

Guidelines for quality management in aerobic and anaerobic biowaste processes

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Executive Summary

This document provides a framework for quality management in biowaste treatment processes, both aerobic composting and anaerobic digestion. It outlines key guidelines and protocols to ensure high-quality end-products such as compost and digestate. The primary focus areas include biowaste processing, sampling, and end-product evaluation.

This document presents strategies for managing biowaste through aerobic composting and anaerobic digestion to produce high-quality compost and digestate. These processes transform organic waste into sustainable, nutrient-rich products while meeting regulatory standards and minimizing environmental impacts. Biowaste processing involves inspections to remove contaminants, pre-treatment to enhance microbial activity, and controlled digestion or composting to ensure pathogen-free, mature outputs. Sampling ensures product quality and compliance, with proper handling and preservation safeguarding sample integrity. Testing assesses nutrients, pH, and safety, while strict hygiene protocols prevent contamination. These guidelines support sustainable biowaste management and the production of environmentally friendly end-products.

The guidelines aim to streamline quality assurance in biowaste management, referencing established standards like CEN/TR 15310, EN 14899, and the EU Fertilizing Products Regulation. They target the production of hygienic, mature, and nutrient-rich end-products with minimal environmental impact. LL-leaders are requested to test the guidelines provided in SPG7 until M28. Continuous feedback will be used to refine the guidelines, aiming to optimize the quality, safety, and quantity of the final product.

1 Objectives and scope

The Biowaste QA/QC protocols give guidance to manage the quality of the biowaste through the collection and processing and end-product. The guidance is based on standards CEN/TR 15310 (2006), EN 14899, Bundesgütegemeinschaft Kompost (BGK) guidelines, Compost quality Indicators (SOILCOM report number 5.1.), and Quality management of digestate from biogas plants used as fertiliser, IEA Bioenergy, 2012. The Biowaste QA/QC protocol is applied to household biowaste materials, in fermentation/biogas process and for the compost or soil improver as end product. The target is to produce high quality end-products causing very little harm to the environment.

2 Biowaste process

The goal of industrial composting is to produce hygienic, mature compost suitable for use as a fertilizing product while preventing odor issues during the post-ripening stage. Post-ripening is the final phase of composting, during which the temperature decreases, and the compost stabilizes and matures into an odor-free, safe fertilizer or soil improver. Its purpose is to ensure product quality, hygiene, and the prevention of odor issues. Composting can occur in entirely closed systems to eliminate unpleasant smells. These systems ensure controlled conditions, preventing odor release, and maintaining environmental quality. (1, 3)

Anaerobic digestion is a vital process in biowaste treatment plants, converting organic waste into biogas and digestate (Fig. 1). The efficiency and output depend on key quality factors such as feedstock management, pre-treatment techniques, process parameter control, and proper post-treatment. By optimizing these factors, biogas yields can be increased, contamination reduced, and nutrient-rich digestate produced, enhancing overall system performance. (2)

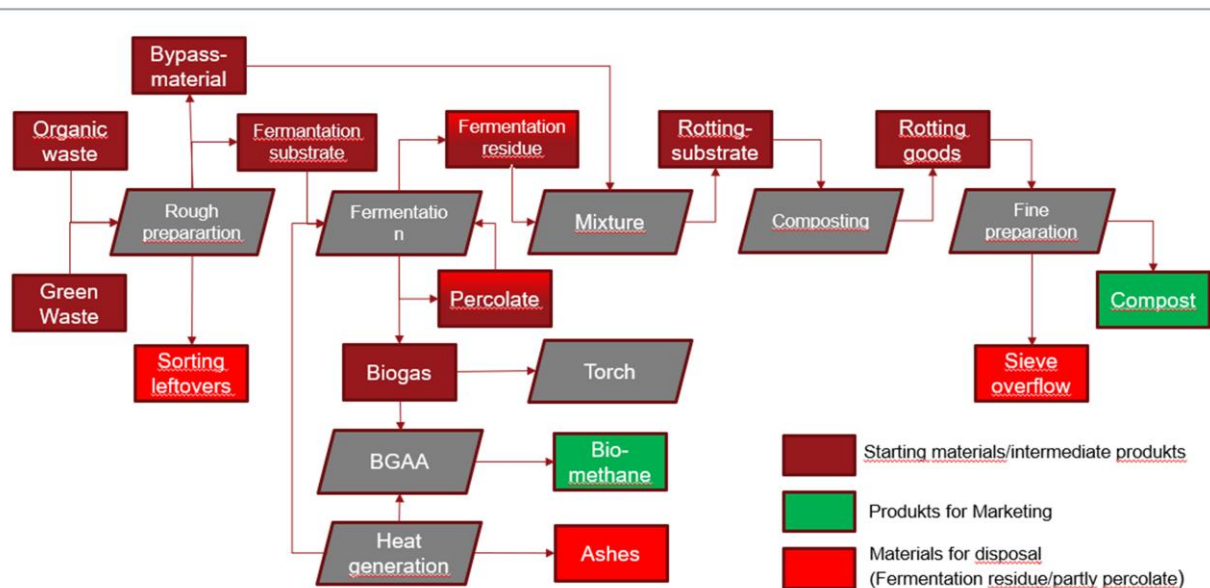


Figure 1. Project material flow management in BKW Bützberg, Germany

2.1 Reception of biowaste

At the reception of bio-waste, a first visual inspection is carried out, based on whether the bio-waste can be received, rejected, or transferred for further processing (Fig. 2). The reception includes defining the type of waste, weighing, unloading, inspection, quality assessment, determining the amount and documenting the data. In practice, the inspection is carried out systematically according to predefined checklists, and the findings are recorded in the plant's digital tracking system or logbook. All accepted, rejected, or conditionally accepted loads must be traceable, which requires documenting not only the inspection outcome but also the inspector's name, signature, and any corrective actions taken. This ensures transparency, regulatory compliance, and provides an auditable record for quality assurance. (3)

