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Water quality — Sampling —

Part 10:
Guidance on sampling of waste waters

Qualité de l'eau — Échantillonnage —

Partie 10: Guide pour l'échantillonnage des eaux résiduaires

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5667-10 was prepared by Technical Committee ISO/TC 147, *Water quality*, Sub-Committee SC 6, *Sampling (general methods)*.

ISO 5667 consists of the following parts, under the general title *Water quality — Sampling*:

— *Part 1: Guidance on the design of sampling programmes*

— *Part 2: Guidance on sampling techniques*

— *Part 3: Guidance on the preservation and handling of samples*

— *Part 4: Guidance on sampling from lakes, natural and man-made*

— *Part 5: Guidance on sampling of drinking water and water used for food and beverage processing*

— *Part 6: Guidance on sampling of rivers and streams*

— *Part 7: Guidance on sampling of water and steam in boiler plants*

— *Part 8: Guidance on the sampling of wet deposition*

— *Part 9: Guidance on sampling from marine waters*

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— *Part 10: Guidance on sampling of waste waters*

— *Part 11: Guidance on sampling of groundwaters*

— *Part 12: Guidance on sampling of sediments*

Annex A forms an integral part of this part of ISO 5667.

Introduction

This part of ISO 5667 is one of a group of standards dealing with the sampling of specific types of water. It should be read in conjunction with ISO 5667-1, ISO 5667-2 and ISO 5667-3.

The general terminology used is in accordance with the various parts of ISO 6107, particularly ISO 6107-2.

Water quality — Sampling —

Part 10:
Guidance on sampling of waste waters

1 Scope

This part of ISO 5667 contains details on the sampling of domestic and industrial waste water, i.e. the design of sampling programmes and techniques for the collection of samples. It covers waste water in all its forms, i.e. industrial waste water, and crude and treated domestic waste water.

Sampling of accidental spillages is not included, although the methods described in certain cases may also be applicable to spillages.

1.1 Objectives

A sampling programme may be based on many different objectives. Some of the more common objectives are:

— to determine the concentration of pollutants in a waste-water stream;

— to determine the load of pollutants carried by a waste-water stream;

— to provide data for the operation of a waste-water treatment plant;

— to test whether given discharge concentration limits are kept;

— to test whether given discharge load limits are kept;

— to provide data for the levy upon discharge of waste water.

When designing a waste-water sampling programme, it is essential for the objective of the study to be kept in mind, so that the information gained from the study corresponds closely to the information required.

Generally, the objectives of sampling are quality control or quality characterization, as described in 1.1.1 and 1.1.2.

1.1.1 Quality characterization

Quality characterization aims at determining the concentration or load of pollutants in a waste-water stream, generally during an extended period of time, for example, to monitor compliance with a standard, to determine trends, to provide data on unit process efficiency or to provide loading data for planning and/or design purposes.

1.1.2 Quality control

The objective of quality control may be one of the following:

a) to provide data for either short-term or long-term control of waste-water treatment plant operation (e.g. control of biomass growth in activated sludge units, control of anaerobic digestion processes, control of industrial effluent treatment plants);

b) to provide data for waste-water treatment plant protection (e.g. to provide domestic waste-water plants with protection against deleterious effects from industrial effluents, to identify the sources of undesirable industrial effluent residues);

c) to provide data for pollution control (e.g. controlling disposal operations to land, sea or water courses).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 5667. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 5667 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 2854:1976, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances.*

ISO 5667-1:1980, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes.*

ISO 5667-2:1991, *Water quality — Sampling — Part 2: Guidance on sampling techniques.*

ISO 5667-3:1985, *Water quality — Sampling — Part 3: Guidance on the preservation and handling of samples.*

ISO 5667-5:1991, *Water quality — Sampling — Part 5: Guidance on sampling of drinking water and water used for food and beverage processing.*

ISO 6107-2:1989, *Water quality — Vocabulary — Part 2.*

3 Definitions

For the purposes of this part of ISO 5667, the following definitions, taken from ISO 6107-2, apply.

