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English Version

Characterization of waste - Sampling of waste from extractive industries

Caractérisation des déchets - Echantillonnage des déchets
issus des industries extractives

Charakterisierung von Abfällen - Probenahme von Abfällen
aus der mineralgewinnenden Industrie

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Foreword

This document (CEN/TR 16365:2012) has been prepared by Technical Committee CEN/TC 292 “Characterization of waste”, the secretariat of which is held by NEN.

The preparation of this document by CEN is based on a mandate by the European Commission (Mandate M/395), which assigned the development of standards on the characterization of waste from extractive industries.

This Technical Report is intended to supplement the existing series of five Technical Reports dealing with sampling techniques and procedures for waste, and provides specific information for sampling of waste from the extractive industry. It follows the principles laid down in EN 14899, *Characterization of waste — Sampling of waste materials — Framework for the preparation and application of a Sampling Plan*. Further information on the relationship between the production of a sampling plan and the overall testing programme objectives can be found in CEN/TR 15310-5.

- CEN/TR 15310-1, *Characterization of waste — Sampling of waste materials — Part 1: Guidance on selection and application of criteria for sampling under various conditions*;
- CEN/TR 15310-2, *Characterization of waste — Sampling of waste materials — Part 2: Guidance on sampling techniques*;
- CEN/TR 15310-3, *Characterization of waste — Sampling of waste materials — Part 3: Guidance on procedures for sub-sampling in the field*;
- CEN/TR 15310-4, *Characterization of waste — Sampling of waste materials — Part 4: Guidance on procedures for sample packaging, storage, preservation, transport and delivery*;
- CEN/TR 15310-5, *Characterization of waste — Sampling of waste materials — Part 5: Guidance on the process of defining the sampling plan*.

This Technical Report focuses mainly on sampling for geochemical rather than geotechnical requirements. Sampling for geotechnical requirements is only addressed to a limited extent and references are made to existing documentation. The Technical Report elaborates on a range of potential approaches and tools of specific relevance to the sampling and testing of wastes from the extractive industry. This approach enables the project manager to tailor his sampling plan to a specific testing scenario and continues the ‘shop shelf’ approach to sampling plan development for waste testing outlined in CEN/TR 15310-1 to -5. This approach allows flexibility in the selection of the sampling approach, sampling point, method of sampling and equipment used. It provides the necessary background information pertaining to the factors that influence the choice of these detailed components of the sampling exercise, and information on the necessary statistical choices that can then be applied to determine the most appropriate testing programme for any given sampling scenario.

This Technical Report also makes references to the overall guidance document for characterization of waste from extractive industries (CEN/TR 16376) which gives guidance and recommendations on the application of methods for the characterization of waste from extractive industries.

Introduction

The guidance outlined in this Technical Report is focused on the key elements to be considered in the development of a sampling plan for extractive waste. This report should be used in conjunction with EN 14899 and its supporting technical reports and is intended to supplement the information contained in these documents with specific and essential information relevant to the sampling of waste from the extractive industry. Where appropriate this report also makes reference to the overall guidance document for characterization of waste from extractive industries (CEN/TR 16376) which gives guidance and recommendations on the application of methods for the characterization of waste from extractive industries¹⁾.

1) Specific features of extractive waste

The extractive industry includes, metal mines, rock quarries, salt mines, coal mines, sand and gravel, limestone and onshore oil and gas operations. When mineralogical material is extracted it is exposed to changes in physico-chemical conditions, which may result in chemical and physical instability of previously stable geological material.

The life cycle of extractive industries starts with the early phase of exploration through operation to closure and after care. In the context of sampling three phases have been defined in this document:

- exploration (including design and permitting);
- operation (extraction and processing, including transport and deposition of waste); and
- closure (including existing waste deposits).

From a sampling perspective different sampling scenarios may be more relevant than the operational phases. For example sampling from diamond drill cores may take place both during exploration and operation, sampling at existing waste rock dumps and tailings facilities may take place both during operation and at closed sites. Both operational phases and sampling scenarios are used as parallel concepts in this document.

One significant feature that makes characterization of extractive waste different from waste characterization in general is the fact that sampling and characterization ideally take place before the waste is produced, i.e. based on drill cores (or drill mud) from exploration drilling. Characterization during exploration is critical since subsequent waste management plans are developed on the basis of this information. However, the availability of material for sampling and characterization at the exploration stage is commonly limited which means that follow-up checks to ensure that the initial data and interpretation are correct will often be needed during operation. If pilot scale tests, extraction and/or processing, are carried out this will have the added benefit of producing a larger number of potential samples for sampling and testing as well as giving the opportunity to sample process waste, i.e. tailings. While the majority of waste is commonly produced during the operation phase of a mine, waste characterization needs to be considered for all phases of the mine life.