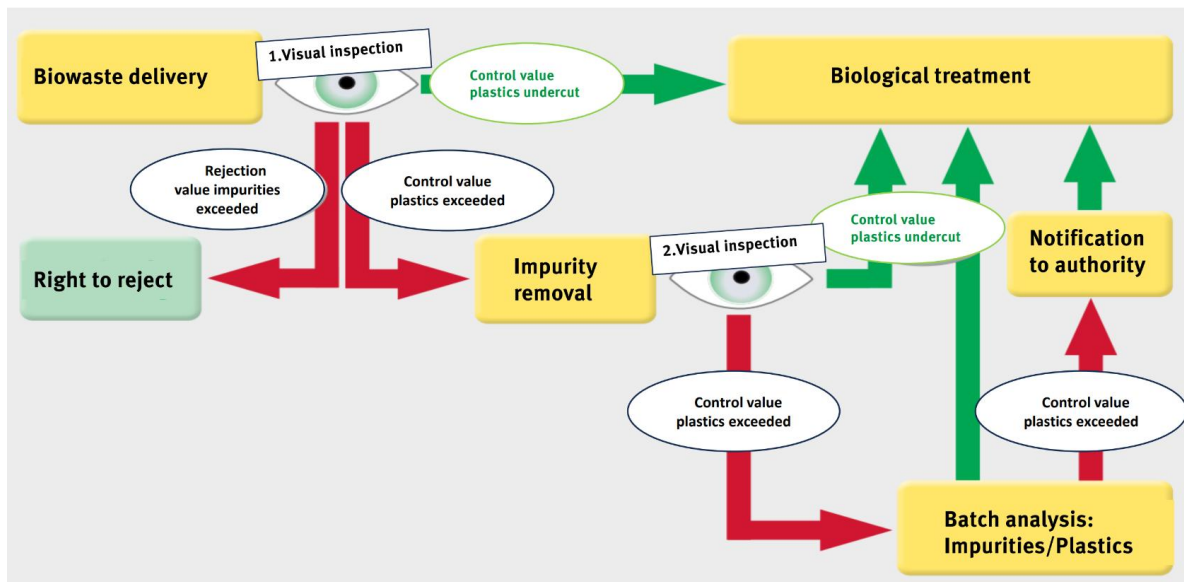


Figure 2. Carrying out a visual inspection for each delivery, BGK. www.kompost.de

The first visual inspection is done at the biowaste reception. No biowaste delivery or acceptance is allowed if it exceeds the control value or if compliance cannot be ensured after removing impurities. Inspection involves checking the unloaded material (and the unloading process, if applicable), and assessing the probability of exceeding the control value or the rejection value due to the noticeable presence of plastics and other impurities. If there are indications that the control value has been exceeded, it must be documented with a photo of the test goods, delivering vehicle, transporter, date, time, type and mass of the delivery, producer, and origin. If no exceedance is assumed, documentation of the result is not required. (3)

2.2 Rough preparation

Biowaste pre-treatment at a composting or biogas plant typically includes several phases or treatments to prepare the waste effectively. These phases can vary depending on the specific plant and processes involved. Mechanical or manual sorting may be required to remove contaminants such as plastics, glass, metals, and other non-organic materials from the waste stream. To facilitate faster and more even decomposition or digestion, the waste is shredded or mechanically reduced in size. This increases the surface area for microbial activity. Simple pre-treatment methods such as mashing and homogenization, or advanced techniques like thermal hydrolysis and ultrasound, help break down structural barriers in feedstocks, especially those with high lignocellulose content. Thermal hydrolysis uses high temperature and pressure to rupture complex organic structures, while ultrasound applies high-frequency sound waves to disrupt cell walls and improve substrate accessibility. (2, 3)

2.3 Anaerobic digestion process

Anaerobic digestion is a critical process in biowaste processing plants, transforming organic waste into biogas and digestate. Several key quality aspects are crucial for the efficiency and outcome of the anaerobic process, which influence both the quantity and quality of the end-products (biogas and digestate).

Feedstock composition and pre-treatment

By focusing on optimizing feedstock management, enhancing pre-treatment techniques, maintaining strict control over process parameters, and ensuring proper post-treatment of both biogas and digestate, the quality of the end-products from anaerobic digestion can be significantly improved. This results in higher methane yields, reduced contamination, and a valuable, nutrient-rich digestate. The organic

matter used as feedstock must be appropriate for anaerobic digestion. High-quality organic waste, free from contaminants (such as plastics, heavy metals, and non-biodegradable materials), enhances process efficiency. Pre-treatment like shredding, pulping, or mixing ensures better surface area for microbial activity, speeding up digestion and increasing biogas yield. Pre-treating waste with heat or pressure (steam explosion) can break down complex organic compounds (e.g., lignocellulose), making them more accessible to anaerobic microbes. Also, a balanced C/N ratio (typically between 20:1 to 30:1) is crucial for efficient microbial metabolism. A low ratio may lead to ammonia inhibition, while a high ratio slows the digestion process. (2)

Process control parameters

Anaerobic digestion operates optimally within two temperature ranges: mesophilic (30-40°C) and thermophilic (50-60°C). Maintaining stable temperatures is vital for optimal microbial activity and biogas production. If operating in thermophilic conditions, appropriate insulation and heating systems are essential. The digestion process naturally reduces pathogens under these conditions, though pre-sanitization may be necessary for certain feedstocks to avoid contamination and lower costs. Options include pasteurization at 70°C for one hour or pressure sterilization at 133°C and 2.4 bar for 20 minutes. Sanitization can also be applied after digestion if necessary. (2, 5, 6)

Anaerobic digestion typically requires a neutral to slightly acidic pH range (6.5 to 7.5). A deviation from this range can hinder microbial activity and lower biogas yields. Regular monitoring is crucial, and buffering agents such as lime or sodium bicarbonate can be added to maintain the ideal pH levels. Hydraulic Retention Time (HRT) and Organic Loading Rate (OLR) are essential process parameters. HRT determines how long feedstock remains in the digester, while OLR controls the amount of waste introduced. Both parameters must be carefully managed to avoid system imbalances. To maintain efficient biogas production, it is important to control the concentrations of ammonia (NH₃) and hydrogen sulfide (H₂S) in the digester. Ammonia and sulfur scrubbers can inhibit methanogenesis by reducing these contaminants. Additionally, activated carbon or iron salts can be added to the digester to further minimize sulfur compounds, improving the biogas system's overall performance. (2)

2.4 Aerobic process

Composting is a process that imitates the biochemical reactions in the soil. In the process microbes break down organic material like food waste into soil. Proper conditions—temperature, humidity, and oxygen—are crucial for efficient decomposition. This process produces carbon dioxide, water, and stable organic matter, enriching the soil. Compost, rich in microorganisms and nutrients, is beneficial for soil improvement and as a growing medium. Raw materials include municipal sludge and biodegradable wastes.

Different composting methods

Composting methods vary based on waste volume, space, and environmental factors. Tunnel composting involves mixing biowaste with bulking agents in reinforced concrete tunnels under controlled conditions. Operating at 55–60°C for 2–3 weeks ensures pathogen and seed destruction, before moving the compost to open pits for further maturation (Table 1). Regular aeration may be done by turning the mass to enhance composting. Drum composting uses rotating steel drums for 5–7 days, with air and rotation aiding the process. (1, 3)

Table 1. Examples of different analyzes and methods used during the composting process. (1, 2, 3)

PROCESS PHASE	Temperature °C	Duration time	Analyze	Method
Bio-waste reception			Total solids	Visual
			Density Mg/m ³	EN13040
			Organic Substance	
Sieving 1			Heavy Metals	Mechanical
Digestion reactor	40-42°C	14-16 days	pH, temperature, methane (%)	
			Total solids: TS in % FS	
			Density Mg/m ³	EN13040
			Organic Substance oTS in %TS	
Tunnel Composting	55°C-75°C	up to 5 weeks	visual moisture, temperature	
			pathogens	E. coli, Salmonella
			stability	ASTM D5975
			self-heating factor	Rottegard (III)
Sieving 2			Total solids	
			Density	EN13040
			Organic Substance oTS in %TS	EN13040
Hygienisation tunnel	55°C-75°C	3 weeks	pathogens	E. coli, Salmonella

