideally, it is desired to determine stack emission odor concentrations that result in ambient odor concentrations which would be acceptable to the community or a particular zoned area. To establish this, it would be necessary to determine the odor annoyance threshold for the average population of the community. Unfortunately, very little data are currently available on odor annoyance thresholds. If available, an ambient odor concentration below the average annoyance threshold would be chosen to represent an acceptable level and this would be related to the desired stack emission odor concentration. Atmospheric dispersion models must be relied upon to relate the stack to the ambient odors for different meteorological conditions.
- 5. There was definite controversy among the Committee members regarding the degree of precision that can be achieved with atmospheric dispersion models in predicting ambient odor concentrations from stack emissions. Those members attesting to their validity indicated that the dispersion models can be used with confidence in making such predictions. Those members questioning the validity of dispersion models were concerned with the lack of scientific data in the technical literature that would validate the calculated ambient odor concentrations with empirically determined values. The odor sensory methods used for source emission and ambient odor measurement should be compatible in order that data comparisons can be made.

There are considerable experimental data relating predicted and observed values for single odorant type emissions. However, limited data are only available on "odors" (mixtures of various odorants or chemical compounds.) Lindvall<sup>19</sup> reported the use of Hogstrom's method<sup>20</sup> for estimating atmospheric dispersions when the odor thresholds were determined for emissions from a sulfate pulp mill by the sampling and sensory methods described by Lindvall. Excellent agreement was obtained between observed and predicted odor detection frequencies for a distance up to 2 km from the source, but the predicted values for 5 and 10 km corresponded to a half and a third of the observed values, respectively.

There is a basic need to collect and publish available odor sensory data comparing observed and predicted values of ambient odor concentration in order to reinforce the use of atmospheric dispersion models.

6. Measurement techniques are needed to evaluate the odorous emissions from fugitive sources (i.e. anaerobic lagoons) where odors escape directly from the source into the atmosphere. Hemeon<sup>21</sup> proposes the use of a pool simulator that would test a sample of wastewater by directing a measured volumetric flow of air across a fixed area of water surface within the simulator and measuring the resultant odor concentration of air discharging from the simulator. These data would be applied to a specific pool of water whose surface area is known and the total odor emission rate would be calculated in odor units per minute.

Based on the use of an atmospheric dispersion model, the ambient odor concentration could be calculated and compared with empirically determined values. This approach is analogous to that discussed in item 5 regarding stack emissions.

7. Measurement of ambient odors has been performed with the Scentometer and also with dynamic olfactometers. There is a consensus of the Committee that the Scentometer is not a satisfactory instrument for measuring ambient odors, primarily because the individual is surrounded by an odorous environment.

There is a definite need for measuring ambient odors, not only for comparison with predicted values obtained by atmospheric dispersion models, but also to determine the ambient odor concentration and be able to relate it directly to an annoyance experienced by the community. More test work is required to validate the use of dynamic olfactometers for this purpose. The same basic criteria should be established for dynamic olfactometers used for measuring ambient odors as for stack emissions (refer to item 3).

- 8. Obtaining representative samples of ambient air for odor sensory measurement is recognized as a basic problem. Additional test work should be conducted to improve the understanding of these parameters of ambient air sampling. These include the duration and frequency of sampling and use of odor locating techniques.
- 9, The relating of ambient odors to annoyance thresholds for different communities or zoned areas is fundamental to establishing ambient odor type standards. This could be accomplished by determining dose-response relationships that equate annoyance with odor intensity and the degree of unpleasant character of a particular odor. For example, dose-response relationships have been investigated by Kendall<sup>22</sup> for diesel exhaust odors and by Lindvall<sup>19</sup> for odors associated with kraft pulp mills. A specific mathematical relationship could be developed by population testing to equate odor intensity with annoyance threshold expressed in terms of percent of population response. The selection of the actual ambient odor limit would be based on this mathematical relationship and should be set at a reasonable level below the mean or 50% population response that would be acceptable to the community and yet be economically achievable. The selection of this ambient odor limit

should normally follow a specified statistical procedure.

This is a relatively complex approach to developing odor regulations. However, there is a strong consensus of the Committee that it could prove to be useful as a long term approach. As a result, it would be necessary for the funding of this program to be provided by the Federal EPA as opposed to any state or local agency.

10. The technical capabilities of various odor control techniques should be established relative to their ability to reduce odor intensity to specific levels. These odor reductions should be directly related to investment costs and operating expenses to establish a cost effective relationship. The application of specific odor control techniques could vary for different categories of industrial sources depending upon the odor intensity, chemical constituents present, and volumetric emission rate.

#### Suggested Approach to Odor Control Regulations

Effective odor regulations are needed. What is meant by "effective" in this context? It could mean achieving a specific but relevant goal that is responsive to the public without causing undue hardship to the odor source and yet is reasonable for the agency to administer. The TT-4 Committee considers this goal to be the elimination of or at least reduction of *valid* odor complaints to a level below that specified to be a community odor nuisance.

The Committee is primarily concerned with the administrative procedures and technical features which could be incorporated into odor regulations for achieving the desired goal. If the existence of a community odor nuisance is confirmed, voluntary compliance by the odor source is encouraged. If the source refuses to comply, legal procedures should be available for the agency to obtain compliance. The Committee considered the specifying of such procedures to be outside the scope of this paper.

A suggested approach to odor control regulations is outlined below:

- 1. Validation of odor complaints by specific procedures that provide for receiving and investigating each complaint.
- 2. An administrative procedure for establishing a community odor nuisance. This procedure would specify the number of *valid* complaints received from separate households during a fixed time period.
- 3. Positively locating the alleged source(s) causing the community odor nuisance. Monitoring the odor emissions from the source(s) with odor sensory methods to provide a basis for estimating the degree of odor reduction required to correct the community odor nuisance.
- 4. Applying a specific compliance program to the source(s) in order to correct the community odor nuisance. Providing a target odor emission concentration for the source to be in position to select and obtain the necessary odor control equipment.

A more detailed discussion of this suggested approach is presented below.

