CHAPTER 4

DESCRIPTION OF THE FACILITY GENERATING SLUDGE

ESSENTIAL ELEMENTS OF A SAMPLING PLAN

- Goals of the Sampling Plan
- **Description of the Facility Generating Sludge**
- Data Objectives
- Selecting and Describing Sampling Points
- Sample Collection Procedures
- Sample Handling Procedures
- Evaluation of Completeness
- Record-Keeping and Reporting Procedures

This section of your sampling plan should provide an overview of the configuration and operation of the facility generating the sludge to be tested. The physical, chemical, and biological characteristics of solids produced by POTWs are determined by the wastewater treatment (i.e., influent wastewater characteristics, type of wastewater treatment) and sludge treatment and handling processes.

Wastewater Treatment Process

A thorough and detailed description of your entire wastewater treatment process provides important information necessary to the development of your sampling plan. A complete description of the wastewater treatment process from the headworks through disinfection will provide information pertinent to the selection of sampling points, collection of a representative sample, and interpretation of analytical results. The description of your wastewater treatment process should include the following items:

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General Description: Identify the type of treatment at your facility and the permitted design capacity (in million gallons per day – mgd) of the facility. For example, is the facility an aerated lagoon, rotating biological contactor (RBC), or conventional activated sludge facility? A flow diagram or schematic is a useful way to provide a general description of the facility and its treatment processes. The flow diagram or schematic should also identify the sample collection sites.

Industrial Pretreatment: Although industrial pretreatment is not a unit process at a POTW, it is a function of wastewater treatment that can have a profound effect on sludge quality. Effective industrial pretreatment is one of the foremost reasons why land application of biosolids has become a sustainable recycling practice. Since industrial pretreatment keeps many pollutants out of wastewater, effective pretreatment reduces the pollutant loading in sludge. Your facility description should include an overview of the industrial pretreatment program or sewer use ordinance including local limits, inspection schedules, and types and number of industries discharging to the collection system.

Screening/Comminution: Describe the location, sequence, and type of screens, racks, or grinders that your facility may employ in the treatment process.

Grit Removal: Describe the type of grit removal mechanism used at your facility and how the grit is disposed. For example, is the grit removed in an aerated grit chamber or by a horizontal-flow grit chamber?

Flow Equalization: Provide information on whether your wastewater treatment facility uses flow equalization to maintain a constant hydraulic or biochemical oxygen demand (BOD) loading rate. If flow equalization is used, this section should describe whether the equalization basins are in-line or off-line and what type of aeration or mixing is used in the basins (if any).

Other Pretreatment Operations: Indicate whether your facility employs other pretreatment operations prior to primary settling. These operations generally involve skimming, flocculation, or preaeration. Skimming tanks are designed to remove solids with a density less than water (i.e., floating material). Facilities that receive a high grease load might have a skimmer. Flocculation is used to increase settling in primary or secondary settling tanks or to condition certain industrial wastes. Numerous objectives are given for preaeration prior to primary settling. Generally, these objectives involve improved treatability of wastewater in subsequent processes. Regardless of the objectives, many of these pretreatment operations can have an impact on sludge quantities and generation rates.

Primary Sedimentation: It is important to note whether your facility has primary settling tanks and, if so, to describe their configuration and operation. Many smaller facilities, such as extended aeration plants and aerated lagoons, do not have primary settling. Consequently, such facilities will not have sludge from primary sedimentation, also known as primary sludge. The presence (or lack of) primary sludge will significantly affect the odor properties of resulting biosolids. Other facilities may have flotation or screening for removal of solids. Imhoff tanks and septic tanks are used by some smaller facilities. A significant consideration to address in your facility description is whether the digestion or degradation of solids or BOD is taking place during the sedimentation process or during the handling of primary sludge after settling.

Biological Treatment: Most modern wastewater treatment plants include at least secondary treatment, which involves the use of a biological reactor for the degradation of BOD and suspended solids. This section should include information that describes the process for biological treatment. For example, describe whether biological treatment is based on fixed-bed media or a complete-mix system. If it is a fixed media, state whether the reactor is a trickling filter or RBC. If the system is complete-mix, state whether it is an extended air system, oxidation ditch, or lagoon. If the system is a lagoon, state whether it is it aerated or facultative. For activated sludge facilities, describe how the reactor operates—plug flow, continuous flow, stepped aeration, or contact stabilization. All of these factors can have an impact on sludge quality and generation rates.

Secondary Sedimentation: Secondary sedimentation or settling is an integral part of the activated sludge process. Secondary clarifiers are designed to separate activated sludge from mixed liquor. Flocculating solids in the aeration basin promotes settling and consequently the removal of suspended solids and BOD. The settled biological solids can be recycled into the reactor or wasted and sent to the sludge treatment process. How and when solids are recycled and/or wasted can affect sludge quality and generation rates.

Advanced Treatment: Increasingly, POTWs are faced with upgrading their facilities to include advanced wastewater treatment in order to reduce nutrient loading to receiving waters. Generally, advanced treatment is designed to address lower effluent discharge permit limits for nitrogen or phosphorus. In addition, any chemicals added for nutrient removal (e.g., alum) should be described. Metals removal may also be a treatment goal. It is particularly important that you describe the advanced treatment processes used at your facility to increase the volume of solids generated.

Disinfection and Miscellaneous Treatment Processes: After final clarification, the wastewater treatment process generally culminates with a disinfection step prior to discharge to the receiving water. The method of disinfection does not significantly impact sludge quality or characteristics, but it should be noted to complete the facility description. The facility description should also discuss any processes that are not necessarily common to all plants. For example, odor controls may be extensive at some treatment works but nonexistent at others. Treatment plants may have very different needs in terms of the types of unit operations that are used to control odors. Additionally, the choice of odor control technology may vary among facilities. Odor treatment utilizing chemical oxidation of the wastewater can have an influence on sludge chemistry. Therefore it is critical that all treatment processes are described, at least briefly, so they can be evaluated for potential impacts on sludge quality or characteristics.