Large-scale operations need multiple drums for volumes over 10,000 tons annually. Open-pit composting uses conical piles of green waste biomass, with mechanical turning or aerator pipes maintaining aerobic conditions. This method is often enclosed under vacuum to minimize gas emissions and adhere to environmental laws. Trough composting operates year-round in concrete troughs with bottom suction aeration to maintain compost quality. (3)

First phase and separation screening

Before filling, the composting tunnel should be thoroughly cleaned and properly vented. Once filled, composting process should start promptly. No additional watering is needed during pre-composting if the mixture is sufficiently moist, with maximum humidity around 65%. Monitoring temperature and air flow must be monitored within the tunnels. After approximately one week (5–11 days depending on capacity), the batch is screened. For example, wind screen and metal separator can be used to remove foreign substances from coarse excess material. Fine compost particles are sieved, and remaining material can be returned to the supporting material after drying. At the same time, possible debris can be removed if the pulp is dry enough. After screening, the moisture content of the compost mass can be assessed visually, and the need for watering before sanitization can be determined. The process water or technical water can be used for watering. (3)

Hygienization of compostable pulp

Hygienization of compostable pulp occurs through a temperature increase, with the second phase lasting at least 3 days. Sanitization is achieved by maintaining temperatures above 55°C for 2 days. During plant composting, exhaust air duct temperatures can be monitored using a process control program, which automatically records the data when sanitization conditions are met. Regular sampling is required to verify sanitization success. Samples are analyzed in an external laboratory for *E. coli*, *Salmonella*, and compost maturity. At this stage, a unique identification number can be assigned to each batch for traceability. To minimize cross-contamination, loader wheels should be washed, and buckets changed between tasks. Sanitized compost must not be mixed with non-sanitized materials, and separate equipment should be used. All premises, machines, and tools must be thoroughly cleaned before being reused for composting, especially if they've been used for other purposes. (3, 5, 6)

Tunnel composting and post-ripening phase

If the compost shows instability based on sensory evaluation, indicating potential odor issues in post-ripening, third tunnel composting stage should be performed. This phase lasts from 10 days to five weeks, with temperatures maintained at 40–45°C. Hygiene of screened compost should be verified through additional analysis after post-ripening. Conduct thorough checks to confirm no post-contamination has occurred before selling compost for further processing. (1, 3)

2.5 Animal by-products: Processing and use

The handling of animal by-products in shops, restaurants, and canteens is based on the EU Animal By-Products Regulation (EC 1069/2009) and its implementing regulation (EU 142/2011). By-products are classified into different risk categories, with specific processing requirements defined particularly for Category 2 and Category 3 materials (Table 2). (5, 6)

Table 2. Required processing and approved end uses of animal by-products by category. (5, 6)

Category	Examples of Material	Required Processing	Approved end uses
Categ. 2	Diseased carcasses, products with antibiotic residues, certain slaughter by-products	Heat treatment: $\geq 133^{\circ}\text{C}$, 3 bar, 20 min; particle size ≤ 50 mm	Biogas production, incineration; not allowed in animal feed; some untreated manure, eggs, and milk may be land-applied if authorized
Categ. 3	Expired meat products, body parts of healthy animals not intended for food, dairy and egg residues	Heat treatment: $\geq 70^{\circ}\text{C}$, ≥ 1 hour; particle size ≤ 12 mm	Animal feed, composting, biogas production, fertilizers/soil improvers (only if properly treated)

Animal by-products can also be used as fertilizers or soil improvers, but their use is strictly regulated. Only certain properly processed materials, such as composted or biogas-treated material and dried and ground animal-derived products, are permitted for use. Once they have treated in accordance with the by-product category regulations, they can be used in agriculture under certain restrictions. Animal-based fertilizers must not be spread on areas where crops for human consumption are grown without sufficient waiting periods, nor can they be applied to grazing lands for livestock without special authorization from authorities. However, they can be utilized in green areas, and in soil improvement for agricultural fields. Operators must ensure that processing and use comply with regulations, and regulatory oversight requires proper documentation and the acquisition of necessary permits. Due to the regulations, incineration or biogas treatment could be simpler alternatives for many operators compared to fertilizer use. (5, 6)

2.6 Pest prevention and facility hygiene

In biowaste processing plants, pest prevention is crucial to maintain hygiene, reduce contamination, and ensure compliance with environmental regulations. Numerous methods can be employed for pest control, often using integrated pest management (IPM) strategies that focus on prevention, monitoring, and control. (3, 17)

Process optimization

In aerobic composting, maintaining proper temperature, moisture levels, and oxygen content prevents pests from thriving. This is particularly effective in controlling flies and other insects that might be attracted to decomposing waste. Using closed or in-vessel composting systems can significantly reduce pest access to the biowaste and limit odors. In anaerobic digestion processes, organic waste is broken down in sealed tanks in the absence of oxygen, making it less attractive to pests like flies and rodents. This

method can also eliminate potential pest habitats by reducing the solid organic matter they feed on. Some pests can be controlled by subjecting infested waste to high temperatures (e.g., in composting processes). In some biowaste processing systems, creating anaerobic conditions can deter pests that thrive in oxygenated environments (such as certain types of flies). (2, 3, 17)

Cleaning and waste management

Educating staff on best practices for waste handling, pest recognition, and hygiene can significantly reduce pest infestations. Training staff to identify early signs of infestations and report issues promptly can help in applying timely measures. Keeping the facility clean and minimizing food sources for pests is fundamental. Regular cleaning of work areas, waste bins, and machinery can prevent the accumulation of organic matter that attracts pests. Proper handling and storage of biowaste in sealed containers helps reduce odors and makes it harder for pests like flies, rats, and birds to access the waste. Pests, particularly insects and rodents, are attracted to damp environments. Controlling moisture levels through proper drainage, ventilating areas where condensation occurs, and fixing leaks can prevent these pests from thriving. Biowaste generates odors that attract pests. Proper ventilation, biofilters, and odor-neutralizing technologies can reduce the attraction of flies, rodents, and birds. (17)

Physical barriers, traps, and monitoring systems

Installing fine mesh screens on windows, vents, and doors helps prevent the entry of flies, insects, and birds into the facility. Ensuring that doors close tightly and using air curtains (high-velocity air streams) at entry points can deter flying pests. Sealing cracks, gaps, and holes in the building can prevent rodents like rats and mice from entering the facility. Insect Light Traps (ILTs) attract and trap flying insects using ultraviolet light and sticky boards or electric grids. Mechanical traps, live traps, or glue boards can help capture rodents before they become a significant issue. Regular pest monitoring through traps, inspections, and surveillance is key to detecting problems early before they escalate. (17)