3.1 composite sample: Two or more samples or sub-samples, mixed together in appropriate known proportions (either discretely or continuously), from which the average result of a desired characteristic may be obtained. The proportions are usually based on time or flow measurements.

3.2 sampling line: The conduit which leads from the sampling probe to the sample delivery point or the analysing equipment.

3.3 sampling point: The precise position within a sampling location from which samples are taken.

3.4 spot sample: A discrete sample taken randomly (with regard to time and/or location) from a body of water.

4 Sampling equipment

4.1 Sample containers

The laboratory responsible for analysing the samples should be consulted on the type of container that should be used for sample collection, storage and transportation.

ISO 5667-2 and ISO 5667-3 contain detailed information on the selection of sample containers.

The sample container needs to prevent losses due to adsorption, volatilization and contamination by foreign substances.

Desirable factors to be considered when selecting sample containers are

— high resistance to breakage;

— good sealing efficiency;

— ease of reopening;

— good resistance to temperature extremes;

— practicable size, shape and mass;

— good potential for cleaning and re-use;

— availability and cost.

For waste-water sampling, plastics containers are recommended for most determinands. Some exceptions exist where only glass containers should be used, when for example the following analyses are to be made:

— oil and grease;

— hydrocarbons;

— detergents;

— pesticides.

If sterilized or disinfected sewage samples are to be collected, sterile containers and sampling apparatus should be used (e.g. see ISO 5667-5).

4.2 Type of apparatus

4.2.1 Manual sampling equipment

The simplest equipment used for taking effluent samples consists of a bucket, ladle, or wide-mouthed bottle that may be mounted on a handle of a suitable length. The volume should not be less than 100 ml. When manual samples are to be used for the preparation of composite samples, the volume of the bucket, ladle or bottle should be well defined and known to a precision of within ± 5 %. Manual samples can also be taken with a Ruttner or Kemmerer sampler, consisting of a 1 litre to 3 litre volume tube with a hinged lid at each end of the tube, or other samplers operating on a similar principle.

Manual sampling equipment should be made of an inert material that does not influence the analyses that will be carried out on the samples later (see ISO 5667-2).

Before starting sampling, the equipment should be cleaned with detergent and water, or as directed by the equipment manufacturer, and finally rinsed with water. The sampling equipment may be washed before use in the waste-water stream from which the sample is taken in order to minimize the risk of contamination. Special attention should be paid to rinsing after cleaning, if the analytes under study are detergents. The sampling equipment cannot be washed in the waste stream when this will influence the analysis carried out later (e.g. analysis for oil and grease, and microbiological analysis).

4.2.2 Automatic sampling equipment

A number of commercially available devices allow a continuous sample or a series of samples to be collected automatically. They are often easily portable and may be used for any type of waste water. Two types of automatic samplers are primarily available, namely time-proportional and flow-proportional (see ISO 5667-2), but some of the samplers have both possibilities built in. The sampler can be based on the following principles of sample collection:

— a chain pump (paternoster pump);

— compressed air and/or vacuum;

— continuous stream of the effluent;

— pumping (often by means of a peristaltic pump).

No single principle can be recommended as being suitable for all sampling situations. When selecting sampling equipment, the following features should be taken into consideration, and the user should determine the relative importance of each feature when establishing the requirements for a specific sampling application.

a) The sampler should be able to take time-weighted composite samples, for example, sampling over different time intervals of flow activity for constant flow rates.

b) The sampler should be able to take a series of discrete samples taken at fixed intervals, held in individual containers. For example, when carrying out diurnal studies to identify periods of peak load.

c) The sampler should be able to take a succession of short period composite samples being held in individual containers. This can also be useful in monitoring specific periods known to be of interest.

d) The sampler should be able to take flow-weighted composite samples, i.e. taking variable volumes of sample depending on stream flow for a fixed period of time. This facility can be useful when carrying out substrate load studies.

e) The sampler should be able to take a succession of flow-weighted samples, each being held in individual containers. This can be useful when trying to identify periods of variable substrate loading, when data need to be correlated with variable flow rates.