#### Validation of Odor Complaints

The following procedures are suggested for receiving and investigating odor complaints:

1. Each complaint received by phone would be logged on a printed form to identify the name and address of the complainant. Also logged on the complaint form are the time and location of odor exposure, the length of exposure time, the intensity of odor exposure (strong, moderate or weak), a description of the odor, the wind direction and identification of the alleged source if one is perceived.

If the complainant desires not to be identified to the source, confidentiality could be provided. However, if legal proceedings are necessary, it is possible the complainant may be asked to testify.

2. The alleged source (if known) would be contacted without delay and informed of the complaint including the exact time and location of exposure. This permits the alleged source an immediate opportunity to respond to the complaint. Also, a voluntary resolution of the odor complaint could be achieved. The agency should avoid accumulating a number of complaints before notifying the alleged source.

3. Coincident with item 2, an agency inspector would be dispatched without delay to the scene of the complaint to establish its validity. The presence of odor, its intensity and duration, the wind directions, interview with complainant, investigation of potential sources, identification of and interview with alleged source(s) are measures to be considered in establishing the validity of the complaint.

A printed form for investigating odor complaints would be filled out by the inspector for each complaint. A permanent record of these findings could be kept and made available to the alleged source and public, except for the name of the complainant if confidentiality is desired.

- 4. The alleged source, if identified, could be contacted by the inspector and requested (but is not required) to respond in writing to the complaint. The alleged source should indicate its position and action to be taken regarding the complaint. This written response likewise could be kept as a permanent record by the agency and made available to the public.
- 5. Voluntary complaints should be received by the agency before they solicit complaints from others.

#### Establishing a Community Odor Nuisance

An administrative procedure in the regulation would be provided to establish the existence of a community odor nuisance. The procedure would specify the number of *valid* complaints received from separate households during a fixed time period.

The TT-4 Committee suggests that a community odor nuisance exists when a significant number of people from separate households allege the existence of an objectionable odor and an investigation of these complaints by the agency confirms this. The specification of what exactly is "significant" is dependent upon the community's characteristics such as population distribution, socioeconomic activity, and land use zoning.

The existence of a community odor nuisance should be established first *before* regulatory limits are applied to a specific odor source to obtain compliance.

#### Locating the Alleged Source(s)

The investigative procedure for determining the validity of each complaint should provide information which may identify or locate the source(s) causing the community odor nuisance. However, actual testing of the odor emission from the source(s) may provide a more objective basis, not only for locating the source of the problem but also the proportionate contribution of each source if multiple sources are involved. As a result, it is essential that the technical capability be available for sampling and measuring odor emissions from the source with reliable odor sensory methods.

For stack type emission, the following procedure is suggested:

- 1. An acceptable odor sensory sampling and measurement method is described and documented in detail for use by both the regulatory agency and the individual sources.
- 2. The alleged source(s) are tested by sampling the stack emissions to determine the odor dilution ratio by the accepted method. Also, the volumetric flow rate from the stack(s) is measured. If multiple sources are involved, the percent contribution toward the odor nuisance can be estimated from the odor sensory data obtained.

This testing could be omitted when a single source is only involved and the solution to the odor problem is self evident.

3. Monitoring the stack emission for odor dilution ratio provides a basis for estimating the degree of odor reduction required to correct the community odor nuisance.

As was indicated previously, an odor sensory measuring technique is also available for evaluating the odor emissions from fugitive sources.

It should be recognized that considerable test work is still required to validate the use of odor sensory methods considered to be suitable for regulatory purposes to measure the odor emissions from stack and fugitive type sources.

#### Compliance Program

In applying a compliance program to a source, a stack type emission is chosen as an example to illustrate this suggested approach.

When a specific source is identified as contributing to the community odor nuisance, an informal meeting could be held between the agency and the odor source. The purpose of such a meeting would be to collect and exchange information for establishing a compliance program to eliminate or at least reduce valid complaints below the number specified to be a community odor nuisance.

The elements of such a compliance program are suggested below and it is assumed that new odor control equipment is required:

- 1. Odor sensory testing of the stack emission(s) from the source to determine the odor dilution ratio and volumetric flow rate for each emission that potentially could cause the odor problem. The odor sensory method used should be acceptable to the agency.
- 2. Establishing a target odor dilution ratio for the stack emission(s) at a specified volumetric flow rate. This is a key step in the compliance program and is necessary for estimating the degree of odor reduction to be achieved with the new control equipment.

This target value should not be set unreasonably low to ensure that *no* odor be detected beyond the property line of the source because this approach may not be technically and/or economically achievable. Instead, the primary incentive for establishing the target value is to eliminate or reduce valid complaints below the number specified to be a community odor nuisance.

There was definite controversy among the Committee members as to how this target value should be arrived at, *based upon currently available odor sensory data*. This disagreement is characterized by the discussion in the previous section (Technology Needs—item 5) regarding the use of atmospheric dispersion models for predicting ambient odor concentrations from stack emissions.

An atmospheric dispersion model can be a useful tool for estimating a stack odor concentration that results in an ambient odor concentration which would be acceptable to the community. However, it also is important to determine the odor annoyance threshold that can be related to the population of the community experiencing the odor problem. Based on this knowledge, an ambient odor concentration can be selected below the known annoyance threshold which would be reasonable and yet capable of avoiding complaints. The availability of odor annoyance threshold data is rather limited and more odor sensory data are required to compare observed and predicted values of ambient odor concentration resulting from atmospheric dispersion models.

An estimate of the target stack odor concentration could be made with an atmospheric dispersion model based upon a selection of an ambient odor concentration to avoid complaints. Various meteorological conditions should be considered to take into consideration the local factors. These include the present odor concentration and volumetric rate of the stack emission, the location of the odor complaints with respect to the odor source, the prevailing wind direction and speed, atmospheric stability, the surrounding topography, duration of averaging exposure time, and frequency of occurrence during the year. The selection of values for these meteorological parameters should be reasonable for achieving compliance but yet are capable of preventing exposure to a community odor nuisance.

The stack odor concentration estimated from the atmospheric dispersion model should be reviewed carefully and as is appropriate, adjusted based upon the best available technical information regarding odor control technology and the cost required to achieve the desired odor reduction. The ability of the source to finance the new equipment investment and associated operating costs should also be a consideration.

