SLOVENSKI STANDARD
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Zemeljska dela - 4. del: Obdelava prsti z apnom in/ali hidravličnimi vezivi

Earthworks - Part 4: Soil treatment with lime and/or hydraulic binders

Erdarbeiten - Teil 4: Bodenbehandlung mit Kalk und/oder hydraulischen Bindemitteln

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Erdarbeiten - Teil 4: Bodenbehandlung mit Kalk und/oder hydraulischen Bindemitteln

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Contents

Page

European foreword

This document (prEN 16907-4:2015) has been prepared by Technical Committee CEN/TC 396 "Earthworks", the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document is one of the product European Standards within the framework series of EN 16907 on *Earthworks*, as follows:

— *Part 1: Principles and general rules;*

— *Part 2: Classification of materials;*

— *Part 3: Construction procedures;*

— *Part 4: Soil treatment with lime and/or hydraulic binders* (this document)*;*

— *Part 5: Quality control;*

— *Part 6: Land reclamation with dredged hydraulic fill;*

— *Part 7: Hydraulic placement of mineral waste.*

Introduction

In the context of the present standard, the treatment of a material designates the operation which consists of mixing, more or less thoroughly, the material with lime, or hydraulic binder, or both of them, and optionally with additional water. The objective is to enhance the properties of materials with poor characteristics for use in earth structures.

Although the technique has been known for a long time, its application at a large scale, for the construction of earth structures, started in the 1960s. Since then, the technique has seen a spectacular development thanks to its many benefits, among which are:

— enhancement of the mechanical properties of material;

— elimination of lorry movements for disposal of site material;

— reduced lorry movements for importation of construction material;

— reduced noise and nuisance to local residents;

— less wear and tear on the local road network;

— no tipping charges or landfill tax;

— maintained landfill capacity;

— no waste of valuable non-renewable aggregate resources;

— reduced construction time and cost.

Once treated, and depending on the treatment product and the dosage, the material can be used in fill, capping layer or any part of the structure, provided it meets the specification of the project.

The treatment products considered into this standard are limited to the following standardized products: cement, fly ash, blast furnace slag, hydraulic road binder and lime.

For the purpose of this standard, these treatment products will be designated as binders.

For the purpose of this standard, cement, fly ash, blast furnace slag and hydraulic road binder will be designated as hydraulic binders. Lime is air lime and has no hydraulic property. Typical uses are as follows:

— lime is generally used to dry up wet materials, and/or to enhance the performance of cohesive materials;

— hydraulic binders are mainly used to quickly and significantly increase the mechanical performance of non-cohesive materials;

— in presence of cohesive material and depending on the application, lime and hydraulic binder may be used together, in two steps on site, or through a pre-blended form like a hydraulic road binder.

The materials considered in this standard are: soils, weak and intermediate rocks (including chalk), recycled materials, artificial materials. They can also be mixes of these different types.

The success of a treatment operation relies upon the respect of specifications as well as of good practices that closely depend on local geological and climatic conditions. Thus, in addition to the requirements of this standard, reference may be made to the guidelines of good practices valid in the place of use. Some of them are included as notes in the standard or in the annexes at the end of this document.

1 Scope

This European Standard applies to the treatment with binders of natural soils, weak and intermediate rocks (including chalk), recycled materials and artificial materials for the execution of earthworks during the construction and maintenance of roads, railways, airfields, platforms, dykes, ponds and any other types of earth structure.

It relates only to the treatment by layers for earthworks, as opposed to the treatment by columns for example.

The standard specifies the requirements for the constituents of the mixtures, the preliminary laboratory testing methodology, the laboratory performance classification, and the execution and control.

NOTE 1 The informative annexes also give example of good practices for execution and control.

The laboratory performance classification specified in this European Standard covers the two types of treatment : improvement and stabilization.

— For improvement, the classification takes into account the short term performance.

— For stabilization, the classification takes into account the medium to long term performance.

NOTE 2 For stabilization, the classification is based on the laboratory performance classification specified in FprEN 14227–15, except for the classification according to tensile strength and modulus ("R_t and E") which has been replaced by a performance classification according to "R_t and E" specific to earthworks.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 197-1, *Cement - Part 1: Composition, specifications and conformity criteria for common cements*

EN 450-1, *Fly ash for concrete - Part 1: Definition, specifications and conformity criteria*

EN 459-1, *Building lime - Part 1: Definitions, specifications and conformity criteria*

EN 13282-1, *Hydraulic road binders - Part 1: Rapid hardening hydraulic road binders - Composition, specifications and conformity criteria*

EN 13282-2, *Hydraulic road binders - Part 2: Normal hardening hydraulic road binders - Composition, specifications and conformity criteria*

EN 13286-2, *Unbound and hydraulically bound mixtures - Part 2: Test methods for laboratory reference density and water content - Proctor compaction*

EN 13286-5, *Unbound and hydraulically bound mixtures - Part 5: Test methods for laboratory reference density and water content - Vibrating table*

EN 13286-40, *Unbound and hydraulically bound mixtures - Part 40: Test method for the determination of the direct tensile strength of hydraulically bound mixtures*

EN 13286-41, *Unbound and hydraulically bound mixtures - Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures*