The features listed in items a) to e) refer to the types of sample to be collected according to 5.3.1. Additionally, the user should also aim for the following attributes when choosing sampling equipment, unless the circumstances dictate that certain of them may not be necessary, in particular the ability to take samples from a pressurized main or sewer.

f) The ability of the sampler to lift samples through the required height for any chosen situation.

g) Rugged construction and minimum of functional components.

h) Minimum number of parts exposed or submerged in the water.

i) The sampler should be corrosion resistant and electrical parts should be protected against the action of ice, damp or a corrosive atmosphere.

j) The sampler should be of simple design and easy to maintain, operate and clean.

k) The sampling line from intake point to sample delivery point should have a minimum internal diameter of 9 mm to minimize clogging, and the intake should be protected in order to prevent clogging of the uptake line.

l) The intake liquid velocity should be a minimum of 0,5 m/s, in order to prevent phase separation in the sampling line and measuring chamber.

m) The ability to purge sampling lines to receive fresh sample.

n) The precision and accuracy of delivered volumes should be at least 5 % of the intended volume.

o) The time interval between discrete samples should be adjustable from 5 min to 1 h.

p) Sample containers and tube joints should be such that they can be easily detached, cleaned and replaced in the sampling apparatus.

q) It may be necessary for the sampler to provide integral compartments for storage of sample containers in the dark at 0 °C to 4 °C during the whole sampling period, and allow the addition of chemical preservatives to sample containers before or during the sampling period.

r) Portable samplers should be lightweight, capable of being protected against tampering and vandalism, be resistant to inclement weather, and be able to operate under a wide range of ambient conditions.

s) Samplers should be capable of operating during sufficiently long sampling periods without attention (several days).

t) Samplers should be intrinsically spark-free in order to lower the risk of explosion, particularly in areas where methane or volatile organic solvents may be encountered.

u) It may be necessary for the sampler to operate while sampling from pressurized mains, and this factor should be considered before making a final choice of machine type.

When selecting sampling equipment, the user should also bear in mind that the operation manual should be easy to read, and in a language that is understood by and appropriate for the operator. The availability of after-sales service and spare parts should also be considered. Finally, it is imperative that the equipment requirements for the supply of electricity or compressed air correspond to the availability of services at the location where the equipment is to be used.

SAFETY PRECAUTIONS — Local requirements for safety should be observed at all times.

5 Sampling procedure

5.1 Sampling location

SAFETY PRECAUTIONS — In all cases when selecting sampling locations, safety and health aspects should be observed. (See clause 6.)

5.1.1 General description

This part of ISO 5667 discusses sampling techniques that can be carried out in several types of sampling locations, for example:

a) inside industrial plants (e.g. between untreated waste streams);

b) discharge points from industrial plants (combined untreated waste);

c) in urban sewerage systems, including pressurized mains and gravity systems;

d) inside waste-water treatment plants;

e) outlets from waste-water treatment plants.

In all cases, it is essential that a location is selected which is representative of the waste stream to be examined.

For the selection of sewer sampling locations, a study of the sewer system should be carried out initially. By studying drawings of the sewer system, possible locations can be identified. Subsequently, a site inspection, including the use of chemical tracer studies, as necessary, should be conducted in order to ensure that the locations of the sewers and the path of the waste stream correspond to the drawings, and to make sure that the selected location is representative for the sampling purpose.

Reference should be made to ISO 5667-1 for guidance on the planning of sampling programmes.

5.1.2 Sampling from sewers, channels and manholes

Before sampling, the chosen sampling location should be cleaned in order to remove scale, sludge, bacterial film, etc. from the walls.

A location should be chosen where the effluent has a high turbulent flow, to ensure good mixing. Often accessibility, lack of site security, or power unavailability may preclude the use of the best sites.

Since effluent channels are generally designed to cope with both effluent and storm-water discharge conditions, and/or for higher flows than those actually occurring, laminar flow may often occur. In the absence of a location with turbulent flow conditions, such conditions should be induced by restricting the flow, for example with a baffle or weir. The restriction should be made in such a way that sedimentation upstream of the restriction does not occur. The sampling intake point should always be located downstream from the restriction and, as a general rule, it should be located at least 3 times the pipe diameter downstream of the restriction. The inlet of the sampling probe should preferably face the direction of flow, but may face downstream if too many blockages result [also see 4.2.2 l)].