Based upon the target odor dilution ratio which is established for the stack emission, the source with agency approval would select a specific method of odor control. As a result, the source would investigate the availability of odor control equipment and the delivery time required. It is possible that pilot plant or commercial scale testing is required to confirm performance before new equipment is ordered. The compliance schedule should allow sufficient time for the various phases of the project to be completed.

3.

The overall solution to the odor problem should not be limited to only a choice of odor control method but also should allow for selecting a stack height to utilize the dispersion capability of the atmosphere.

- 4. A final meeting between the agency and the source should result in a compliance program that consists of a written agreement stating specific items to be accomplished within a definite time period.
- 5. When the necessary equipment has been installed and put into operation, the system would be tested and the stack odor dilution ratio determined. The frequency of *valid* odor complaints would be noted. If significant valid complaints are being received during a certain time period, monitoring the stack emission of the new control system is important to establish whether this source or another is causing the odor problem.

After an adequate time has been allowed to establish a history of odor complaints subsequent to the startup of the new odor control system, the agency and the odor source would have an informal hearing. Its purpose would be to arrive at a conclusion regarding the correction of the community odor nuisance, determine if further action is required and establish a stack emission odor monitoring program that is contingent upon the number of complaints received.

The results of this meeting should be confirmed in writing. Such a written document would not preclude a community odor nuisance being established in the future for this particular source, provided that the specified number of valid complaints are received during the fixed time period.

#### **Technical Gaps to be Plugged**

In the section under Technological Needs, a number of items are listed for which experimental work may be required. First, all available information and data on each specific issue should be collected and evaluated. Then, wherever specific technical gaps are determined to exist, test programs should be developed and executed.

- 1. Basic criteria should be established for dynamic olfactometers that are to be used for measuring stack emissions and ambient odors (refer to items 3 and 7) for regulatory purposes. Jim Reinke of the TT-4 Committee has initiated a test program for a round-robin evaluation of dynamic olfactometers.
- 2. The use of atmospheric dispersion models to predict ambient odor concentration from stack and fugitive type emissions should be critically evaluated (refer to items 5 and 6). Reliable odor sensory data are needed to compare observed and predicted values of ambient odor concentration. Such available data should characterize results obtained for single odorant compounds and compare them with those obtained with "odors" (mixtures of various odorants or chemical compounds). Bob Kenson of the TT-4 Committee is collecting information and data regarding atmospheric dispersion models in order that the Committee is in position to develop guidelines for their use and recommend further test work.
- 3. Techniques in sampling ambient odors should be investigated (refer to item 8).
- 4. Relating ambient odors to annoyance thresholds for different communities or zoned areas is fundamental to establishing ambient odor type standards (refer to item 9). However, this represents a relatively complex technical program since considerable testing would be required and specific industrial sources would have to be considered for such a program. Federal funding would be required to accomplish this.

In connection with relating odors to annoyance, it would be desirable to quantify the terms: quality, intensity, frequency, and duration of an odor to establish objective criteria for determining an odor to be objectionable.

5. Establish the technical capabilities of various odor control techniques for different industrial categories to reduce odor intensity to specific levels. For each odor control technique and industrial category, determine a cost effective relationship between the odor reduction achieved and the investment costs and operating costs expended.

#### Summary

Present odor regulatory approaches are considered generally to be unsatisfactory. There are two basic needs: (1) develop sound administrative procedures for establishing the existence of a community odor nuisance, and (2) obtain reli-

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able odor sensory data that can be related to community acceptance or annoyance of a particular odor.

Specific issues regarding administrative procedures are presented. These include validating odor complaints and establishing that a community odor nuisance exists before applying a compliance program to the odor source. Likewise, technological needs are discussed. These include improved sampling and odor sensory measurement techniques for stack emissions and ambient odors, critical evaluation of atmospheric dispersion models to predict ambient odor concentrations, and relating ambient odors to annoyance thresholds for different communities or zoned areas.

A suggested approach to odor control regulations is detailed. Specific procedures are provided for validating complaints, for establishing the existence of a community odor nuisance, for locating the alleged source(s) causing the odor problem, and applying a compliance program to the source.

It is the hope of the TT-4 Committee that this position paper will stimulate interest and discussion on the part of all segments of the community; the public, industrial sources, and the regulatory agencies. In particular, the Committee desires that the technical members of the community participate actively in the development and testing of improved odor sensory methods that will provide the needed scientific data for effective odor control regulation.

#### Acknowledgment

The author is sincerely grateful to the members of the TT-4 Committee for their significant, individual efforts and contributions to this position paper. An attempt was made to consider the diverse comments received and provide a balance that hopefully approximates a consensus of the Committee. If any Committee member feels this was not achieved, the author so apologizes.

#### References

- W. C. L. Hemeon, "Malodors—a basis for regulations," J. Air Poll. Control Assoc. 21: 770 (1971).
   M. Feldstein, D. A. Levaggi and R. Thuiller, "Odor Regulation by Emission Limitation at the Stack," paper 73-273 presented in DOA Association with the stack of the stac at APCA Annual Meeting. June 1973.