Chemical control

Pesticides and Insecticides should be used sparingly and in a targeted way to avoid harming non-target organisms or creating resistance. In some cases, biowaste plants might apply low-toxicity baits or sprays around the facility to control pests like cockroaches or flies. If rodent infestations become problematic, rodenticides can be used but must be carefully managed to avoid environmental contamination and harm to non-target species. (17)

2.7 Hygiene and occupational safety

Sanitized digestate poses minimal risk of pathogen transfer compared to raw animal manure, but precautions are essential to prevent recontamination. Recontamination can occur from raw manure, slurries, or un-sanitized materials. Biogas plants should maintain strict hygiene by separating “dirty” areas for raw feedstock from “clean” areas for sanitized digestate, disinfecting vehicles, and ensuring workers change shoes and clothing when transitioning between these areas. Feedstock should not come from farms with livestock health problems, and transport practices must minimize cross-farm contamination. Tankers should be fully loaded, cleaned, and disinfected with standard procedures to maintain biofertilizer quality. (4)

It is crucial to prioritize cleanliness and hygiene throughout the premises. This includes maintaining high standards of personal hygiene and consistently using appropriate protective equipment. Responsibilities for the management, development, and quality of the bio-waste process should be clearly assigned. Designated personnel should be responsible for key tasks such as operation, staff training, reporting, maintenance, and cleaning. The safety of all personnel, including contractors and others working on-site, must be ensured by clearly communicating potential occupational safety risks. This should be managed

through a work permit system, which includes both written and verbal instructions about the necessary protective equipment and precautions specific to the area. When working with acids and bases, it is essential to understand the health risks they pose and to use the appropriate protective equipment to mitigate these risks. Respiratory protection must be worn in all process areas. Footwear used in process rooms must not be worn in control rooms or social areas to prevent cross-contamination. (4)

3 Sampling

3.1 Sampling plan

A detailed sampling plan for waste testing should meet regulatory, environmental, and safety objectives. A sampling plan closes the gap between high-level policy goals and practical technical instructions for sampling. The guidance presented in Chapter 3 is based on EN 14899 and CEN/TR 15310 series (7 – 13).

3.2 Involved parties

All the involved, relevant parties need to be identified and consulted with, including waste producers and authorities. Involved parties include legislators, regulators, waste producers, waste managers, and the samplers. These parties often have different interests, and their collaboration is necessary to finalize the sampling plan. The creation of the sampling plan may involve multiple revisions and discussions among involved parties to ensure all objectives are met.

3.3 Objectives and technical targets

Objectives need to be broken down into measurable technical goals to guide the sampling and testing process. The purpose of the testing program must be clear, including whether the sampling is for basic characterization, compliance testing, or verification testing. This clarity is crucial for defining the type and quality of information needed from the sampling.

To properly define the objective, consultations with relevant parties are necessary. Typically, each objective requires its own sampling plan, though in some cases, multiple objectives can be combined into a single plan. Common objectives might include:

- Comparing material quality against legal standards
- Characterizing the material due to changes in ownership
- Determining whether the material can be reused or how it leaches
- Assessing risks to human health or the environment

The sampling plan should translate these objectives into practical, technical goals by considering factors like the material's condition, accessibility, and volume. These goals will also guide the data analysis and ensure that the testing objectives are met. The plan must also identify any limitations that could affect the reliability of the data. These limitations influence the level of confidence needed in the results, which directly impacts the number of samples that should be collected.

It's essential to select the most appropriate sampling techniques to meet the requirements of the study. Techniques such as composite sampling, sub-sampling, or incremental sampling should be clearly defined in the plan based on the specific needs of the test. Ultimately, the objective must explain why the waste is being tested—for instance, to evaluate its environmental impact or to check compliance with legal standards. Example objectives include testing for safety, reuse potential, or ensuring compliance with landfill acceptance criteria.

Necessary general level of testing

The sampling plan should clearly define the level of testing needed to meet the technical goals of the testing program. This will guide both the type of investigations to be conducted and how often they need to occur. Additionally, the plan may outline the acceptable level of uncertainty introduced by the sampling process and how it affects the overall accuracy of the test results. It should also identify the specific waste material to be represented and determine the appropriate sample sizes to ensure reliable data.

Constituents to be tested

All constituents to be analyzed must be clearly documented in the sampling plan. These properties or constituents should be specified based on several factors. First, consider the material's origin, which helps in identifying key constituents related to its source. The intended use of the material also plays a role in defining which constituents are important for analysis. Additionally, the total volume of the material being assessed should be taken into account when specifying the constituents.

Regulatory compliance is essential, so it is important to ensure that the selection of constituents aligns with local and national regulations. Similarly, any contractual requirements should be reflected in the selection process. Knowledge of the material or process can also guide the identification of relevant constituents. Finally, any agreed-upon information between the involved parties should be included in the sampling plan. Key substances for testing should be selected based on relevant regulations, such as those concerning heavy metals or organic compounds. The sampling plan must record all the details of the process, including instructions for sample collection, preservation, and transport.

Background information on waste

All necessary background data about the waste, including its origin, physical properties, and process information must be gathered.

Health and safety precautions

All safety precautions that protect the sampler from potential hazards during sample collection, handling, and transportation must be documented and in place during the sampling process. Potential hazards for samplers include any conditions or substances that could pose a risk to health or safety during collection, handling, or transport of the waste. This can include sharp objects, toxic or irritant chemicals, biological contaminants, high temperatures, dust, or unstable material. All such hazards should be identified in advance, and appropriate protective measures must be implemented.

Sampling approach: probabilistic or judgmental sampling

Choose between a probabilistic or judgmental approach. Probabilistic methods use statistical tools to ensure random and representative samples, and it is generally preferred to ensure representativeness. Judgmental methods are based on expert knowledge, and it can be useful in certain cases.

Defining the approach

The sampling plan must specify when, where, by whom, and how samples will be taken and collected to ensure they meet the sampling objectives. The amount of material sampled should be sufficient to satisfy the requirements outlined in the relevant standards for the testing program. If necessary, the sampling plan should also include provisions for replicate samples. At a minimum, the sampling approach must cover key aspects such as the increment size, sample size, whether individual or composite samples will

be used, the number of samples to be collected, the locations for sampling, and the sampling frequency, with dates clearly specified when applicable.

3.4 Selection and application criteria for sampling

Technical goals

Once the sampling plan's objective is set, the next step is to define technical goals. These goals clarify what is needed for sampling, data analysis, and the use of statistical tools to interpret results accurately. If standards or laws specify sample types or parameters, this process is straightforward; otherwise, goals should be set with input from all involved to balance reliability with resources. Clear technical goals lead to practical sampling instructions, though some may need further detail, like decisions on scale or confidence level.

Population and Sub-population

The population refers to the total volume or area of material to be sampled. Careful identification of the population, including defining its boundaries in space or time, ensures that sampling is representative. When the overall population is large or heterogeneous, defining sub-populations can be necessary.