NOTE 1 If mixing is good just upstream of the obstacle, then the intake can be located there, taking care that sediment is not sampled and ensuring that the intake remains below liquid level.

Whenever practicable, permanent sampling locations should be established, care being taken to ensure reproducible sampling conditions.

Before proceeding with the sampling of industrial discharges, the conditions inside the plant (e.g. processes and production rates) should be noted and recorded along with any potential hazards, for example excessively wet floors.

As a general rule, the sampling point should be one-third of the effluent water depth below the surface of the water.

5.1.3 Waste-water treatment plants

When choosing sampling locations for waste-water treatment plants, it is again important to refer to the objective of the data collection programme, of which the sampling is a part.

Typical objectives are

— control of the performance of the entire treatment plant: samples should be collected at the main inlet and main outlet points;

— control of the operation of individual processing units, or groups of units: samples should be collected at the inlet and outlet of the units in question.

When sampling at the inlets of plants, the objective of the sampling programme should be carefully considered. In some situations, there may be a need to sample crude sewage in the mixture with recirculated processing liquid (e.g. in the assessment of primary sedimentation tank loadings and efficiency). In other cases, it may be necessary to exclude the effect of these liquids (e.g. when collecting data designed to assess domestic/industrial loadings to a plant or to assist in industrial effluent control).

Representative sampling is often facilitated by using locations downstream of a measuring flume or weir (see 5.1.2).

When sampling effluents from processes employing more than one individual treatment unit (e.g. several sedimentation tanks), care should be exercised in ensuring that the sample is representative of the overall effluent stream rather than any one specific treatment unit (unless that unit forms the basis of a specific study).

Frequent reviews of a plant's sampling locations need to be made, to ensure that any relevant changes in the operation of unit processes are taken into account when sampling. For example, the percolating filter operation may be changed from a "single-pass" operation to a "recirculation" or "alternating-double-filtration" operation: treatment plant operation may involve changes in the manner in which feed or return liquors are introduced to the plant (e.g. return of sewage from storm tanks, changes in the position at which processing liquors are returned to the treatment plant).

Whenever sampling waste waters, great care should be exercised to overcome or minimize the substantial heterogeneity caused by suspended solids that are often present. Similarly, thermal stratification of separate industrial effluent streams may be found when sampling effluents or discharges from industrial processes, and measures have to be taken to promote the mixing of such streams before sampling.

5.1.4 Qualitative sampling

It may be necessary to sample the surface by skimming, in order that qualitative information about emulsified and floating material can be obtained. Wide mouth jars are suitable containers, but guidance should be sought from the receiving laboratory.

5.2 Frequency and timing of sampling

5.2.1 General aspects

This subclause deals with the frequency of sampling, i.e. the number of samples to be taken, the duration of the sampling period, and the time at which sampling should take place.

5.2.2 Number of samples

Section three of ISO 5667-1:1980 gives general guidelines on the time and frequency of sampling. This subclause contains more specific guidelines for the sampling of waste water.

The concentration of the various determinands in an effluent stream will vary due to random and systematic changes. The best technical solution, to determine the true values, would be to use an on-line automatic instrument providing continuous analyses of the determinand of interest. However, this approach is rarely applicable, because suitable instrumentation for the determinands of interest is inappropriate for field application, unavailable or too expensive.

For this reason, water analyses should be based on samples taken at regular intervals during a certain period (i.e. the control period). The samples should be composite samples, unless the determinations to be carried out prohibit the use of a composite sample. The choice of the necessary number of samples taken during each control period should be decided on the basis of statistical techniques (see ISO 2602, ISO 2854 and ISO 5667-1).

5.2.3 Sampling time

The objective of a sampling programme often dictates when and how a sample is collected.

Generally, when sampling sewages and effluents, it is normal to make allowance for the following sources of variation in quality:

a) diurnal variations (i.e. within-day variability);

b) variations between days of the week;

c) variations between weeks;