The operational phase of a mine or quarry encompasses all the activities from mineral deposit development to detailed planning for closure. There are two main waste streams from the production process that need to be characterised, i.e. waste material generated as part of the extraction that will not go through mineral processing and the waste produced during processing. The waste produced prior to mineral processing will primarily be waste rock separated at the excavation front. In a hard rock mine, sampling may be done before blasting from drill cores, or after blasting. After mineral processing the waste will primarily be tailings (i.e. tail end of the process), and samples may be collected from pipelines, discharge trenches or conveyer belts. Extractive waste may contain chemicals added as part of the production process. Normally, if not recovered for construction purposes, all extractive waste is deposited on site.

1) As defined in Directive 2006/21/EC.

This guidance is also applicable for sampling from closed sites in case sampling and testing of waste is required. Sampling at closed sites, including abandoned historic mine-sites, may in some cases require specific approaches e.g. due to accessibility and limited background information.

NOTE Given the great variety of waste types, sampling situations and objectives, this Technical Report cannot provide definitive instructions that cover all scenarios. Instead, it discusses the basic considerations to be followed, and provides guidance on selection of sampling approaches that might be relevant to the three principle phases of a mine: 1) Exploration, 2) Operation and 3) Closure. Sampling of existing waste deposits at mines that are still in operation would be very similar to Scenario 3) Closure.

2) Document structure

The structure of this sampling guideline is based on the concepts and procedural steps outlined in Figure 2 of EN 14899:2005 and subsequent subclauses, with some additions to address specific features of the extractive industry.

Clause 2 key elements of a sampling plan, is the core of this guidance document. This clause is divided into ten sub-sections that describe the steps of developing sampling plans, from defining the involved parties to describing the sampling techniques. It lists possible objectives for the different stages of the extractive waste characterization, background information that may be available, explains generic levels of testing and describes sampling approaches and techniques.

1 Scope

This Technical Report gives additional and specific information on sampling for testing of waste from the extractive industry to support the development of appropriate sampling plans. This supplementary guidance to EN 14899 is required because waste from the extractive industry differs considerably from the waste types and sampling scenarios covered in the existing technical reports (CEN/TR 15310-1 to -5) that support the Framework Standard. This guidance document should be used in conjunction with EN 14899 and its supporting technical reports CEN/TR 15310-1 to -5.

The approach to sampling described in this document is primarily focused on the requirements to undertake mineralogical and geochemical testing of the waste. Whilst much of the background information provided is also relevant to geotechnical investigations there may be important additional requirements or differences in approach for determining relevant physical parameters. For example, many geotechnical parameters are determined using field tests, which are not discussed in this document. References to alternative source documentation are provided.

The guidance provided in this document applies only to above-ground exposure to radio-nuclides present in the undisturbed earth crust and **not** to the production, processing, handling use, holding, storage, transport, or disposal of radioactive substances that are or have been processed for their radioactive, fissile or fertile properties.

This Technical Report provides some discussion of current best practice, but is not exhaustive. To clarify the text, the document provides a number of worked examples in the Annexes.

2 Key elements of a sampling plan

2.1 General

The sampling plan identifies the appropriate and practical activities required to achieve the set objectives of the characterization testing programme. The purpose of a sampling exercise shall be clearly understood by the sampler. The development of a sampling plan helps to ensure that the objectives of any waste testing programme are consistently met and is crucial for cost effective and appropriate sampling. The sampling plan provides traceability which can be used to validate the data produced. This is especially important where new datasets will be generated over time.

The framework standard EN 14899 identifies a process flow chart that defines the essential elements of a sampling plan and how those elements are linked. The basic steps identified in this flow chart have been followed in this supplementary guidance, with some minor changes (see Figure 1) to account for specific circumstances of the extractive industry. The flow chart indicates a step by step process to sampling plan development, although in reality they may be considered out of order. Some elements of the sampling plan may be prepared in parallel and iterations may be necessary. Additional information is provided in the following sections that are specific to the extractive industry.

It is important to recognise that characterization may often be an iterative process. The sampling plan may initially be developed for screening purposes and may then form the basis of a characterization study. The characterization study may require testing of samples previously collected but not subjected to testing or form the basis for collection of more samples required for more comprehensive testing all specified in the sampling (Figure 1).

Characterization of waste from a quarry may be relatively simple in comparison to wastes from metal extraction. However, generating a sampling plan using the outline approach advocated in this guidance document is still recommended. Development of a comprehensive sampling plan will facilitate discussions with stakeholders, and it may help the operator to identify issues that may require consideration.

2.2 Identify involved parties (EN 14899:2005, 4.2.1)

It is recommended that sampling plans for a given site and phase of operation are, where possible, discussed with involved parties prior to any sampling taking place. It is important to identify and include parties with an