Sludge Treatment and Handling Process

While wastewater treatment operations certainly can have an effect on solids properties, the processes involving direct manipulation of wastewater sludge have the greatest potential to impact quality. A thorough description of the sludge treatment and handling process is a critical step in preparing your sludge sampling plan. The following considerations should be included in your description of sludge treatment and handling processes:

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Solids Sources: Depending on the type of facility, solids can be contributed from any of several unit operations within the POTW. The types of sludge and the proportion of each in the final mixture have a significant impact on sludge quality and odor properties. For example, primary sludge is highly putresible. Primary sludge or a sludge that has a high percentage of sludge from primary settling or clarification has a greater potential to cause malodor than a digested sludge. Also, sludge that results from advanced treatment for nutrient removal can have greater nitrogen or phosphorus content and an associated higher value as a fertilizer or soil conditioner. All solids sources and their relative proportions within the sludge treatment and handling process must be described in detail.

Preliminary Operations: In general, preliminary operations include pumping, blending, storage, and in some cases thickening of solids prior to dewatering or other processes. Also, as more facilities are required to have advanced treatment, sludge blending becomes important (relative to the production of a consistent material for dewatering and/or land application). In addition, some facilities find it necessary to employ sludge grinding or degritting prior to subsequent processes, based on the configuration of the facility or the characteristics of the wastewater. Most POTWs, with the exception of lagoon systems, have the ability to store sludge prior to dewatering operations or disposal. The conditions under which sludge is stored can impact both its dewatering capability and its chemical quality as a soil conditioner. For example, some facilities aerate stored sludge, while others employ gravity thickeners that double as storage tanks. In some cases, thickeners (e.g., flotation thickeners) are used prior to storage and dewatering. All preliminary sludge operations must be described in detail.

Pathogen Reduction/Vector Attraction Reduction (PR/VAR): Other than the character of the wastewater being treated, the treatment processes used for PR/VAR are probably the single biggest factor influencing sludge quality, and must be described in detail. The federal Part 503 regulations establish the requirements for PR/VAR prior to the use or disposal of sewage sludge. During the development and implementation of the Part 503 regulations, EPA published a variety of guidance documents describing the operation standards and tests necessary to achieve Class A or Class B pathogen-reduction status. Pathogen reduction and vector attraction reduction methods and options are listed in Appendix C.

The following documents discuss treatment processes that are acceptable for PR/VAR:

- "Standards for the Use or Disposal of Sewage Sludge; Final Rules," *Federal Register,* Friday, February 19, 1993.
- *Part 503 Implementation Guidance,* EPA 833-R-95-001, October 1995, US EPA, Office of Water.
- *Control of Pathogens and Vector Attraction in Sewage Sludge,* EPA/625/R-92/013, July 2003, US EPA, Office of Research and Development.
- *A Plain English Guide to the EPA Part 503 Biosolids Rule.* EPA/832/R-93/003, September 1994, US EPA, Office of Wastewater Management.

These documents describe acceptable treatment processes and specify the testing, documentation, and record-keeping necessary to demonstrate proper PR/VAR. Citing the pathogen reduction alternative and vector attraction reduction option (along with specific treatment objectives of these requirements) employed at your facility will adequately identify the sludge treatment process. Pathogen and vector attraction reduction alternatives and options are listed in Appendix C.

Dewatering: There are a variety of methods for reducing the water content of sludge. Dewatering is typically accomplished via filter presses, centrifugation, or drying beds or lagoons. Heat-drying dewaters sludge and can also be used to meet pathogen and vector attraction reduction requirements, if the appropriate operational standards are achieved. As would be expected, the method of dewatering has a strong impact on the physical properties of sludge. Also, there is increasing evidence that the chemicals used to condition sludge and improve dewatering can have a significant influence on sludge chemistry and even odor potential. The dewatering methods (including chemical additions) must be described in detail.

Disposal or Recycling Option: The handling and storage of treated sludge after PR/VAR can have an impact on sludge quality and odor properties, particularly for undigested materials; therefore, the methods of disposal and/or recycling must be described in detail. For example, some heat-dried biosolids can become malodorous after being rewetted, and lime-stabilized biosolids can cause odor problems if stored long enough for the pH to drop (allowing microbial activity to resume). For compost curing, federal regulations require testing after prolonged storage. If land application is your final solids management option, this section should also include details on how sludge is handled prior to land application. For instance, if the material is stored or stockpiled prior to land application, you need to describe how long, where, and under what conditions the material is stored.

CHAPTER 4 REFERENCES

POTW Sludge Sampling and Analysis Guidance Document. Permits Division, Office of Water, Washington, DC 20460. August 1989.

Sampling Manual for Pollutant Limits, Pathogen and Vector Attraction Reductions in Sewage Sludge, 3620-BK-DEP2214, Rev. 12/2000. Pennsylvania Department of Environmental Protection, Bureau of Water Quality Protection, Division of Wastewater Management. December 2000.

Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge. US EPA, Office of Research and Development, EPA/625/R-92/013. Revised July 2003.

Examination of Mechanisms for Odor Compound Generation During Lime Stabilization, Kim et al. Water Environment Research, Vol. 75, No. 2, 121-125pp.

Guide to Field Storage of Biosolids. US EPA, Office of Wastewater Management, EPA/832-B-00-007, July 2000.

Wastewater Engineering; Treatment, Disposal, and Reuse. Metcalf & Eddy, Inc. Third Edition. 1991.

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