Assess Variability

To design an effective sampling program, it's crucial to understand the types of variability in the waste being analyzed. Variability in waste materials can't usually be changed without significant intervention, so understanding it upfront helps optimize sampling efforts. In spatial variability, the differences in the material across physical locations. Temporal variability changes in material characteristics over time.

Scale

When selecting sample size, it should be remembered that small-scale variations may be less relevant if they don't impact the overall goals. The mass or volume of material sampled should be chosen with this in mind.

Sampling Approach

Probabilistic sampling is preferred when high reliability is required. It gives each part of the population an equal chance of selection, which helps ensure that results represent the entire population. If more accuracy is needed, you can increase the number of samples. Judgemental sampling method may be necessary when time or resources are limited. It targets specific areas rather than the whole population and is practical when full representation isn't feasible. However, note that it's less reliable for generalizing results to the entire population.

Practical instructions

Sample Size and Pattern

The number of samples should be sufficient to capture the variability within the population. Incremental sample size, as well as the total number of increments, should be determined based on statistical analysis. Different patterns (e.g., grid sampling, random sampling) can be chosen depending on the material characteristics and the objectives of the sampling.

Use of Composite or Individual Samples

Composite samples, formed by combining multiple increments, are useful when an overall estimate of material properties is needed. Individual samples are preferred when variability between different areas or layers of the material must be analyzed separately.

Reliability

Reliability encompasses precision, bias, and confidence in the results. The balance between the cost and desired reliability of the sampling results is an important consideration. Probabilistic sampling provides quantifiable reliability, whereas judgmental sampling carries higher uncertainty.

3.5 Sampling Techniques

Sampling Objective

The first step is to determine the type of waste and its physical state—whether it is liquid, solid, sludge, or paste. Choose a sampling method: probabilistic sampling is ideal for reliable, representative results, while judgmental sampling is suitable when full representativity isn't possible due to limitations like time or cost.

Sampling techniques by material type

Liquid sampling

For drums or casks, the choice between surface, bottom, or stratified sampling depends on the liquid's homogeneity. In vertical tanks, surface or bottom sampling is used based on the tank's size and the uniformity of the liquid. In horizontal tanks, surface sampling is conducted through a hatch or a bottom outlet. Pipelines can be sampled at the end, tap, or valve, or by diverting the flow if access is limited. For lagoons or pits, a weighted bottle or pond sampler is effective for collecting samples from the perimeter or during draining.

Solid sampling (coarse or lumpy materials)

For small volumes in bags or drums, either judgmental or probabilistic sampling is used based on how varied the material is. For larger volumes in hoppers or stockpiles, different sections are sampled with probabilistic techniques to ensure a representative mix. For solids on a conveyor belt, systematic samples are taken at regular intervals to ensure fair representation.

Sludge sampling

In containers or tanks, similar procedures as for liquid tanks are followed, and sludge stratification or homogeneity before sampling must be considered. In lagoons or pits, weighted bottle, or pond samplers are used for liquid waste.

Paste-like substances

In drums or blocks, directional or geometric sampling should be used depending on homogeneity. For paste in motion, samples are taken at intervals to ensure even representation.

Powders, granules, crystals

For static materials in hoppers or heaps, scoop or sample splitters are usable for small portions and systematic sampling from different points for larger amounts. For moving materials on conveyors, sample is taken periodically as the material travels along the conveyor.

Sampling equipment

The equipment is selected to suite the material type, such as scoops for powders or pond samplers for liquids. All tools must be clean and well-maintained to avoid contamination.

3.6 Sub-sampling

The objective of sub-sampling is to reduce the size of waste samples in the field, making transportation to a laboratory easier while ensuring that the sample remains representative. Sub-sampling should always reflect the original waste material accurately.

Key definitions

A field sample is the total amount of material collected from a sampling location before any reduction or treatment. A laboratory sample is the portion of the field sample sent to the laboratory for analysis. A composite sample is a mixture of at least two individual samples combined in proportional amounts for analysis.

Sub-sampling methods

Samples should be reduced in size while maintaining their representation of the original waste material. Procedures must be followed to minimize contamination or alteration of the sample's characteristics. There are two main approaches to sub-sampling: manual and mechanical methods. Manual methods include quartering, where the material is piled, flattened, and divided into quarters, with two opposite quarters removed and repeated until the desired sample size is achieved. Scoop sampling involves manually collecting material using a scoop at regular intervals, effective for homogeneous, granular materials. Mechanical methods include the riffle divider, which is suitable for granular or powder-like materials, where the material is poured through a device with alternate slots to split it evenly. The rotary sample divider is an automated method that splits material into several parts as it rotates, ensuring precise division.

Sub-sampling for different waste types

For granular materials, thorough mixing is necessary before quartering or using a riffle divider to ensure even distribution. Liquids and sludges should be stirred to homogenize before sub-sampling, with a scoop or specialized sampler used for sludges. Paste-like materials require thorough mixing to achieve uniformity, followed by sub-sampling with a scoop or spatula.

3.7 Sample handling and delivery

When dealing with waste materials, it is crucial to ensure that the chosen methods for packaging, storage, and preservation are well-suited to the specific type of waste and its intended analysis. Collaboration with the laboratory is essential in this process, as their expertise can guide the selection of appropriate techniques that maintain sample integrity and reliability throughout handling and transportation.

General steps for packaging and labeling

Selecting sample containers involves ensuring material compatibility to prevent reactions or contamination. For instance, plastic containers are suitable for inorganic analysis, while glass containers are preferred for organic analysis. The size of the container must correspond to the volume needed for analysis, and airtight, tamper-proof seals should be used for regulatory samples. Proper labeling is crucial;

samples should be clearly labeled with details such as source, date, and any necessary preservation methods.

Preservation

General preservation techniques aim to stabilize samples, maintaining their characteristics until analysis. This may include temperature control and the use of chemical preservatives. It is important to analyze samples within a specified time frame to avoid degradation. Specific preservation methods may vary by waste type, so consultation with the laboratory is recommended to determine whether freezing, chemical additives, or refrigeration is necessary.

Storage and transport

For short-term storage, samples should be kept under appropriate conditions, such as controlled temperatures, to prevent changes in their characteristics. During transport, packaging must ensure that sample containers are secure and protected from damage. Insulated containers may be necessary to maintain temperature stability. Clear documentation should be maintained during transport, ensuring that the sample remains traceable from collection to the laboratory.

4 Quality and safety of compost and digestate

Compost and digestate quality is assessed by physical, chemical, and biological criteria. These include moisture content, particle size, pH level, nutrient content, organic matter content, C/N ratio, inorganic contaminants, stability, maturity, pathogen content, and microbial activity. Accurate measurement involves tests and laboratory analysis to ensure the end-product meets the required standards for safe and effective use. By following the required criteria, fertilizer producers can create a product that is not only beneficial for soil and plants but also safe for the environment and human health. Required analyzes depend on the intended end-product and applicable national or EU legislation. (1, 2, 19)

4.1 Quality criteria in Europe

Quality criteria in Europe vary by country, reflecting differences in regulatory frameworks, environmental conditions, and agricultural practices. However, some of the countries follow European Union (EU) guidelines, particularly the Fertilizing Products Regulation (EU) 2019/1009, which sets common standards for quality across member states (CE-marked fertilizer products). Detailed guidance on the requirements for CE-marked fertilising products is provided in Internal Report IR6 (18).