- 3. W. H. Prokop, "Status of Regulations for Source Emission and Ambient Odors," paper 28 presented at The New York Academy of Sciences, Conference on Odors: Evaluation, Utilization and Control. Oct. 1973
- G. Leonardos, "A critical review of regulations for the control of odors," J. Air Poll. Control Assoc. 24: 456 (1974). N. A. Huey, L. C. Broering, G. A. Jutze, and L. W. Gruber, "Objective odor pollution control investigations," J. Air Poll. Control 5.
- Assoc. 10: 441 (1960). Standard Method for Measurement of Odor in Atmospheres (Dilution Method) ASTM-D1391-57 (reapproved 1967), 1972 Annual Book of ASTM Standards Part 23, American Society
- Testing Materials, Philadelphia, PA.
   J. L. Mills, R. T. Walsh, K. D. Luedtke, and L. K. Smith, "Quantitative odor measurement," 13: 467 (1963).
   D. M. Benforado, W. J. Rotella, and D. L. Horton, "Development"
- of an odor panel for evaluation of odor control equipment," J. Air Poll. Control Assoc. 19: 101 (1969).
- H. E. Friedrich and D. M. Benforado, "Utilization of the Odor Panel Technique for Evaluating Odorous Industrial Emissions, paper 73-271 presented at APCA Annual Meeting, June 1973.
- ASTM D-22 (Sensory Evaluation Committee) Task Force D 22-02.09, "Proposed Revision of D 1391-57 Standard Method for 10. Measurement of Odor in Atmospheres (Dilution Method)," April 1977
- 11. The Research Corporation of New England, "Technical Report to the Illinois Environmental Protection Agency on the Evalua-tion of Four Odor Measurement Systems," Dec. 1975.
- 12. Bay Area Air Pollution Control District, San Francisco, California,
- Bay Area Air Pollution Control District, San Francisco, California, Amendment to Regulation No. 2, Division 15, "Odorous Sub-stances," Effective May 5, 1976.
   State of California Health and Safety Code, Section 41705: De-scription of Agricultural Operations Exempted.
   Copley International Corporation, "A Study of the Social and Economic Impact of Odors—Phase III," Final Report prepared for the Environmental Protection Agency, Feb. 1973.
   State of Wisconsin Air Pollution Control Rules, Chapter NR154
- 15. State of Wisconsin Air Pollution Control Rules, Chapter NR154, Section 154.18, Effective April 1, 1972. State of Pennsylvania Standards for Contaminants, Chapter 123,
- 16. Section 123.31, Adopted Sept. 2, 1971. State of Minnesota Pollution Control Agency Regulations APC-9
- 17. and APC-10, Effective Sept. 14, 1971. J. P. Wahl, R. A. Duffee and W. A. Marrone "Evaluation of Odor
- 18. Measurement Techniques: Volume I Animal Rendering Indus-try," report prepared for U. S. Environmental Protection Agency

- try," report prepared for U. S. Environmental Protection Agency (EPA-650/2-74-008-a) Jan. 1974.
  T. Lindvall, "On sensory evaluation of odorous air pollutant in-tensities," Nord. Hygiene Tidskr, Supplement 2 (1970).
  U. Hogstrom, "A method for predicting odor frequencies from a point source," Atmos. Environ. 6: 103 (1972).
  W. C. L. Hemeon, "Measurement of Fugitive Odor Sources," APCA Specialty Conference on Odor Control Technology II, Pittsburgh, PA, March 1977.
  D. A. Kendall, P. L. Levins and G. Leonardos, "Diesel Exhaust Odor Analysis by Sensory Techniques," paper 740215 Automotive
- Odor Analysis by Sensory Techniques," paper 740215 Automotive Engineering Congress, Feb. 1974.

## Critique

#### J. Neil Mulvaney

Ontario Ministry of the Environment

Although it does not achieve all that it sets out to do, the Committee Paper is a stimulating and useful contribution. One of the primary objectives of the Position Paper is stated to be the determination of the effectiveness of agency enforcement of current odor regulations. This objective does not appear to have been achieved. The paper concludes that, "present odor regulatory approaches are generally unsatisfactory," but no real evidence is offered in support of this even by reference. The regulatory agencies are chided for preferring to retain the nuisance concept to regulate odors, either as the sole tool or as backup where odor measurement techniques are specified. A reading of the paper seems to confirm the wisdom of such agencies, at least until the technical gaps identified in the paper have been plugged.

A crucial assumption made in the paper is that hazardous or toxic odorous vapors and gases require a separate type of regulation. Because the ability to do this is essential to the acceptability of the kind of regulation proposed in the paper, some statement should have been made about the feasibility of categorizing and separating out odors which are hazardous or toxic and those which are not. The distinction is also important because once it has been made, it might allow a regulatory agency with limited resources to allocate them more meaningfully.

The concept of "a community odor nuisance" occupies a fundamental place in the Committee Paper. Before entirely buying the idea that the existence of such a community odor nuisance should be established before regulatory limits are applied, I would want to have some assurance that alternative arrangements were available so as not to leave unprotected, members of the public who do not happen to be located in a populous area. The concept of the community odor nuisance is likely designed to eliminate the need to satisfy those members of a community who may be abnormally sensitive. It should be mentioned that this objective tends also to be achieved in respect of the nuisance standard or similar criteria. It will usually be necessary to have testimony from several affected members of the community before success in this kind of litigation can be confidently predicted. Notwithstanding the above comments, the writer feels that the concept of "a community odor nuisance" is an important one.

The paper indicates that the establishment of the existence of a community odor nuisance should take into account the characteristics of the particular community. This does not seem to be unreasonable if a fair way can be worked out to accomplish it. A similar approach has been taken to noise control by-laws, although it should be pointed out that in that area more data are available as to annoyance and discomfort thresholds.

The paper indicates that the Committee was essentially unamimous in commenting that a regulatory agency should consider the investment and operating costs of odor control techniques in applying a compliance program to an odor source. This is a very broad statement and I am not sure of its exact meaning. If if suggests that the onus on this issue will always be on the regulatory agency, then I do not agree with the thinking. In my view this would be inconsistent with the other firm conclusion reached that "the choice of a control method should be up to the individual source but with agency approval." It seems to me that once the community odor nuisance has been established, it is up to the source to come forward with a realistic program acceptable to the agency to eliminate the nuisance. It will only be where such a program is not forthcoming that the agency is forced to direct the implementation of a program. When the agency is forced into that position as a result of the failure of the source to come forward with a program, it seems to me that the onus should be on the source to bring forward data on investment and operating costs and to demonstrate that for a specific increment of odor control investment there will not be a significant reduction in the community odor problem. Also, if the Committee is suggesting here that if there is no technique sufficiently effective to solve the problem that is economical for a particular company, then compliance should not be required,

then the writer disagrees. The courts, in nuisance cases, have held that an operation which cannot be carried on within the law, cannot be carried on at all. Surely, our environmental legislation should not permit lower standards of protection than those which have been imposed by the courts for centuries.

The determination as to the existence of an odor nuisance made by a court is said to be based on an evaluation of the subjective testimony of opposite parties. The thrust of the paper here places confidence on technology not yet fully tested in favor of a standard applied by the courts for a long time. So long as the courts consider the evidence of each witness carefully, and reject evidence of those witnesses who appear to be biased or influenced by some improper motive, abuses are not likely to happen. Also, evidence in such cases is not entirely subjective. If a witness has gotten up in the night to close his bedroom windows or if the children are forced out of their own backyard into the house by objectionable odors, these events in themselves may be demonstrated as factual.

