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Earthworks - Part 7: Hydraulic placement of extractive waste

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

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Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
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ICS 93.020

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16907-7

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Earthworks - Part 7: Hydraulic placement of extractive waste

Terrassements - Partie 7 : Placement hydraulique d'excédents miniers

Erdarbeiten - Teil 7: Hydraulische Einbringung von mineralischen Abfällen

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European foreword

This document (EN 16907-7:2021) has been prepared by Technical Committee CEN/TC 396 "Earthworks", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2022, and conflicting national standards shall be withdrawn at the latest by January 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document is one of the European Standards within the framework series of EN 16907 on *Earthworks.* The set of standards prepared by CEN/TC 396 is divided into several parts, which correspond to different steps of the planning, execution and control of earthworks and should be considered collectively as a group of standards for executing earthworks. The full set of Parts is as follows:

— EN 16907-1, Earthworks — Part 1: Principles and general rules;

— EN 16907-2, Earthworks — Part 2: Classification of materials;

— EN 16907-3, Earthworks — Part 3: Construction procedures;

— EN 16907-4, Earthworks — Part 4: Soil treatment with lime and/or hydraulic binders;

— EN 16907-5, Earthworks — Part 5: Quality control;

— EN 16907-6, Earthworks — Part 6: Land reclamation earthworks using dredged hydraulic fill;

— EN 16907-7, Earthworks — Part 7: Hydraulic placement of extractive waste (this document).

Within this document, references to specific parts of the standard are written by reference to the full reference (e.g. "EN 16907-2").

These "Earthworks standards" do not apply to the environmental planning and geotechnical design that determines the required form and properties of the earth-structure that is to be constructed. They apply to the design of the earthworks materials, execution, monitoring and checking of earthworks construction processes to ensure that the completed earth-structure satisfies the geotechnical design.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

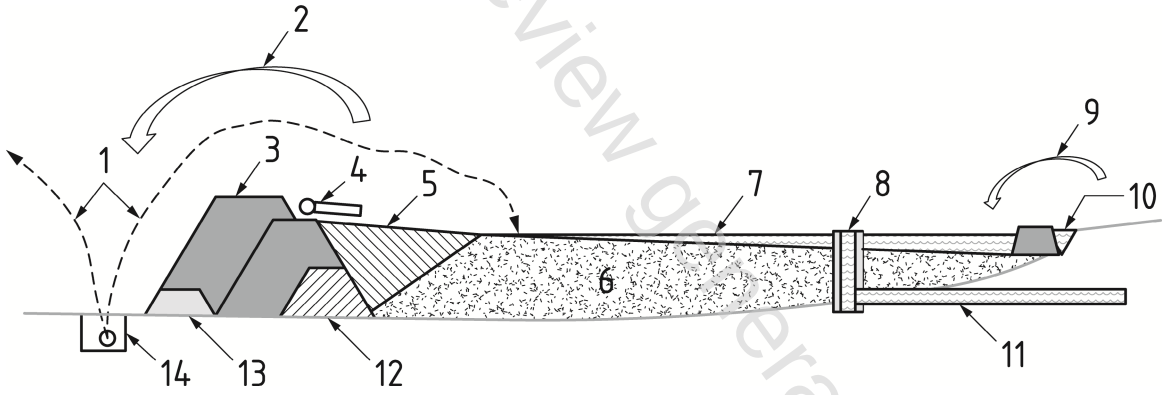
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Introduction

European Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from the extractive industries states that the preparation of a waste management plan is required for certain mine waste facilities (MWFs). One of the objectives of the waste management plan is to ensure both short- and long-term safe disposal of the extractive waste by choosing a design which achieves geotechnical and geochemical stability of any hydraulic fill placed above a pre-existing ground surface. By inference this requires that suitable features are incorporated into the design, construction, operation and maintenance, closure and after-closure of a MWF to prevent major accidents and to limit any adverse consequences for human health and/or the environment. This document addresses all technical stages of the development of a hydraulic fill project in the context of the Extractive Waste Directive (EWD), with an emphasis on waste and facility characterization and on earthworks procedures.