Table 3. Quality parameters and analytical methods for compost and digestate in Europe. (1, 2, 3, 19)

Category	What is measured	Methods / Reference
General quality criteria	Moisture, particle size, pH, nutrient content, organic matter, C/N ratio, inorganic contaminants, stability, maturity, pathogens, microbial activity	Laboratory tests and analyses; EU 2019/1009 (requirements for CE-marked products)
Impurities	Glass, plastics, metals, bones, stones	CEN/TS 16202, sieving, handpicking; plastics: 13C/14C analysis, FTIR, Raman, pyrolysis-GC/MS
Pathogens	<i>Salmonella</i> , <i>E. coli</i>	Compost hygienization; standardized methods: ISO 6579-1:2017 and ISO 16649-1/2/3
Harmful substances	Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)	Sample digestion in strong acids + ICP-OES (EN 13650)
Organic contaminants	POPs: PCBs, PCDD/Fs, PAHs, phthalates, pesticide residues	Analysis according to regulations; monitoring based on EU and national legislation
Weed seeds	Number of germinating weeds	Compost mixed with peat, monitored under controlled conditions (2–3 weeks), seedlings counted

Nutrient content	Macro- and micronutrients (N, P, K; trace elements such as B, Mo, Zn, Fe)	Kjeldahl (N), colorimetry (P), flame photometry (K), ICP-OES (EN 13650), water extraction (EN 13652)
Cation exchange capacity (CEC)	Nutrient retention and release capacity; effect on soil fertility, pH stability	Ammonium acetate method, soil testing methods
pH	pH level (ideal range 6.0–8.0)	EN 13037 (20 ml compost + 100 ml water)

The quality criteria can vary in Europe by the nutrient content, organic matter, contaminants, stability, maturity and so on. These variations ensure that compost products meet local agricultural, environmental, and safety requirements, reflecting the diverse conditions and practices across Europe. (19)

4.2 Quality evaluation of compost

4.2.1 Compost maturity

Measuring compost maturity is crucial to ensure that compost is stable and safe to use as a soil amendment. Several methods can be used to assess compost maturity, each focusing on different physical, chemical, and biological parameters. To determine compost maturity, it is best to use a combination of methods to get a comprehensive assessment. Physical inspections (color, odor), chemical analyses (C/N ratio, pH, EC), and biological tests (germination test) together provide a robust evaluation of compost maturity. These measures ensure that the compost is stable, safe, and effective as a soil amendment. (1, 3)

Table 4. Compost maturity parameters and analytical methods. (1, 2, 3)

Category	What is measured	Methods / Reference
Phytotoxicity	Effect on seed germination and plant growth	Germination test using cress (<i>Lepidium sativum</i> L.) in compost substrate (EN 16086-2; 2012)
Nitrogen immobilization potential	Potential to temporarily tie up nitrogen in soil	Mix compost with mineral N solution, incubate 1 week at 37°C (Vandecasteele et al., 2016)
C/N ratio	Carbon to nitrogen ratio; indicator of compost maturity	Analyze carbon and nitrogen content of compost: EN 13137 and EN 13654-2
Mineral N and NO₃-N/NH₄-N ratio	Mineral nitrogen and nitrate/ammonium ratio	Chemical analysis; well-matured compost should have NH ₄ ⁺ very low; NO ₃ ⁻ /NH ₄ ⁺ > 1
Electrical Conductivity (EC)	Total salt content of compost	Shake 50 mL compost in 250 mL water for 1 hour, then measure EC (EN 13038)
Self-heating factor	Ability of compost to generate heat under controlled conditions	Rottegrad Test or similar; scale I–V, minimum III
Oxygen Uptake Rate (OUR)	Microbial activity / stability	Measure oxygen consumption; max 25 mmol O ₂ /kg OM/h (EN 16807)
Other stability methods	Compost stability and microbial activity	ASTM D5975; TMECC 05.08-B
Organic matter	Organic matter content after combustion	Determine ash content after burning (EN 13039)
Moisture content	Water content affecting microbial activity and decomposition	Drying at 103°C until constant weight (EN 13040); ideal 40–60%
Bulk density	Weight per unit volume; affects transport and spreadability	Fill known volume, weigh, adjust for moisture (EN 13040)
Particle size	Size distribution affecting aeration, water retention, and usability	Visual estimation or sieving (EN 15428)
pH buffering capacity	Compost's ability to resist pH changes, ensuring stability and nutrient availability	Titration method; depends on composition and maturity

4.2.2 Visual screening

Visual assessment is a valuable, immediate tool for determining end-product quality. It provides quick feedback on the readiness and suitability of end-product use. While it does not replace laboratory analysis for detailed quality parameters, it helps in making informed decisions about the process and its end-use. (1, 3)

Table 5. Visual quality parameters and assessment methods for compost. (1, 3)

Parameter	Quality criteria / Description	Assessment method
Color	Middle to dark brown; rich dark brown to black indicates well-decomposed organic material. Black may result from high temperatures or worms. Lighter shades suggest immaturity or high undecomposed material.	Visual inspection
Odor	Pleasant, earthy smell (like forest soil) indicates microbial activity and stability. Ammonia, sulfur, or rotten-egg smell indicates excess nitrogen loss or anaerobic conditions.	Smell/olfactory evaluation
Impurities	Free of visible plastics, glass, metals, or other non-organic materials. Small stones or sticks acceptable in minor amounts. Presence of plastics, glass, or metals lowers quality.	Visual inspection or sieving
Texture	Relatively homogeneous, crumbly texture similar to soil. Large recognizable pieces indicate incomplete composting; dusty material suggests poor conditions.	Visual and tactile assessment; sieving optional
Moisture content	Moist to the touch, forms a ball in hand without dripping. Not excessively wet or dry.	Tactile assessment
Temperature	Moderate temperature matching ambient air; hot compost indicates ongoing decomposition.	Thermometer or tactile assessment

4.3 Quality of digestate

The quality of digestate as a fertilizer depends on the feedstock's composition and the effectiveness of the anaerobic digestion (AD) process. The digestate is rich in nitrogen, phosphorus, and potassium, making it valuable as a fertilizer. However, contamination by heavy metals or non-organic substances can lower its quality. The digestate should be regularly tested for heavy metals and other contaminants to ensure it meets agricultural safety standards. Ensuring the digestate is fully stabilized (fully digested) prevents issues with odor or pathogen content. Maturation and proper handling of the digestate can improve its usability as a soil conditioner. Composting the digestate post-digestion can further stabilize the organic matter and eliminate pathogens, improving its quality as a soil conditioner. Hygienization processes should be implemented (e.g., pasteurization) if the digestate is to be used in agriculture to ensure it is free of harmful pathogens and safe for application. Sensors for real-time monitoring sensors should be installed for key parameters such as gas composition, temperature, pH, and organic load. Automated feedback control systems can adjust the process conditions dynamically, ensuring optimal performance. Using data analytics and machine learning can help predict system performance, allowing proactive adjustments to improve biogas yield and digestate quality. (2, 5, 6, 19)