Perhaps some discussion would have been helpful in the report on the issue of side effects which can result from a solution to an odor problem. One of the illustrations of this is where, in order to correct an odor problem, noisy control equipment has been installed which, in turn, results in complaints from the community. It may be that this raises an issue which could be usefully dealt with in the guidelines.

The paper infers that the enforcement of a nuisance statute is difficult and also implies that such provisions in the law are undesirable because they are too subjective. I have already dealt with the issue of subjectivity. Our own experience in the Province of Ontario shows that enforcement is not that difficult and indicates that the courts are quite comfortable with the traditional nuisance standards which they have worked out over hundreds of years. The concept of an emission which causes material discomfort to some person is not all that difficult for the ordinary person to understand and, indeed, may be more relevant to him than numerical standards. For this reason, it may be that it would be wise to preserve the provisions of this kind in the law, at least in the foreseeable future.

The only real reference to legal procedures in the report is a statement to the effect that they should be available for the agency to obtain compliance and that they are outside the scope of the paper. It is suggested that the issues raised by legal considerations are not that easily put outside the scope of the paper, the purpose of which is to develop guidelines and considerations for developing odor control regulations. As was pointed out above in respect of the nuisance kind of standard, we are dealing with principles which have been established for a long time in the law and these questions must be addressed if any consideration is given to removing them by substituting alternative approaches. Considerations of this kind are inherent in the development of a regulation as are considerations of civil rights, access to information, and questions of appeal. For example, the method of determining whether a community odor nuisance exists is set out rather generally in the paper and in the actual development of a regulation of this kind you would probably have to come to grips with the question of how a determination made by the agency can be challenged through some appeal or review process.

Notwithstanding the above observations, I wish to reemphasize that the Committee Paper is an extremely stimulating and important contribution.

## Critique

#### Alan R. Mitchell Minnesota Pollution Control Agency

Regulatory agencies with jurisdiction in the pollution control area would tend to agree with the position of the TT-4 Committee of the Air Pollution Control Association that present methods of regulating the emission of odorous pollutants have been cumbersome and unsatisfactory. One of the reasons for this, as the TT-4 Committee points out, is the lack of adequate monitoring equipment, but another major reason is the fact that state and federal regulatory agencies have placed their major emphasis on the so-called criteria pollutants-particulate matter, sulfur dioxide, nitrogen oxides, photochemical oxidants, carbon monoxide, and hydrocarbons.\* However, since a large percentage of complaints about air pollution received by regulatory agencies involves odor pollution, there will continue to be a growing interest in the regulation of industries which emit odorous pollutants and new regulatory approaches will undoubtedly be forthcoming

The TT-4 Committee in its position paper has discussed several major aspects of odor regulation which I identify as (1) the objective of odor control, (2) the regulatory standard, and (3) administration of the standard. I would like to critique the position paper under those major headings.

#### The Objective of Odor Control

The TT-4 Committee identified the objective of odor regulation as the abatement of odors in the ambient air to a level below an average annoyance threshold level that is based on a community odor nuisance standard.\*\* The TT-4 Committee also suggests that the objective is to abate a community odor nuisance *after* it has been established.

I think regulatory agencies would have two major areas of disagreement with the TT-4 Committee position. One, the objective of odor regulation must be to *prevent* the odor from occurring in the first place, not to abate it after citizens have complained. Two, the objective is to eliminate the odor for all noses in the community, including the sensitive ones. Reduction of the odorous pollutant only to a level that does not annoy the average nose is unacceptable. I recognize that often such activities as farming may not be regulated at all and that such considerations as zoning and population may influence the necessity or intent to regulate odors. However, once a regulatory agency acting within its authority determines that regulation of odorous pollutants is appropriate, the objective must be to prevent the existence of an odor in the ambient air for all citizens in the community.

It should be pointed out briefly that the objective of odor regulation as far as the regulatory agency is concerned depends to a great extent on the intent of the legislative body which created the agency. The regulatory agency can only carry out the duties and functions which the legislature has authorized it to carry out.

#### The Regulatory Standard

The question here is what should the law (i.e., the regulation) provide so that the objective is maintained. This is the step at which the regulatory agency establishes the numbers or criteria which the emitter of the odorous pollutants must achieve. Adoption of the standard by regulatory agencies has nothing to do with enforcement, or the validity of complaints, or the identity of emission sources, or the development of compliance programs. Complaints, for example, may lead to the development of a standard, but individual enforcement activities do not occur when the standard is being developed.

We should focus here, then, only on the criteria that should be contained in an odor regulation. The TT-4 Committee discussed the merits and demerits of an ambient standard and a stack emission standard. Regulatory agencies generally use both standards and the TT-4 Committee recognizes that both are needed. The ambient standard is necessary because this is the underlying objective, and the stack emission standard is necessary because it is the best mechanism for assuring that the ambient standard is achieved. This is the approach used by the regulatory agencies and envisioned by the Clean Air Act for meeting the ambient standards for the criteria pollutants. For example, an emission standard which limits the amount of sulfur dioxide which may be emitted by a power plant is developed that is adequate to meet the ambient standard for  $SO_2$ . A similar approach is appropriate in the odor control area.

The TT-4 Committee recommends an ambient standard in terms of the number of valid complaints received from separate households during a certain period of time. The regulatory agencies, as the Committee recognizes, rely basically on a nuisance standard.<sup>†</sup> The different standards result because of the underlying differences between the Committee and the agencies over the extent of odorous pollutants which should be permitted in the ambient air.

The TT-4 Committee discusses the lack of adequate reliable odor sensory devices for measuring odors. There can be no doubt that reliable equipment would provide a tremendous assistance. Such equipment would be a valuable compliance tool to determine the extent of odors in the community. Moreover, it would substantiate modeling techniques used to determine stack emission standards necessary to meet ambient standards.