All sectors of the extractive industry are likely to produce a residue which, during mineral processing, will have been physically, and sometimes chemically, altered due to both the comminution and concentration processes employed. These residues (extractive waste/tailings) comprise fine particulate materials which are generally discharged from the process plant in slurry form as a hydraulic fill, noting that coarse particles are generally neither transported nor deposited by hydraulic means. Such extractive wastes, regardless of their consistency and general characteristics, need to be placed in a secure containment facility unless they are to be immediately recycled. The metal mining industry tends to refer to these facilities as “tailings management facilities” (Figure 1), the aggregates and industrial minerals sectors as “silt lagoons” (Figure 2), and the energy sector as “ash lagoons”. Within this standard, all three are referred to as mine waste facilities (MWFs).

NOTE Definitions of some of the less familiar terms used in this document can be found in Clause 3.

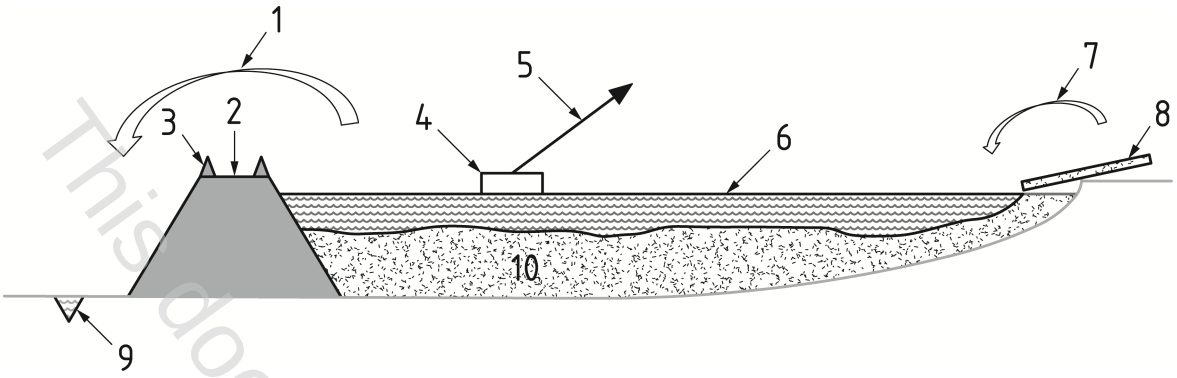


Key

1	seepage recycle to MWF or return water dam	8	process water/excess runoff via decant
2	emergency spillway	9	plant site runoff
3	stage-raised confining embankment	10	perimeter runoff diversion system
4	tailings discharge pipeline	11	return pipeline to process plant or return water dam
5	tailings beach	12	pre-deposition embankment
6	fine tailings/slimes	13	seepage control drain
7	supernatant pond/reservoir	14	seepage return pump

Figure 1 — Typical section — tailings management facility

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Key

1	emergency overflow/spillway	6	lagoon
2	earthfill confining embankment	7	site runoff
3	edge protection	8	silt discharge pipeline
4	floating lagoon level pump control system	9	drainage control channel
5	return to clean water lagoon	10	unconsolidated silt deposit

Figure 2 — Typical section — silt lagoon

When deposited using hydraulic filling techniques, the MWF for such fine particulate wastes comprises an engineered facility impounding or containing both the extractive waste and a proportion of free water derived from processing operations, from other site waters and from rainfall. This process requires the design and construction of a dam, confining embankment or other structure serving to contain, retain, confine or otherwise support such wastes on surface in a terrestrial environment, together with the appurtenant infrastructure.

Numerous techniques are available for the execution, operation and rehabilitation of a MWF, some of which are standardized and have a long history of application to the extractive industry. It is therefore recognized that no standard can prescribe or recommend specific engineering or environmental elements of the design of a complex hydraulic fill structure such as a MWF, which is site-specific and determined by the climate, geology, topography, hydrology, seismology and environmental setting. However, of importance is that hydraulic placement of extractive waste can only be managed properly if sufficient knowledge of its geochemical, physical and geotechnical properties and behaviour is available. Such knowledge may be obtained through detailed characterization of the waste and of the waste facility and its subsequent consequence classification. The different regional situations in geology and climate result in national differences in the earthwork procedures, and therefore this standard identifies the general principles and systems for the execution, operation and rehabilitation of a MWF as they relate to earthworks.

This document is part of a European Standard on Earthworks, it having been decided by CEN/TC 396 to establish a stand-alone document on the hydraulic placement of extractive wastes relating to earthworks. This document provides the geotechnical and geochemical standards necessary to meet the requirements of Directive 2006/21/EC and presents a unified approach for all stakeholders involved in the development of hydraulic fill projects and in the extension of existing mine waste facilities, together with a framework for project initiation and implementation.

