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RESIDENTIAL, SEMI-PUBLIC AND COMMERCIAL

EFFLUENT SAMPLING TECHNIQUES

At different times and for various reasons, it may be desirable to sample effluent from a wastewater treatment system. In order to be accurate, especially to determine system performance, any wastewater sampling must follow specific procedures and guidelines. Detailed sampling parameters and procedures are described in STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, published by American Public Health Association, American Water Works Association and Water Environment Federation. The CODE OF FEDERAL REGULATIONS, TITLE 40, PROTECTION OF ENVIRONMENT, published by the Office of the Federal Register, outlines how samples must be analyzed and evaluated to be considered valid by regulatory agencies. WASTEWATER SAMPLING FOR PROCESS AND QUALITY CONTROL, MANUAL OF PRACTICE NO. OM-1, published by the Water Environment Federation, provides specific instructions on sampling techniques and the conclusions that can be drawn. In order to properly sample water or wastewater flows and draw accurate conclusions, all of these procedures must be strictly followed.

Wastewater sampling is generally performed by one of two methods, grab sampling or composite sampling. Grab sampling is just what it sounds like; all of the test material is collected at one time. As such, a grab sample reflects performance only at the point in time that the sample was collected, and then only if the sample was properly collected. Composite sampling consists of a collection of numerous individual discrete samples taken at regular intervals over a period of time, usually 24 hours. The material being sampled is collected in a common container over the sampling period. The analysis of this material, collected over a period of time, will therefore represent the average performance of a wastewater treatment system during the collection period.

Numerous industry references list various parameters for wastewater testing and whether samples should be collected using grab sampling or composite sampling methods. For example, grab sampling allows the analysis of specific types of unstable parameters such as pH, dissolved oxygen, chlorine residual and temperature. However, the most widely used indicators of treatment system performance, including $CBOD_5$ (five day carbonaceous biochemical oxygen demand), TSS (total suspended solids) and TN (total nitrogen) require the use of composite sampling techniques. STANDARD METHODS (20th Edition, Section 1060 § B, "Collection and Sampling") states "*A sample can represent only the composition of its source at the time and place of collection."* Grab samples may be used to represent "*some well-mixed surface waters, but rarely, wastewater streams"* for water quality evaluation. The widely varying flow patterns of residential treatment systems make it impossible to evaluate performance by analyzing a single grab sample of effluent. Residential treatment systems receive a frequent number of short hydraulic surges throughout the day followed by intermittent periods of no flow whatsoever. Routine variations in the volume and strength characteristics of incoming wastewater create fluctuations in the quality of treatment system effluent.

The CODE OF FEDERAL REGULATIONS (Title 40, Chapter 1, § 133.102) stipulates that treatment system performance must be evaluated by tabulating 30 day averages of system effluent. By definition, a single, or even a series of grab samples can never be used to evaluate the long-term performance of any wastewater treatment system.

While the limitations of determining system performance by grab sampling are apparent, the use of grab samples for the evaluation of a residential treatment unit is further compromised if the sample is collected from a location where the effluent does not have sufficient velocity to keep the effluent solids in suspension. WASTEWATER SAMPLING FOR PROCESS AND QUALITY CONTROL (Manual of Practice No. OM-1, § "Representative Sampling") directs that samples be collected *"at points where the sample stream or tank is well mixed."* The manual goes on to say *"avoid taking samples at points where solids settling occurs or floating debris is present. These situations occur normally in quiescent areas, where the velocity of the flow has decreased."* For this reason, system performance can never be evaluated by a sample of effluent taken from a pump chamber, distribution box, sump, roadside ditch or any device that contains effluent below the flow line.

The intermittent flow pattern of a residence intensifies this problem by allowing solids to settle out within a sump during low flow periods. Even the few solids present in high quality effluent will settle out when retained within a sump. If only a very few solids settle within a sump during a low flow period today, they remain and accumulate with additional solids settling out over successive days. Any sample from a sump will contain effluent suspended solids combined with days, weeks, months or years worth of accumulated solids. A sample of liquid from such a sump cannot be analyzed for system performance, as it is scientifically impossible to determine what portion of the solids were suspended in the effluent and what portion of the solids had accumulated in the sump over a period of time.

EFFLUENT SAMPLING TECHNIQUES (Cont.)

Using any sample drawn from a sump to evaluate the performance of a residential wastewater treatment system is simply inappropriate. Samples must be taken from a location where the effluent is free-flowing and has sufficient velocity to keep the effluent solids in suspension.

Composite samples of effluent, collected, stored, analyzed, tabulated and averaged over an extended period of time provide the only verifiable indication of treatment system performance. Collecting and analyzing these composite samples is often an expensive and time-consuming process. For these reasons, most regulatory organizations recognize independent third-party certifiers, who use composite sampling methods to conduct performance evaluation and accurately measure system performance in a standardized, reproducible setting. Attempting to evaluate a residential treatment system in the field by analyzing a grab sample taken from a sump or any other containment vessel provides a compound degree of error and will yield erroneous conclusions about system performance.

GUIDELINES FOR SAMPLE COLLECTION, STORAGE AND ANALYSIS

EFFLUENT PARAMETER	MINIMUM SAMPLE SIZE	SAMPLE TYPE	PRESERVATION REQUIRED	MAXIMUM HOLDING TIME
Carbonaceous 5 Day Biochemical Oxygen Demand ($CBOD_5$)	1,000 mL	Composite	Refrigerate, 4°C	6 hrs./48 hrs.
Total Suspended Solids (TSS)	200 mL	Composite	Refrigerate, 4°C	7 days
pH	50 mL	Grab	Analyze immediately	0.25 hrs.
Dissolved Oxygen	300 mL	Grab	Analyze immediately	0.25 hrs.
Temperature	N/A	Grab	Analyze immediately	0.25 hrs.
Total Residual Chlorine	500 mL	Grab	Analyze immediately	0.25 hrs.
Ammonia Nitrogen	500 mL	Composite	Analyze as soon as possible or add H_2SO_4 to pH <2, refrigerate	7 days/28 days
Nitrate Nitrogen	100 mL	Composite	Analyze as soon as possible, refrigerate	48 hrs. (28 days for chlorinated samples)
Total Kjeldahl Nitrogen (TKN)	500 mL	Composite	Add H_2SO_4 to pH <2, refrigerate	7 days/28 days
Oil & Grease	1,000 mL	Grab	Add H_2SO_4 to pH <2, refrigerate	28 days
Total Phosphorus	100 mL	Composite	Add H_2SO_4 to pH <2, refrigerate	28 days
Fecal Coliform	N/A	Grab	Add 0.008% $Na_2S_2O_3$, cool to 4°C. All collection utensils and techniques must be sterile	6 hrs.

These guidelines provide an overview of the considerations and steps required to properly sample and analyze wastewater treatment system effluent. Refer to the Norweco Technical Bulletin EFFLUENT SAMPLING FOR RESIDENTIAL TREATMENT SYSTEMS for complete, detailed instructions on effluent sampling and analysis of residential treatment units.

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