EN 13286-42, *Unbound and hydraulically bound mixtures - Part 42: Test method for the determination of the indirect tensile strength of hydraulically bound mixtures*

EN 13286-43, *Unbound and hydraulically bound mixtures - Part 43: Test method for the determination of the modulus of elasticity of hydraulically bound mixtures*

EN 13286-45, *Unbound and hydraulically bound mixtures - Part 45: Test method for the determination of the workability period of hydraulically bound mixtures*

EN 13286-46, *Unbound and hydraulically bound mixtures - Part 46: Test method for the determination of the moisture condition value*

EN 13286-47, *Unbound and hydraulically bound mixtures - Part 47: Test method for the determination of California bearing ratio, immediate bearing index and linear swelling*

EN 13286-48, *Unbound and hydraulically bound mixtures - Part 48: Test method for the determination of degree of pulverisation*

EN 13286-49, *Unbound and hydraulically bound mixtures - Part 49: Accelerated swelling test for soil treated by lime and/or hydraulic binder*

EN 13286-50, *Unbound and hydraulically bound mixtures - Part 50: Method for the manufacture of test specimens of hydraulically bound mixtures using Proctor equipment or vibrating table compaction*

EN 13286-51, *Unbound and hydraulically bound mixtures - Part 51: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrating hammer compaction*

EN 13286-52, *Unbound and hydraulically bound mixtures - Part 52: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrocompression*

EN 13286-53, *Unbound and hydraulically bound mixtures - Part 53: Methods for the manufacture of test specimens of hydraulically bound mixtures using axial compression*

EN 14227-2, *Hydraulically bound mixtures - Specifications - Part 2: Slag bound granular mixtures*

EN 14227-4, *Hydraulically bound mixtures - Specifications - Part 4: Fly ash for hydraulically bound mixtures*

EN 15167-1, *Ground granulated blast furnace slag for use in concrete, mortar and grout - Part 1: Definitions, specifications and conformity criteria*

3 Terms and definitions

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

3.1
air lime
lime which combines and hardens with carbon dioxide present in air

3.2
binder
product which, when mixed with a material, provides either a short term or a long term enhancement of the properties of the material

Note 1 to entry: The binders covered by this standard are limited to the following standardized products: cement, fly ash, blast furnace slag, hydraulic road binder and building lime.

3.3
binder spreading unit
equipment used to distribute the binder uniformly on the soil to be treated. These include spreaders that are capable of applying binders under the form of powder or suspension into water

3.4
cement
cement is a hydraulic binder, i.e. a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water

3.5
curing period
period of time during which a treated mixture is left undisturbed after final compaction, in prescribed conditions to limit evaporation, to allow stabilization processes to continue

3.6
demonstration area
area representative of the proposed material for stabilization using the appropriate binders and equipment, to be implemented by the contractor prior to commencement of the main stabilization works

3.7
in situ soil mixing plant
equipment used to thoroughly mix the binders with the soil. These machines come in various sizes and include mainly two types of plants: stationary tool mixers (plough) and moving tool mixers (rotovators, soil pulverisers, etc.)

3.8
fly ash
fine powder produced by the combustion of pulverized coal or lignite with or without co-combustion materials in energy generating plants and captured by mechanical or electrostatic precipitators

Fly ash may be:

— siliceous, where the essential chemical components are silicates, aluminates and iron oxides;

— calcareous, where the essential chemical components are silicates, aluminates, calcium oxide and sulphates

Note 1 to entry: Siliceous fly ash is a pozzolanic material and requires a source of calcium oxide, e.g. lime or cement, to produce a hydraulic reaction.

3.9
friable
easily broken up

Note 1 to entry: In a two stage process the initial addition of lime is primarily to make the cohesive material friable so that the cement can be added.

3.10
ground investigation
examination of a site required to provide geotechnical data which are representative of the ground conditions and relevant to the project considered. This includes surface and subsurface investigation, laboratory work and factual reporting

3.11
hydraulic binder
binder, when mixed with water, hardens both in the air and under water and remains solid, even under water

3.12
hydraulic road binder (HRB)
factory produced hydraulic binder, supplied ready for use, having properties specifically suitable for treatment of materials for bases, sub-bases and capping layers as well as earthworks, in road, railway, airport and other types of infrastructures

3.13
lime
calcium oxide and/or hydroxide, and calcium-magnesium oxide and/or hydroxide produced by the thermal decomposition (calcination) of naturally occurring calcium carbonate (for example limestone, chalk, shells) or naturally occurring calcium magnesium carbonate (for example dolomitic limestone, dolomite)

Lime may be under the form of quicklime, hydrated lime, or lime slurry

Note 1 to entry: All references to lime in this standard are for Building lime according to EN 459–1.

3.14
lime slurry
suspension of hydrated lime into water. It is produced from either quicklime or hydrated lime, in a specific device, at the lime plant or at the jobsite

3.15
mix-in-place or in-situ treatment
method of treatment which is carried out with a mobile plant

3.16
material (or soil)
for the purpose of this standard, a material can be a natural soil, or a weak or intermediate rock (including chalk), or a recycled material, or an artificial material

Note 1 to entry: For the purpose of this standard, the terms material and soil are exchangeable.