"ODOR SCHOOL"® Curriculum Development for Training Odor Investigators

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Proceedings of
Air and Waste Management Association International Specialty Conference: Odor and Environmental Air.
Bloomington, MN: 13-15 September 1995. pp. 121-127

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ABSTRACT

The EPA's "Visible Emissions Evaluation Field Certification and Classroom Lecture Program" trains field investigators as visible emissions evaluators. The visible emissions course is commonly refered to as "Smoke School".

An analogous training program consisting of classroom and field sessions prepares investigators to conduct field evaluation of ambient odors. The purpose of the training is to produce a qualified observer whose judgement of odors will be consistent and minimally affected by variable field conditions.

Training for field odor investigations must prepare the investigator to make observations in accordance with standard procedures and to record pertainent information in a standard, clear format. The trained odor investigator must also be provided with an understanding of how to prepare and present the investigative reports to supervisors, facility managers and officials.

The "Odor School" curriculum development has progressed over ten (10) years through cooperative efforts with county health officials, city and county planning managers, state agency personnel and facility managers. The author was a field odor investigator for the Minnesota Pollution Control Agency from 1974 to 1977.

Principles of odor chemistry and odor control technology are presented in the curriculum. Measurement and observation techniques are part of the training and course exercises. Standard data collection formats are incorporated and adaptability of the standard formats are discussed. Legal limits and applicability of the methods are a major emphasis of the training.

INTRODUCTION

This paper presents the basic purposes, methods and rationale for training field odor investigators. The training is embodied in a curriculum analogous to the curriculum used for training visible emissions evaluators.

"Smoke School" is the common term used for describing the "Visible Emissions Evaluation Field Certification and Classroom Lecture Program (Course)". The course trains field investigators as visible emissions evaluators, commonly called "smoke readers". The U.S. Environmental Protection Agency published "Guidelines for Evaluation of Visible Emissions" (EPA-340/1-75-007), April, 1975, as part of the Stationary Source Enforcement Series. The guidelines addressed certification, field procedures, legal aspects and other subjects related to visible emissions evaluation.

"Smoke School" provides the field investigator with an understanding of visible emissions and confidence in assigning an opacity measure to a visible emission using the unaided eye. "Smoke readers" are often described as having "calibrated eyes". This ability to "calibrate" one's senses is not necessarily intuitive. However, "calibration" of the sense of hearing is fully accepted in the field of music. The common elements in training to read opacity and training to hear music notes are the use of standard scales and standard terminology.

Measurement of ambient odors is accomplished using the ASTM Odor Intensity Referencing Scale defined and outlined in ASTM E544-75,88, Standard Practice for Referencing Suprathreshold Odor Intensity. The ASTM practice is designed to reference an unknown odor sample to the odor intensity of a series of concentrations of a reference odorant, ie. 1-butanol or 2-butanol; Static-Scale Method (Procedure B).

Description of ambient odors is accomplished using standard characterization terminology such as standard odor descriptors proposed by the Taste and Odor Committee of the International Association on Water Pollution Research and Control (IAWPRC). The IAWPRC proposed "flavor wheel" for characterizing natural waters uses the flavor-profile format recognizing the three-tier method for describing odors; similar to the fragrance industry's principle of three odor "notes" (top, middle and base).

Field investigators, using a standard odor intensity scale and standardized odor descriptor terminology, can provide measured, dependable and repeatable observations of ambient odors. The need to observe or monitor and document ambient odors is present in communities that have or may add potentially odorous activities such as industries, wastewater treatment plants, landfills or composting facilities.

C**URRICULUM DEVELOPMENT**

The purpose of the "Odor School" curriculum is to provide a field odor investigator with certain guidelines to be followed when making odor observations of the ambient air. The legitimacy of "Odor School" is based in large part on the legitimacy of "Smoke School", training field investigators as visible emissions evaluators.

The standard curriculum of "Smoke School" is primarily a traditional class room lecture format with field exercises using smoke generator practice runs and certification runs. If an "Odor School" curriculum were patterned rigidly on the "Smoke School" lecture format the students would hear and see information about odors and the sense of smell. However, with traditional classroom lecture only, the students would not overcome general perceptions such as "odors are subjective" and "odors can not be quantified".

A comprehensive curriculum for training field odor investigators must use teaching methods that guide students along a learning path. Two learning theories are applicable to sensory training: Multiple Intelligence Theory and Transfer Theory.

Multiple Intelligence Theory, based on research started in 1979 called Harvard Project Zero, is a philosophy of education that recognizes the broad range of student abilities. Multiple Intelligence Theory groups learning capabilities into seven (7) comprehensive categories:

1) linguistic,
2) logical-mathematical,
3) spacial,
4) kinesthetic,
5) musical (sensory),
6) interpersonal and
7) intrapersonal.

A curriculum for training odor investigators, that uses Multiple Intellegence Theory, will ensure each student's learning capabilities are addressed.

Transfer Theory uses the students' ability to learn in one situation to learn in a modified form in another situation. For example, when learning the basic concept of odor intensity, students first learn color intensity scales and then transfer that learning concept to odor intensity scales.

Therefore, a comprehensive curriculum for training field odor investigators, that is founded on the principles of Multiple Intelligence Theory and Transfer Theory, will achieve broad student understanding and proficiency in quantifying odors.

CORE SUBJECTS

The essential elements of the "Odor School" curriculum provides student with a basic understanding and working knowledge of odor chemistry, odor parameters, odor observation techniques, meteorology, standard field procedures and documentation.