This document is generic in content, and much of the text is synoptic as it is recognized that the range of extractive operations is broad and that the precise characteristics of each waste and its depositional properties will be dependent on the geology, the extraction and mineral processing techniques adopted, and on the type and location of the MWF. For more detail, reference is made to textbooks and other documents included in the Bibliography, particularly "*The hydraulic transport and storage of extractive waste, Guidelines to European Practice".*

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1 Scope

This document gives recommendations for the hydraulic placement of extractive wastes and may be applicable to the following:

— all stakeholders engaged in the deposition of extractive wastes using hydraulic placement techniques with respect to geotechnical and geochemical aspects of the investigation, engineering design, construction and operation of a mine waste facility and all associated monitoring activities;

— those extractive industries involving the production of fine particulate wastes which, in the course of industrial processing, require to be stored in a safe, stable and environmentally acceptable location;

— practitioners in non-extractive industries in fields where similar techniques may be applicable and for which no other European guidance exists.

The scope of this document includes all aspects of a dam, confining embankment or other structure serving to contain, retain, confine or otherwise support such wastes on surface in a terrestrial environment. The overall framework for the standard and for each stage of a hydraulic fill project is shown in Figure 3.

This document addresses the characterization of the extractive waste for the purposes of hydraulic placement in the MWF, both as part of the confining embankment and for safe storage. In addition the standard recommends:

— minimum requirements for the data to be acquired before the design and execution stage of a hydraulic fill project;

— guidelines for the selection of the type of confining embankment appropriate for the selected site;

— guidelines for the selection and characterization of the construction materials;

— general principles on the design and execution of the hydraulic fill project from pre-deposition through operation to closure and rehabilitation;

— guidelines for monitoring and quality control of all stages of the hydraulic fill project to ensure long-term safety and stability.

This document considers how to store safely a given material resulting from a preceding process. It does not define, establish or specify detailed elements of the design of a hydraulic fill project but provides overall recommendations in order to comply with good regulatory and engineering practice. The document recognizes that similar techniques may be applicable to the hydraulic placement of materials in the non-extractive industries where no other European guidance exists.

This document does not consider the design of earth-structures in terms of safety and serviceability. These are ruled by EN 1997 (series) (Eurocode) and other relevant standards. This document assumes that the earth-structures have been properly designed.

This document is not applicable to landfill, dredging or the hydraulic filling aspects related to grouting.

