Designation: E 884 – 82 (Reapproved 1993)

Standard Practice for Sampling Airborne Microorganisms at Municipal Solid-Waste Processing Facilities[1]

This standard is issued under the fixed designation E 884; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers sampling of airborne microorganisms at municipal solid-waste processing facilities, hereafter referred to as facilities. Investigators should consult Practice D 1357 for the general principles of conducting an air-sampling program.

1.2 This practice applies only to sampling airborne bacteria and fungi, not viruses. Since sampling airborne viruses is significantly more difficult than sampling bacteria and fungi, reliable methods of sampling viruses are not yet available.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1356 Terminology Relating to Atmospheric Sampling and Analysis[2]

D 1357 Practice for Planning the Sampling of the Ambient Atmosphere[2]

2.2 *Other Standards:*

Microbiological Methods for Monitoring the Environment, Water and Wastes[3]

Air Sampling Instruments for the Evaluation of Atmospheric Contaminants[4]

3. Definitions

3.1 *microbiological aerosol*—an airborne particle partially or exclusively composed of microorganisms including bacteria and fungi.

3.2 For definitions of other terms used in this practice, refer to Terminology D 1356.

4. Summary of Practice

4.1 Concentrations of selected airborne bacteria and fungi are determined using both liquid impinger and multi-stage impactor samplers.

4.2 Procedures are included for selecting sampling locations; determining numbers of samples, types of microorganisms to be sampled, intervals between sample collection and analysis; choosing sampling equipment; preserving samples; and reporting results.

5. Significance and Use

5.1 Bacteria and fungi present in municipal solid wastes (as well as in other forms of waste) may become airborne as dusts during waste processing. Several investigations to determine the health significance of these microbiological aerosols have been hindered by the lack of standardized procedures for sampling airborne bacteria and fungi in an industrial environment and by the absence of standards for assessing their health significance. Because it is difficult to correlate airborne levels of bacteria and fungi with epidemiological data, this standard is designed to permit the formation of a data base to aid in the assessment of the health significance of airborne microorganisms. It is intended that the use of this practice will improve sampling precision and thereby facilitate comparisons between sampling results.

6. Apparatus

6.1 Two types of samplers are used in each sampling program for microbiological aerosols at waste processing facilities **(5)**.[5]

6.1.1 *Multi-Stage Impactor*, for collection of airborne microbes on agar plates. It is recommended that an impactor be used for sampling all of the types of bacteria and fungi listed in 10.6.1.[6]

6.1.2 *All-Glass Impinger*, for collection of airborne microbes in a liquid medium. It is recommended that an impinger be used for sampling fecal coliforms and for determination of total plate count.[7]

6.2 *Air Sampling Pumps*, providing approximately 40 L per min (1.4 CFM) free-flow capacity.

6.3 Additional equipment such as carts, stands, and tool

[1] This practice is under the jurisdiction of ASTM Committee D-34 on Waste Management and is the direct responsibility of Subcommittee D34.01 on Sampling and Monitoring.

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[2] *Annual Book of ASTM Standards*, Vol 11.03.

[3] Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161. Request EPA-600/8-78-017.

[4] Available from American Conference of Governmental and Industrial Hygienists, 6500 Glenway Avenue, Building D-5, Cincinnati, Ohio 45211.

[5] The boldface numbers in the parentheses refer to the list of references at the end of the method.

[6] The six-stage and two-stage microbiological samplers manufactured by Anderson Samplers, Inc. have been found to be satisfactory.

[7] Air sampling impinger No. 7540 manufactured by Ace Glass, Inc. (AGI 30) has been found to be satisfactory.

boxes are routinely used during dust-sampling programs.

7. Reagents and Materials

7.1 *Agars for Use with the Multi-Stage Impactor*:

7.1.1 *Littman Oxgall*, for total number of fungi present and for identification of the following species of fungi: (*a*) *Aspergillus flavus* and (*b*) *A. fumigatus.*

7.1.2 *Vogel and Johnson*, selective for *Staphylococcus aureus.*

NOTE 1—A fungicide such as nystatin should be used with these agars.

7.1.3 *Levine eosin methylene blue*, specific for enterics including *Klebsiella* spp. (Note 1)

7.1.4 *Trypticase soy*, for total bacteria count. (Note 1)

7.2 *Liquid Media for Use in Impingers*:

7.2.1 *Lactose Broth with Antifoam A*, for analysis of fecal coliform and total plate count.