The "sense of smell" depends on chemical molecules interacting with the olfactory nerves. Different industries and odor sources emit different chemical types. For example, the wastewater industry with related wastewater emissions generally emit odors that are from the "sulfide family" of chemicals. This type of odor chemistry information enables the field investigator to recognize odor types and the related odor sources.

The measurement of odors is accomplished in the laboratory and in the field. Determination of odor concentration using the dilution method is routinely conducted in laboratory environments with controls and trained panelists. Intensity measure is also conducted in the laboratory, however, can also be accomplished in field conditions. The field investigator must understand and appreciate the laboratory conditions needed for certain odor measurements and the field conditions acceptable for selected odor measurements, ie. intensity and descriptors.

The physiology of the olfactory process includes the air flow dynamics of the nasal cavity and the exposure of the olfactory nerves with the chemical stimulus; normal breathing and "sniffing". The "sniffing" observation techniques of a field investigator differentiate between normal breathing and "sample taking". A carbon mask is used by the field investigator to breath normally without exposure to the ambient odor. The carbon mask is removed for a "sniffing" observation to accomplished a single measurement in a series of measurements over a defined period of time, ie. ten measurements over a 30 minute period (three minutes of normal breathing between each "sniffing" observation).

Area meteorology and micro-meteorology affect the transport and changes in odors. Wind speed, temperature, humidity and vertical mixing affect odorous plume dispersion and subsequent odor dilution. Field investigators must routinely recognize the micro-meteorology of the local area adjacent to the ambient odor (ie. complaint or monitoring location) and adjacent to the potential odor sources.

A professional evaluation approach that is systematic and uniform is essential. Data collection on standardized forms insures record keeping uniformity and facilitates data base entry. Field investigators interact with the community in person and over the phone during investigations and monitoring. The appearance of professional procedures enhances the community's acceptance of the monitoring program or investigative activity.

APPLICABILITY

Ambient odors originate from many types of sources and facilities. Odorous emission sources may include point sources (ie. stacks and vents), area sources (ie. lagoons and landfills) and fugitive sources (ie. leaks and open doors). Source control is often addressed by prevention, containment and treatment of odorous gases. However, source odor limits are not commonly regulated nor easily measured. Measurement of the ambient odor levels surrounding a potential odor source is a proactive approach to monitoring source performance.

Monitoring and documenting ambient odors supports community understanding of nuisance situations and the specific sources or activities that may be causing the community nuisance. Facilities and/or communities may elect to use ambient odor monitoring to measure performance in mitigation efforts and compliance agreements.

Trained "Odor School" field investigators acknowledge three limitations of field odor observations:

1) Variable field conditions,
2) Complex odor emissions and
3) Legal acceptance.

The understanding of basic meteorology and the appreciation of micro-meteorology mitigates the problems in observing odors during variable field conditions. However, certain variability in wind and complexity in terrain can exasperate field investigators and limit data collection.

Odor complexity and odor emission variability can produce ambient odors significantly different from the source odors. Differences in source odor character and ambient odor character challenge the field investigator in tracking odorous plumes. Laboratory evaluation of the source odors can support the field investigation by identifying odor characters at the recognition threshold and at full strength.

Certification of "smoke readers" is part of "Smoke School", visible emissions evaluation training. Accreditation of "Smoke School" is derived from US EPA and State agency regulatory and enforcement programs. Similar certification for trained odor investigators results from local jurisdiction accreditation. Field odor monitoring requirements of a local ordinance, a conditional use permit or a compliance plan stipulation become the defacto accreditation of "Odor School" and certification of its graduate field odor investigators. However, litigation may occur depending on whether the odor monitoring record supports enforcement actions or provides defense remedies for a sources. Therefore, ultimate legal acceptance will depend on documented record quality and the professionalism and comprehensive training of the field investigators.

CONCLUSIONS

An analogous training program to "Smoke School", called "Odor School", trains field odor investigators to observe and record the intensity and descriptors of ambient odors using standard methods, such as a standard odor intensity scale and a standardized set of odor descriptors. The ASTM Standard Practice for Referencing Suprathreshold Odor Intensity (E544-75,88) is a bonified reference method for determining and documenting ambient odor levels. Likewise, the use of the "flavor wheel" for natural waters, proposed by the Taste and Odor Committee of the International Association on Water Pollution Research and Control (IAWPRC), is a recognized method and format for characterizing odors.

Field odor investigators can be trained and qualified to monitor and document ambient odors. Knowing the extent of actual odors in the community and their frequency of occurance will improve understanding of air quality and guide facilities and community officials in addressing odor causes. A community and facilities may come to recognize the levels of acceptable and unacceptable odors and develop plans to mitigate the nuisance odors.

The possibility of litigation necessitates quality documentation and proficient investigators. A monitoring and investigative record can provide substantial litigation support as well as litigation defense. The legal standing of odor observations may follow opacity observation legal development. The EPA published "Guidelines for Evluation of Visible Emissions" (EPA-340/1-75-007), April, 1975, recognizes the following points on the legal standing of opacity observations:

1) The opacity of emissions may be ascertained according to a definite scientific scale;

2) Inspectors can be trained to read opacity of emissions of any color; and

3) It is not necessary for inspectors to have a chart or any other aid in the field at the time observations are made.

Ambient odor observations are analogous to opacity observations in the use of standard methodology, systematic procedures and professional approach. A field odor investigator that has completed a comprehensive training course and practiced as an apprentice will be a qualified evaluator of ambient odors.

Excerpts of the City of Maplewood, Minnesota, Beam Avenue (Ramsey County) Compost Site Conditional Use Permit are attached to provide an example of one community's approach to setting a performance standard for odorous emissions. The City inspectors, with County and State inspectors, attended "Odor School" in June, 1994, receiving classroom and field training for field odor investigators.

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