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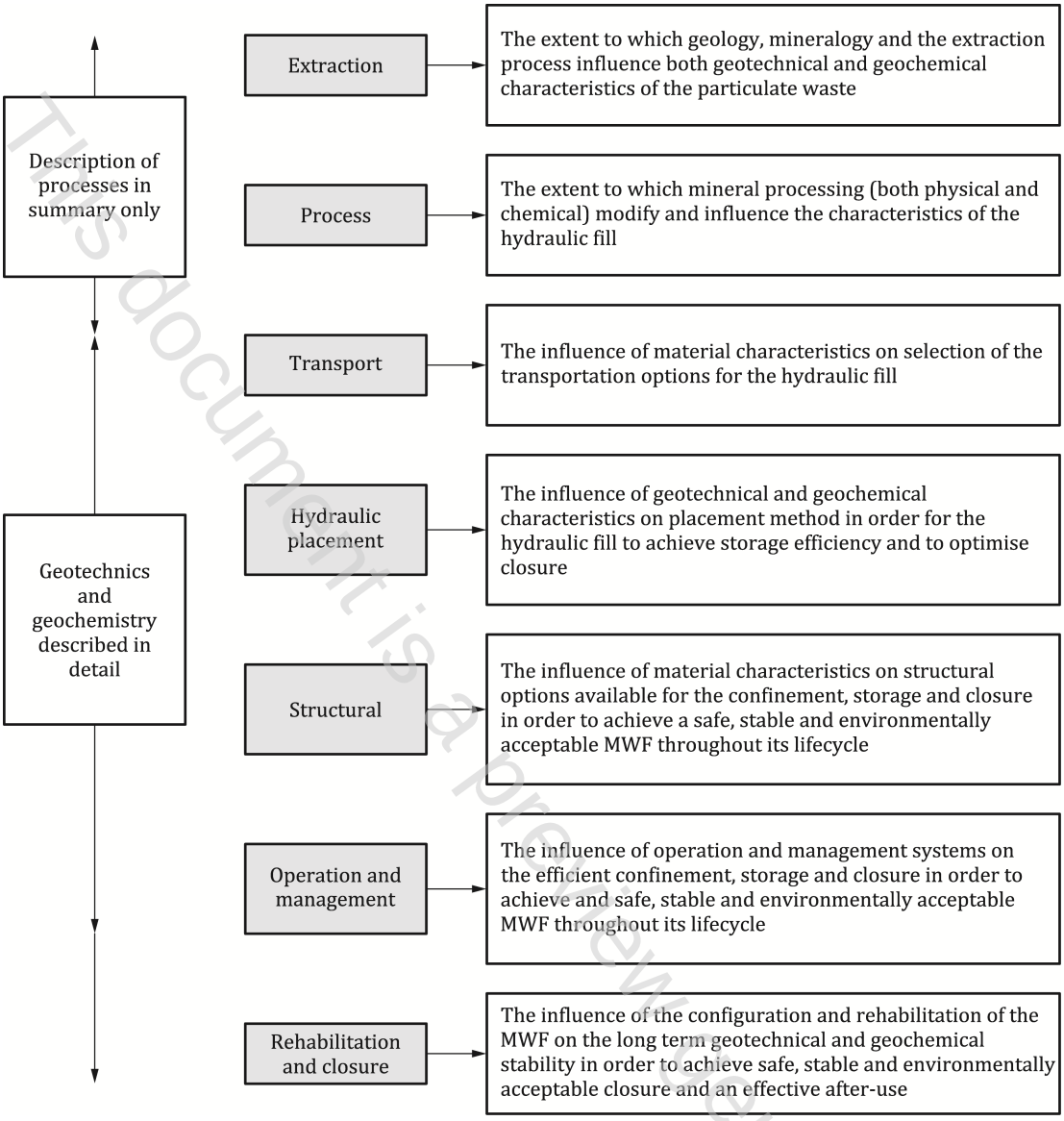


Figure 3 — Stages of hydraulic placement covered by this document

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1990, *Eurocode - Basis of structural design*

EN 1997 (series), *Eurocode 7: Geotechnical design*

EN 1998 (series), *Eurocode 8: Design of structures for earthquake resistance*

EN 14899, *Characterization of waste - Sampling of waste materials - Framework for the preparation and application of a Sampling Plan*

EN 15875, *Characterization of waste - Static test for determination of acid potential and neutralisation potential of sulfidic waste*

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EN 16907 (series), *Earthworks*

EN ISO 14688 (series), *Geotechnical investigation and testing – Identification and classification of soil (ISO 14688 (series))*

EN ISO 14689, *Geotechnical investigation and testing - Identification, description and classification of rock (ISO 14689)*

EN ISO 17892 (series), *Geotechnical investigation and testing – Laboratory testing of soil (ISO 17892 (series))*

EN ISO 18674 (series), *Geotechnical investigation and testing – Geotechnical monitoring by field instrumentation (ISO 18674 (series))*

EN ISO 22282 (series), *Geotechnical investigation and testing – Geohydraulic testing (ISO 22282 (series))*

EN ISO 22475-1, *Geotechnical investigation and testing - Sampling methods and groundwater measurements - Part 1: Technical principles for execution (ISO 22475-1)*

EN ISO 22476 (series), *Geotechnical investigation and testing – Field testing (ISO 22476 (series))*

CEN/TR 15310 (series), *Characterization of waste – Sampling of waste materials*

CEN/TS 16229, *Characterization of waste - Sampling and analysis of weak acid dissociable cyanide discharged into tailings ponds*

CEN/TR 16363, *Characterization of waste - Kinetic testing for assessing acid generation potential of sulfidic waste from extractive industries*

CEN/TR 16365, *Characterization of waste - Sampling of waste from extractive industries*

CEN/TR 16376, *Characterization of waste - Overall guidance document for characterization of waste from the extractive industries*

3 Terms and definitions

For the purposes of this document the following terms and definitions apply

Note 1 to entry: For additional information, see Directive 2006/21/EC.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
comminution
act of crushing, milling and grinding geomaterials in order to reduce their grain size in advance of mineral processing

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