5 Quality management system

Quality management system is a written description of the compliance with fertilizer product regulations. It covers production, quality control, and testing methods used to ensure compliance. The content of the must be updated regularly, with responsible individuals listed, and changes must be documented. The quality management system covers the entire production chain. (4)

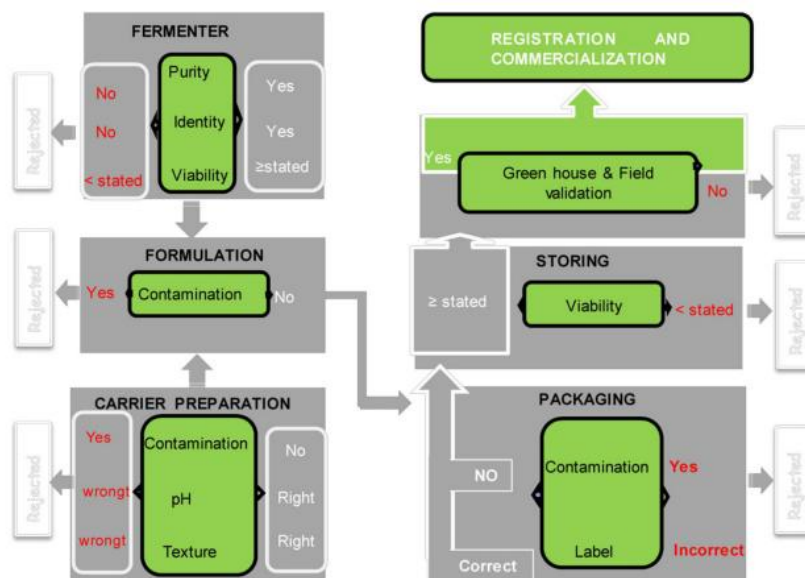


Figure 3. Quality control in the biofertilizer manufacturing process (20).

Employee training

The manufacturer must ensure that employees involved in the production of fertilizer products are trained in the quality management system and its guidelines. Employees must understand how their actions affect the product's quality. Responsible individuals must be appointed to ensure the monitoring of the quality management system at various stages, such as during the reception of ingredients and maintenance. (4)

Batch definition and traceability

In batch definition, it must be ensured that batch-specific traceability is implemented. A batch can be a production or sales batch, and its size is determined to handle quality deviations. The quality management system describes how traceability is ensured at all stages of production. For animal-derived by-products, a commercial document must be provided to ensure traceability. (4, 5, 6)

Quality monitoring and sampling plan

The Quality management system describes how product-specific requirements for fertilizers are ensured, including harmful substance levels, hygiene, and nutrient levels. Parameters to be monitored and action limits must be documented, and compliance must be verified by batch. A sampling plan must be created, defining sample locations, timings, and analyses. Sample results must be recorded and kept for five years. Product labels must be regularly checked for accuracy. More on sampling is provided in chapter 3. (4, 7-15)

Handling and quality requirements for ingredients

Quality management system must describe how handling and quality requirements for different ingredient categories are ensured and monitored. This includes action limits, rejection criteria, and procedures when limits are exceeded. Ingredient categories, such as primary materials, plants, compost, digestate, and animal-derived by-products, require special attention to ensure compliance with processing, hygiene, and stability requirements. The monitoring process must include temperature and time parameters, as well as sampling and analysis methods. Legal requirements, such as maximum permissible concentrations of harmful substances, must be met for all ingredient categories. The receipt, inspection, and handling requirements of ingredients must be documented. In the production of mixed fertilizers, it must be ensured that all ingredients meet product-specific requirements. (4, 5, 6)

Disturbance situations and quality deviations

The quality management system must describe how to handle disturbance situations, such as failure to reach target temperatures in the process. A record of disturbances must be kept, and the system must include actions to be taken during disturbances, how deviations are recorded, and who should be notified. If disturbances cannot be corrected, procedures for the ingredients or products must be defined. (4)

Quality deviations can occur in ingredients, purchased products, or finished products. Corrective actions must be taken if deviations affect the product quality or nutrient levels. A quality deviation is serious if the product does not meet regulatory requirements. The quality management system must describe how deviations are handled, how their causes are investigated, how recurrence is prevented, and the procedures for the handling and disposal of rejected batches. (4)

Storage and legislation

The quality management system must describe how the quality of ingredients and finished products is ensured during storage and transportation. If non-compliant by-products are generated in the production process, their storage and disposal procedures must also be described. The manufacturer must be aware of the fertilizer legislation applicable to their operations and ensure that any changes in legislation are accounted for when updating the quality management system. It is beneficial to document the legal requirements in the quality management system. (4, 5, 6, 19)

List of references

1. Amery, F. et al. (2020). *Compost Quality Indicators*. SOILCOM Report No. 5.1.
2. IEA Bioenergy. (2012). *Quality Management of Digestate from Biogas Plants Used as Fertiliser*.
3. Siebert, S. & Jüngling, M. J. (2010). *Composting and Quality Assurance in Germany*. German Quality Assurance Organisation for Compost (Bundesgütegemeinschaft Kompost e.V., BGK).
4. Ruokavirasto. (2024). *Quality Management System Guide for National Fertilizer Product Manufacturers*.
5. Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation)
6. Commission regulation (EU) No 142/2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive
7. EN 14899, Characterization of waste. Sampling of waste materials. Framework for the preparation and application of a Sampling Plan
8. CEN/TR 15310-1 (2006): Characterization of waste. Sampling of waste materials. Part 1: Guidance on selection and application of criteria for sampling under various conditions
9. CEN/TR 15310-2 (2006): Characterization of waste. Sampling of waste materials. Part 2: Guidance on sampling techniques
10. CEN/TR 15310-3 (2006): Characterization of waste. Sampling of waste materials. Part 3: Guidance on procedures for sub-sampling in the field
11. CEN/TR 15310-4 (2006): Characterization of waste. Sampling of waste materials. Part 4: Guidance on procedures for sample packaging, storage, preservation, transport and
12. delivery
13. CEN/TR 15310-5 (2006): Characterization of waste. Sampling of waste materials. Part 5: Guidance on the process of defining the sampling plan
14. FprEN 12579 (2024): Soil improvers and growing media - Sampling
15. ISO 5667-13 (2011): Guidance on sampling of sludges
16. García-Fraile, P., Menéndez, E., & Rivas, R. (2015). *Role of bacterial biofertilizers in agriculture and forestry*. *AIMS Bioengineering*, 2(4), 230–252. <https://doi.org/10.3934/bioeng.2015.4.230>
17. Association Fertile Auro (FeA) & Zero Waste Europe. (2019). *Community Composting: A Practical Guide for Local Management of Biowaste*. Zero Waste Europe Guides No. 1.
18. Friege, H. 2024. *Results of the survey gathering data on current collection systems (IR6)*. Internal report of the BIN2BEAN project.
19. Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.
20. Soumare, A., Boubekri, K., Lyamlouli, K., Hafidi, M. & Ouhdouch, Y. (2020). *From Isolation of Phosphate Solubilizing Microbes to Their Formulation and Use as Biofertilizers: Status and Needs*. *Frontiers in Bioengineering and Biotechnology*, 7, 425. <https://doi.org/10.3389/fbioe.2019.00425>