Stack emission standards are a necessary element of an adequate odor regulation. The TT-4 Committee prefers a stack standard that is a target odor dilution ratio determined

<sup>\*</sup> These are specific pollutants identified by the U.S. Environmental Protection Agency as pollutants which have an adverse effect on public health or welfare. See Clean Air Act §108, 42 U.S.C. §1857 c-3 and 40 C.F.R. Part 50 (1976).

<sup>\*\*</sup> An interesting analogy that comes to mind is the United States Supreme Court's holding that states may apply "contemporary community standards" as part of the test in determining whether certain material is obscene. See *Miller v. California*, 413 U.S. 15 (1973). See also *Paris Adult Theatre I v. Slaton*, 413 U.S. 49 (1973) and *Smith v. United States*, 45 U.S.L. W. 4495 (1977). I am reminded of the words of Mr. Justice Stewart in *Jacobellis v. Ohio*, 378 U.S. 184 (1964) where he said:

I shall not today attempt further to define the kinds of material I understand to be embraced within the shorthand description [hard-core pornography]; and perhaps I could never succeed in intelligibly doing so. But I know it when I see it ....

<sup>&</sup>lt;sup>†</sup> Nuisance law may vary slightly from state to state but Minnesota's definition of nuisance is illustrative of the others. Minnesota Statutes, Section 561.01 (1976) defines nuisance in the following terms:

Anything which is injurious to health, or indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, is a nuisance.

after an odor problem occurs. This is chronologically and perhaps legally inappropriate. The stack emission standard must be included when the regulation is promulgated, otherwise a new source would be permitted to be constructed and to create an odor problem where one did not exist before. Furthermore, it provides an identical stack standard for all existing sources, rather than an ad hoc one, which the Committee seems to prefer.

One aspect of emission standards that the TT-4 Committee discusses only briefly is the approach of establishing emission standards for specific odor-causing pollutants. The example the Committee mentions is total reduced sulfur limits for the kraft pulp mill industry. The most effective method to avoid odors in the ambient air is to limit the amount of odor-causing pollutants which may be emitted. While this approach requires more effort to isolate the odor-causing pollutants which may be emitted. While this approach requires more effort to isolate the odor-causing pollutants, to determine their odor thresholds, and to relate their ambient thresholds to a stack concentration, it is my judgment that in the future there will be more regulations setting these kinds of standards.

A factor which the Committee fails to consider is the "technology-forcing" aspects of pollution control. "Technology-forcing" is a phrase which the courts have developed to describe a philosophy that pollution control is so important that claims of economic or technical infeasibility can not excuse noncompliance. See Union Electric v. Environmental Protection Agency, 96 S. Ct. 2518 (1976) and Train v. Natural Resources Defense Council, 421 U.S. 60, 90 (1975).<sup>‡</sup> There may be instances in which industry will be required to develop the technology necessary to alleviate an odor problem.

In sum, it appears that the TT-4 Committee and the regulatory agencies agree that changes will be forthcoming in odor regulation. Developments in odor sensory devices will expedite these changes. Future regulations will continue to require compliance with both ambient and emission standards, and in my judgment these standards will be more specific and more stringent than is suggested by the Committee.

#### Administration of the Standard

Once the standard is adopted, of course, it remains for the regulatory agency to administer it and to insure that all existing and new sources comply with the requirements of the regulation, regardless of whether the standard is a community nuisance standard, an emission limitation, or some other

<sup>&</sup>quot;The first responsibility of Congress is not the making of technological or economic judgment—or even to be limited by what is or appears to be technologically or economically feasible. Our responsibility is to establish what the public interest requires to protect the health of persons. This may mean that people and industries will be asked to do what seems to be impossible at the present time." 116 Cong. Rec. 32901-32902 (1970).



**Morton Sterling** Wayne County Department of Health

This is a written summary of comments made at the TT-4 Committee presentation of "Position Paper on Odor Control Regulations".

We take major exception to any guideline document that establishes or attempts to determine the validity of citizen

terests of the agency, the source, and the public.

standard. Much of this administration will involve validating complaints, identifying sources, and resolving compliance schedules, as the Committee suggests. I have no quarrel with this portion of the paper, as most of my disagreement involves the requirements of the standard itself, but there are several points I wish to make regarding administration or enforcement of the odor regulation.

Once a standard is duly promulgated all sources that fall under the purview of the regulation are required to comply with it. Compliance at this juncture means nothing less than meeting the numbers and criteria of the regulation. If the standard does not require a certain number of complaints, as I promote, then compliance is required whether complaints are received or not. Sources will be required to install the necessary pollution control equipment regardless of the number of complaints.

The Committee has expressed a concern that a source have an opportunity to present data to the regulatory agency regarding the economics of compliance. Depending on the laws of the jurisdiction in which the source is located, an individual source may apply for a variance from the standard on the grounds of economic hardship. In addition, the source most likely had an opportunity to present general economic data to the agency at the time the regulation was adopted.

One factor which does not seem to be given adequate weight by the Committee in discussing administration of the regulation is the length of time needed by the source to meet the standard. New sources must comply upon commencement of operation but existing sources will require a period of time to install pollution control equipment to meet the standard. Informal dispositions are preferred by the regulatory agencies and the sources, but if operation is to continue in violation of the standard while equipment is being installed, the compliance schedule must be kept to a minimum. In developing these compliance schedules, the number of complaints will certainly be a factor.

#### Conclusion

I have two major disagreements with the position of the TT-4 Committee. One, a community odor nuisance standard which requires a certain number of complaints over a certain period of time is inadequate. The standard must be designed to eliminate the odor for all the citizens. Two, an odor problem cannot be allowed to develop before abatement efforts need be undertaken. Pollution control equipment must be installed before the problem occurs.

Regulatory agencies are in accord with many of the positions taken by the Committee. Certainly development of reliable odor sensory devices will be a tremendous asset to both the agency and the source in identifying and preventing ambient odor problems. In addition, the equitable administration of whatever odor standard is promulgated is in the best in-

odor complaints based upon the number registered per unit time. This is a matter which each community must establish for its own basis of action. Of course, in the ultimate a problem may require a judicial decision. Local agencies have been dealing for years with odor-type community problems and

<sup>&</sup>lt;sup>†</sup> These cases involve interpretations of the federal Clean Air Act. The "technology-forcing" requirement was derived from a reveiw of the legislative history behind the Act. Senator Muskie, explained the bill to the Senate in the following words:

they are quite adept at distinguishing between valid citizen concerns and those of a harrassing or nonobjective nature.