7.2.2 The exact amount of Antifoam A to be added should be determined prior to field sampling. Sufficient antifoam should be added to prevent loss of fluid from the impinger, but excess should be avoided.

7.3 *Media Preparation*:

7.3.1 Conduct the following according to *Microbiological Methods for Monitoring the Environment, Water and Wastes* **(14)**: (*a*) laboratory quality assurance, (*b*) selection and use of laboratory apparatus, (*c*) washing and sterilization, and (*d*) preparation of culture media.

7.3.2 Preincubate all sampling media to determine if contamination has occurred and to dry the agar surface. Excessive evaporation from the media or excessive contamination of the exterior surfaces of the petri dishes must be guarded against during this preliminary incubation.

7.3.3 Media level in the sampling container is critical to collection efficiency.

7.3.3.1 *Impactor*—The petri dishes must be of such a size that the agar surface is at the manufacturer's specified distance below each stage. The manufacturer of the Andersen impactor specifies 27 mL of agar per standard Andersen petri dish. The agar surface must be smooth and free of bubbles to ensure an even air flow.

7.3.3.2 *Impinger*—For the all glass impinger, 20 mL of broth is recommended **(17).** Autoclave impingers, and then aseptically add 20 mL of sterile broth. Mark its level on the impinger, and record any significant loss during sampling. After sampling, the volume must be reconstituted to the original or the actual volume carefully calculated because a known volume must be used for quantitative work.

8. Precautions

8.1 Due to the nature of municipal refuse, common sense dictates that some precautions should be observed when sampling dusts at municipal solid-waste processing facilities. Recommended safety practices include wearing hard hats, safety shoes, safety glasses, gloves, and respirators as well as washing hands before eating or smoking.

9. Sampling

9.1 *Location and Number of Sampling Sites*:

9.1.1 All sampling shall be carried out during normal plant operations.

9.1.2 Use not less than two sampling locations inside the facility at work sites or zones where employees are most likely to be exposed to airborne dust concentrations **(7).** (Note 2) Among these locations, those where sampling equipment can be located without interfering with facility operations shall be preferred.

NOTE 2—Examples of potential sampling locations are (*a*) on a tipping floor near or on a front end loader; (*b*) at a hand-picking station along a conveyor belt; and (*c*) along catwalks or platforms in frequent use by employees.

9.1.3 Outside the facility, locate at least one sampling site 300 m (1000 ft) upwind from the facility and at least one sampling site 100 m (330 ft) downwind from the facility. Measure the distances upwind and downwind from the same point, the point at which the emissions leave the facility or, in the case of multiple discharge points, from a central point equidistant from the discharge points.

9.1.4 Carefully measure and record the actual distances of the sampling sites from the points of emission and wind direction and velocity.

9.2 *Position of Sampling Inlet*—Locate the sampling inlet(s) 1.5 m (5 ft) above the floor level to approximate the breathing zone of a worker or other person exposed to the dusts. Locate the vacuum pumps where they will not disturb the air flow patterns around the sampling inlet(s).

9.3 *Number of Samples*:

9.3.1 Inside the facility, collect not less than 5 replicate samples at each sampling site.

9.3.2 Outside the facility, collect not less than 3 replicate samples at the upwind site(s) and not less than 5 replicate samples at the downwind site(s).

9.3.3 Wide variations in reported microbiological aerosol levels within facilities make it unlikely that the collection of five samples will yield a tight distribution of results; therefore, where economically feasible, it is recommended that the sample size be increased to more than five.

9.4 *Air Temperature*:

9.4.1 Collect samples when the air temperature at the sampling site is above 5°C (40°F).

9.4.2 At temperatures below 5°C (40°F), the sampling medium may crystallize, thus affecting recovery of microorganisms.

10. Procedure

10.1 Record air temperature and relative humidity for each location sampled.

10.2 Label all impingers to denote sampling run and location. Label all petri dishes to denote sampling run, location, and stage of impactor.

10.3 *Air-Flow Rates*:

10.3.1 Determine the air-flow rate by an in-line flow meter. Where this is not possible, calibrate air-flow rate with a gas-flow meter according to the procedure described in Ref **(16).** The recommended flow rate for the Andersen impactor is 28.3 L/min. The optimum flow rate for the all-glass impinger is 12.5 L/min.

10.3.2 Maintain a constant air-flow rate through the sampler during the sampling time. Before sampling, allow the vacuum pump to warm up for not less than 1 min. Use clamps, T-shaped