Annex 1 SAMPLING OF GROWING MEDIA AND SOIL IMPROVERS – GUIDELINES

OBJECTIVE AND PURPOSE OF USE

These guidelines are intended for the sampling of growing media and soil improvers. The instructions are based on standards FprEN 12579:2024 (Soil improvers and growing media - Sampling) and ISO 5667-13 (Guidance on sampling of sludges), covering materials in both solid and liquid form. The guidelines describe the entire process of representative sampling from preparation to laboratory delivery, with a particular focus on microbiological analysis.

BEFORE SAMPLING

Required equipment

- Sampling tools: shovel, scoop, auger, etc. (e.g. made of steel: easy to clean and disinfect)
- Disinfectants: e.g. >70% ethanol, paper towels
- Protective gear: sterile disposable gloves, coveralls, shoe covers
- Sample containers: composite sample container (30–60 l), official sample bags (7 l), rubber bands for sealing bags, labeling and sealing materials
- Cooler and ice packs for shipping samples
- Sampling record form and other required documentation

Cleaning of equipment

- Clean and dry all tools
- Disinfect with >70% ethanol and allow to dry

SAMPLING BY MATERIAL TYPE

Solid material (e.g. heap, pile)

- Assess the size of the heap, divide into sections of max. 5000 m³
- Calculate number of sampling points: $n_{\text{nok}} = 0.5 \times \sqrt{V}$, rounded to the nearest whole number

Volume (m ³)	Openings	Points/opening	Sample volume (l)
<600	1	12	2 l
<1600	2	10	1 l
<2600	3	9	1 l
<3600	4	8	0.7 l
3600–5000	5	6	0.7 l

- Take equal-sized incremental samples randomly from a depth of 5–50 cm (over 0.5 litres)
- Combine all incremental samples into a composite sample in a clean container (20–30 l)
- Mix gently, and take two official samples (A & B, 4–5 l each) into 7-litre official sample bags

Liquid or slurry-like material (e.g. closed tank, open container)

- Mix thoroughly or take samples from different depths and locations
- From a closed tank, take incremental samples from the pipe outlet or tap (see section 3.1)
- Record the total volume, production time and number of samples
- Divide the mixed composite sample into representative A & B samples (1 l each)

- Place the sample bottle in an official sample bag and include sample-specific identification tag (see section 5)

MICROBIOLOGICAL SAMPLING

- Disinfect and dry sampling tools thoroughly before and after sampling
- Use new plastic bags or sterile containers
- Use disposable gloves and shoe covers
- Record aseptic sampling in the sampling record
- Minimum sample size 1 l / 200 g; depends on the quality assurance standard applied
- Storage and transport at 5 ± 3 °C; freezing is not allowed
- Comply with national and international regulations for handling and transporting biohazardous samples

Incremental samples

For microbiological testing, visually divide the sampled portion into equal segments for the number of samples required. Then determine the number of incremental samples and divide by the number of segments and round up to the next whole number to obtain the number of sampling points for each segment. Incremental samples shall be taken from each segment randomly. Incremental samples from each segment are combined and packed individually being kept separately.

SAMPLE LABELING, STORAGE AND TRANSPORT

- Label the sample: sample name, date, sampler
- Pack in two bags, place the identification label between them
- Seal the outer bag
- Transport to the laboratory under cold conditions as quickly as possible; target temperature $< +5$ °C (do not freeze)
- Store in the laboratory at $< +10$ °C, analyze within 48 hours

Annex 2 Compost sampling – Instructions for Schools

These instructions are used when taking compost samples for analysis purposes. It is important to work carefully and maintain good hygiene. Always take the sample together with an adult.

1 BEFORE STARTING

You will need the following tools for sampling:

- Shovel, scoop or similar tool
- Clean plastic bag or container for the sample
- Disposable gloves
- Respiratory masks

Cleaning: wash and dry tools if they are dirty.

If the sample needs to be sent, prepare the following materials for shipping:

- Cooler box
- 2–4 cold packs
- Labels and markers for marking the samples
- Sampling record sheet
- Address to which the sample will be sent



2 HYGIENE AND SAFETY

- Avoid breathing in dusty compost. Use a respiratory mask (FFP2 or FFP3) if necessary.
- When taking a sample, keep the material away from your face.
- If the compost is dusty, you may lightly moisten it with water.
- Do not use a pressure washer or strong water jet – it spreads dust.
- Always wear disposable gloves.
- Do not take samples if you have cuts or broken skin on your hands.
- Dispose of disposable gloves and masks after use.
- Wash your hands thoroughly when finished and before touching your face, food, or drink.

3 SAMPLING



3. Take 5–10 scoops from different spots, totaling about 2 liters.
4. Place the sample into a bag or sealable container.
5. Seal the bag/container tightly.
6. Dispose of disposable gloves and mask after use.
7. Wash your hands thoroughly as soon as you are finished.
8. Clean the tools for the next use.

1. Put on disposable gloves and, if needed, a respiratory mask.
2. Choose the spot where you will take the soil or compost.

4. SENDING THE SAMPLE

Sometimes samples may also be sent for research. The following instructions are for that.

1. Label the bag/container with the date and sampling location.
2. Fill in the sampling record sheet.
3. Send the sample in a cooler box with 2–4 cold packs.
4. Ship as refrigerated transport (below +5 °C) as soon as possible.



5 ASEPTIC SAMPLING

Aseptic sampling is used when the goal is to study microbes in the sample. In this case, the sample must not become contaminated with outside microbes so that the results remain reliable.

1 Preparation

- Disinfect the sampling tools (e.g., scoop, spoon) and allow them to dry before use.
- Ensure you have clean, sterile bags or containers.
- Wash your hands carefully.
- Put on disposable gloves and shoe covers.

2 Sampling

- Take at least 1 liter of liquid or 200 grams of solid sample (exact amount depends on the instructions)
- Place the sample immediately into a clean plastic bag or sterile container
- Seal the container carefully
- Record in the sampling sheet that the sample was taken aseptically

3 Storage and transport

- Store the sample in a refrigerator at about +2...+8 °C
- Do not let the sample freeze
- Follow safety guidelines, as the sample may contain microbes