The guidelines provide overemphasis in many areas on zoning as an element in determining the validity of citizen odor complaints and/or the seriousness of the problem. zoning should not enter into a determination of the validity of citizen complaints. Why citizens who reside immediately adjacent to industrial activities should be treated as second-class citizens is not understood. References to the zoning parameters should be eliminated from the guideline document.

The report indicates that the ASTM syringe method is inadequate. It further indicates that a more objective and reliable means must be developed. Later wording suggests that the ASTM syringe method is of no real value, when our office has not found that to be the case at all. In fact, a recent civil suit filed by this agency (which is now at the Appeals Court level) received the wholehearted support of the Circuit Court judge in the application of the ASTM syringe method as the cornerstone of our allegations. It is my understanding that at the Tuesday TT-4 Committee meeting, the "round robin" testing of the dynamic olfactory method of measurement developed serious reliability problems of its own accord. Until such time as another method is developed and recognized as better than the ASTM syringe method, it certainly should be considered acceptable for use in assisting with the evaluation of odor problems and their solution, and some statement to that effect should be made in the guideline document. Otherwise, enforcement agencies will be left with no reasonably scientific method to assess odor extent objectively, even

though it is recognized that better methods may come about in the future.

The Committee report suggests that setting of an odor standard with no odor is unreasonable and places an undue restraint on the owner of the facility in question. This assessment should be deleted from the report. The determination of acceptable community odor levels is a legislative prerogative, and it could be that certain communities in their wisdom would not wish that any odors be perceptible beyond the boundary line of the source originating such emissions. It is quite likely that most communities would not adopt such a posture, but certainly to call such a posture unreasonable is unwarranted.

It is suggested that in the development of any agreement with an odor emission source, such agreement be in writing. We agree with this principle; however, we would suggest that such agreement be in a legally enforceable format; that is, if there is failure to honor the agreement that is written, such features can be immediately enforceable in a court of law. Our agency has developed such contractual relationships with many offending sources, including owners of facilities which generate odorous emissions creating problems to the community.

Before publication of the guidelines, it seems the Committee should earnestly solicit input from the Control Officials Conference Committee of the APCA as well as STAPPA and ALAPCO, the latter organizations being composed principally of state and local air pollution control officials. It is noted that 24 of the 26 members of the TT-4 Committee are representatives of either industry directly or indirectly affected by the guidelines or academic and consulting organizations, and only two are from regulatory agencies. Input from a wider spectrum of control officials would be helpful in providing a balance to the report.

### Comments

#### A. Turk

City College of the City University of New York

Mr. Prokop is to be complimented for his fearless undertaking of a complex and controversial task. I would like to offer comments on three matters with which the paper is concerned.

The measurement of odor by a dilution technique requires some definition of the target concentration to be reached. Abundant experimental evidence as well as theoretical considerations based on signal detection theory provide convincing arguments against the use of the detection threshold as a target. The recognition threshold is not quite so bad but is still not satisfactory. A much better target would be a standard concentration of a standard odorant that provides a mild but definite odor, such as, for example, 100 ppm of n-butanol.

The problem of identifying a "valid" odor complaint is a sensitive one, but in adversary situations, needs to be defined operationally. I suggest that attempts to develop a criterion be addressed to the question of an "invalid" complaint, all others then being considered to be valid. It is of course, widely accepted that a complaint about a non-operating source, or from an upwind location is invalid. There are many instances, however, in which such straightforward evidence is not at hand. It is therefore important to establish procedures, perhaps based on odor recognition tests under controlled conditions, to define a response which is demonstrably invalid.

Everyone agrees on the need for refinement of atmospheric dispersion models for odors, especially with regard to the appropriate time-averaging interval for establishing ground-level odorant concentrations. It is important to recognize that the establishment of such a model is not simply a paper exercise, but requires a carefully controlled, and rather elaborate experimental design, possibly using a tower from which odorant and a gas tracer are released simultaneously, together with downwind sensory odor judgments and sampling and analysis of the tracer over different time intervals.

### Comments

J. C. Wykowski EXXON Research and Engineering Company

Regarding the TT-4 Odor Committee paper on Odor Regulation, we believe that the basic goal of a regulation should be to prevent ambient odors that are a nuisance to the community and that control methods to reach these goals should not be specified by regulatory bodies. In enforcing odor regulations, the cost effectiveness of alternate solutions should be considered. For example, we consider a limit on the total odor emission to be a penalty on large installations which is not cost effective.

Tools to predict whether there will be an odor problem from a plant are needed in order to design plants to prevent odor complaints. This is preferable to waiting for odor complaints. After causing a nuisance, it is always more difficult to achieve reasonable solutions especially with regard to the time needed for implementation. We agree that technical areas worth pursuing in this regard are:

- Establishing annoyance thresholds for odorants.
- Developing models which accurately predict dilution of odorants by atmospheric dispersion.
- Methods to measure odors reliably and reproducibly.

Regarding odor measurement, our experience with the Scentometer has been poor. It is not sufficiently precise or accurate for regulatory use. The ASTM syringe and dynamic olfactometer methods are better. The dynamic olfactometer is easier to use than the ASTM syringe method and for that reason should give more reproducible and accurate results especially in the hands of untrained people. In determining an odor's annoyance level, it is probably unrealistic to define it in terms of an average response dose. The general community and regulatory bodies will not accept odor levels that half the population would complain about. Some weighted dose-response level will be needed, for example, the level at which 95% of the population would not consider an odor offensive might be appropriate.

Similarly, in using dispersion models to predict ambient odors, the variation in concentration with time, location, and weather conditions should be considered. For criteria pollutants the target concentration is not supposed to be exceeded under the worst weather conditions at any location for a specified averaging time. For odors it might be reasonable to provide facilities where the target, ambient concentration is not exceeded at any location 90% of the time for some appropriate averaging time. In order to do this, more work is needed on the use of atmospheric dispersion models as they apply to odors. Our experience from experimental studies with tracer gases and odorants is that this is not simple or straight forward. A key problem is that the averaging time for the human response to odors is probably two orders of magnitude shorter than that normally considered for short term dispersion predictions.

I hope these comments are helpful. We encourage your efforts to help develop reasonable odor regulations and your efforts which highlight the need for additional work before effective odor regulations can be written.

## Closúre

#### W. H. Prokop

The critiques submitted by Messrs. Mulvaney and Mitchell are important contributions to this session on odor control regulations. Mr. Mulvaney ably defends the nuisance approach to odor regulation and also focuses his remarks on other issues. Mr. Mitchell presents an alternate approach that identifies a specific objective of odor regulations and offers a regulatory standard to meet this objective. The written comments by Messrs. Sterling, Turk, and Wykowski are also significant additions to the position paper. The TT-4 Committee had considerable differences of opinion among its members regarding the various issues that influence the development and promulgation of odor regulations. It was difficult to portray an accurate consensus of the Committee due to the diverse comments received. This summary likewise represents a consensus of four members of the Committee. It is interesting to note that significant disagreement exists in the critiques and written comments on certain issues which are listed below.

#### ODOR CONTROL REGULATIONS

The purpose of this summary is to focus on specific key issues which are extracted from the critiques and comments which have been presented. These key issues and their related discussion are given below:

- 1. *Issue:* The objective of odor regulations is to eliminate odor in the ambient air for all citizens in a community. *Discussion:* Odor regulations should eliminate *objectionable* odors. It seems to be unreasonable to outlaw all odors that can be detected in the ambient air. For example, national ambient air quality standards have been promulgated for criteria health-related pollutants, such as sulfur dioxide and carbon monoxide. Specific tolerances for various levels are allowed in the ambient air for these pollutants. Why should odors which are basically *not* health-related have *no* tolerance in the ambient air?
- 2. *Issue:* Odor regulations must prevent an odor problem from occurring. The regulation should include stack emission limits that apply equally to all sources. Compliance is required with the stack limits, whether complaints are received or not.

Discussion: The emphasis in this approach is to provide a clearcut standard for stack emission that applies to all odor sources regardless of their location and proximity to potential complainants. The position paper considered valid complaints to be proof that an odor problem exists in the community. Even though odors may be present, if no complaints are received, then presumably an odor problem does not exist. The blind application of rigid single-number type limits to all odor sources appears to be unreasonable, both from the standpoint of an agency's manpower being used to enforce a questionable standard and industry's investment in odor control equipment being required where no odor problem exists. As discussed in the position paper, adequate technology is not available today to predict accurately the existence of a nuisance based on stack emission data. As a result, stack emission standards would be unnecessarily stringent to compensate for this technical shortcoming.

State agencies currently have the regulatory mechanism to prevent an odor problem from occurring before citizens have complained. Any new odor source (or existing source) is required to obtain a construction and/or operating permit approved by the agency. At the time of application for such a permit, the agency is in position to evaluate the odor source, the proximity of neighbors, and make a judgment as to the odor control requirements to be met by the source. In fact, the section in the position paper under "Compliance Program" could serve as a guide to be used in processing an application for a permit. This approach has the advantage of evaluating each source on an individual basis and being able to relate the response of potential complainants to the controlled odor emission from the source.

3. *Issue:* Zoning parameters should not be included in odor regulations.

Discussion: Zoning classifications are established for different areas in order to provide stability of land use and avoid incompatible uses. Background odors are an inherent part of our life and they vary in type and intensity depending upon our exposure to them at home, at work or elsewhere. It is reasonable to expect a higher background odor level to be present in heavy industrial and rural areas as opposed to residential communities. Currently, this distinction is made in certain state regulations (Colorado, Illinois, Minnesota, and Missouri) that have different ambient odor limits for residential, industrial

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and rural areas. Further, existing noise control ordinances throughout the U.S. are based upon different decibel limits being established for different zoned areas.

4. *Issue:* Nuisance odor regulations should be retained until such time that proven technology is available for obtaining reliable odor sensory data that can be related to community acceptance or annoyance of a particular odor.

Discussion: Our Committee agrees that odor nuisance regulations should be retained for the present. The concept of a community odor nuisance was presented in the position paper in order to define more explicitly the existence of a nuisance. The number of valid complaints received from separate households within a fixed time period was *not* specified in the paper because this could vary for different zoned areas and for a more populated community compared to a lesser one. The intent of this approach was to eliminate isolated complaints that involve supersensitive individuals. However, an agency may wish to have an alternate approach for protecting a "community" of one household.

5. *Issue*: The ASTM syringe dilution technique should be retained for regulatory use until proven methods are available to replace it.

Discussion: The ASTM syringe method is being modified currently (see reference No. 10 in position paper) to overcome inadequacies perceived to exist in the basic method. Our Committee favors the development of improved odor sensory measuring methods that include dynamic olfactometers. As outlined in the position paper, dynamic olfactometer methods have specific advantages over the ASTM syringe method.

It is the hope of our Committee that the presentation of this position paper and the accompanying discussion will stimulate interest and further input on this subject from the concerned parties: the public, industrial companies, and the regulatory agencies. We encourage the submission of comments which would be included in any future timely revision of this position paper.

Mr. Prokop, Vice Chairman, APCA TT-4 Odor Committee, is with National Renderers Association, Inc., 3150 Des Plaines Avenue, Des Plaines, IL 60018. Mr. Mulvaney is Director, Legal Services Branch, Ontario Ministry of the Environment, Toronto, Ontario, M4V 1P5 Canada. Mr. Mitchell is Special Assistant Attorney General, State of Minnesota, Minnesota Pollution Control Agency, 1935 W. County Road B-2, Roseville, MN 55113. Mr. Sterling is Director, Wayne County Department of Health, Air Pollution Control Division, Detroit, MI 48207. Dr. Turk is in the Department of Chemistry, City College of the City University of New York, New York, NY 10031. Mr. Wykowski is with EXXON Research and Engineering Company, P.O. Box 101, Florham Park, NJ 07932. The Position Paper was presented as Paper No. 77-38.3 at the 70th Annual Meeting of APCA at Toronto in June 1977.