SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 17693-1:2021

01-september-2021

Zemeljska dela - Preskusi obdelave tal - 1. del: Določevanje apna za stabilizacijo zemljin s pH-testom (točka vezave apna LFP, optimalna vrednost modifikacije apna LMO)

Earthworks - Soil treatment tests - Part 1: pH-test for determination of the lime requirement of soils for stabilization (Lime Fixation Point LFP, Lime Modification Optimum LMO)

Erdarbeiten - Prüfungen zur Bodenbehandlung - Teil 1: pH Test zur Bestimmung des Kalkhydratbedarfs von Böden zur Stabilisierung (Bestimmung des minimalen Kalkhydratgehalts (LFP) und des optimalen Kalkhydratgehalts (LMO))

Terrassements - Essais de traitement de sol - Partie 1 : Essai pH pour la détermination du besoin en chaux pour la stabilisation des sols (Point de fixation de la chaux LFP, Optimum de modification de la chaux LMO)

Ta slovenski standard je istoveten z: **FprCEN/TS 17693-1**

ICS:

13.080.99	Drugi standardi v zvezi s kakovostjo tal	Other standards related to soil quality
93.020	Zemeljska dela. Izkopavanja. Gradnja temeljev. Dela pod zemljo	Earthworks. Excavations. Foundation construction. Underground works

kSIST-TS FprCEN/TS 17693-1:2021 **en,fr,de**

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

FINAL DRAFT FprCEN/TS 17693-1

July 2021

ICS 13.080.99; 93.020

English Version

Earthworks - Soil treatment tests - Part 1: pH-test for determination of the lime requirement of soils for stabilization (Lime Fixation Point LFP, Lime Modification Optimum LMO)

Terrassements - Essais de traitement de sol - Partie 1 : Essai pH pour la détermination du besoin en chaux pour la stabilisation des sols (Point de fixation de la chaux LFP, Optimum de modification de la chaux LMO)

Erdarbeiten - Prüfungen zur Bodenbehandlung - Teil 1: pH Test zur Bestimmung des Kalkhydratbedarfs von Böden zur Stabilisierung (Bestimmung des minimalen Kalkhydratgehalts (LFP) und des optimalen Kalkhydratgehalts (LMO))

This draft Technical Specification is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 396.

CEN members are the national standards bodies of 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 United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a Technical Specification. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a Technical Specification.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword

This document (FprCEN/TS 17693-1:2021) 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 Vote on TS.

Introduction

This document describes the reference method for the determination of the lime fixation point (LFP) of soils, also called lime modification optimum (LMO).

LFP (LMO) is the theoretical lime content from which can occur the setting and hardening of soil-lime mix, resulting from the pozzolanic reactions due to the combination of lime with clay components of the soil.

It can be considered as the optimal lime amount to be added in a soil in order to perform its improvement, and the minimal lime amount from which stabilization can occur (terms “improvement” and “stabilization” as defined in EN 16907-4).

1 Scope

This document describes the reference method for the determination of the lime fixation point (LFP) in soil treatment for earthworks.

The test consists in measuring the lowest quantity of lime to be added in a soil suspension in water that will result in a pH value of the soil-lime mix suspension of 12,4, measured at 25 °C ± 1 °C.

This test method cannot be used to provide information about soil reactivity with lime, or other performance values (mechanical characteristics of soil-lime mixes) applicable for improvement or stabilization purposes. Those performance tests will be conducted in a laboratory from a specific study, the lime dosage to be applied being indicated from this method.

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

ISO 3310-1, *Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth*

ISO 3310-2, *Test sieves - Technical requirements and testing - Part 2: Test sieves of perforated metal plate*

3 Terms, definitions, abbreviations and symbols

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

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 Terms

3.1.1
subsample
sample obtained by means of a sample reduction procedure

3.1.2
test portion
sample used as a whole in a single test

3.1.3
lime
general term which includes quicklime, hydrated lime, lime slurry (“milk of lime”), defined and specified according EN 459-1

3.1.4
lime content
amount of added lime in the soil, expressed as the percentage of lime mass to the dry mass of the soil, or expressed as the percentage to the sum of dry mass of the soil and added lime mass

3.1.5
soil improvement with lime
operation which modifies the physical properties of a material - such as water content, plasticity, water and frost susceptibility, compactibility and swelling potential - by the addition of lime (quicklime, hydrated lime or lime slurry)

Note 1 to entry: The quantity of lime added may not be sufficient to induce significant permanent properties

3.1.6
soil stabilization with lime
operation consisting in obtaining an homogeneous mixture of soil with lime, and optionally with water, which properly compacted significantly changes (generally in the medium or long term) the characteristics of the soil in a way that renders it stable, particularly with respect to the action of water and frost

3.1.7
lime fixation point
lime modification optimum
the theoretical lime content from which can occur the setting and hardening of soil-lime mix, resulting from the pozzolanic reactions due to the combination of lime with clay components of the soil

Note 1 to entry: It can be considered as the optimal lime amount to be added in a soil in order to perform its improvement, and the minimal lime amount from which stabilization can occur. In the rest of this document, the symbol c_{LFP} will be used to express this lime concentration.

3.1.8
pH
figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are acid and higher values are alkaline.

Note 1 to entry: The pH is equal to $-\log_{10}c_{H^+}$, where c_{H^+} is the hydrogen ion concentration in moles per litre (mol/L).

3.2 Abbreviations and symbols

Abbreviations for terms and tests

LFP	lime fixation point
LMO	lime modification optimum

Symbols for quantities

C	Weight ratio between 0/5 mm fraction and 0/50 mm fraction	dimensionless (%)
c_{LFP}	LFP : percentage of lime by dry mass of soil	dimensionless (%)
$c_{LFP,soil+lime}$	LFP : percentage of lime by dry mass of soil and amount of added lime	dimensionless (%)
c_{ML}	Lime slurry (milk of lime) concentration	dimensionless (%)
c_{MLS}	Lime slurry (milk of lime) concentration (% solid)	dimensionless (%)
c_Q	Quicklime content	dimensionless (%)

c_S	Hydrated lime (slaked lime) content	dimensionless (%)
D_{max}	Maximum diameter of particles in a soil mass	mm
m	Wet mass of the subsample for the determination of the water content	g
m'	Dry mass of the subsample for the determination of the water content	g
m_0	Initial wet mass of the subsamples for LFP test	g
m_1	Calculated dry mass of the subsamples for LFP test	g
m_2	Lime weight to be added	g
w	Water content of the subsample	dimensionless (%)

4 Principle of the test

Increments of lime (quicklime, hydrated lime or lime slurry of known purities or concentrations) are added successively in a test beaker containing a suspension of the soil test portion in water, at a temperature of 25 °C ± 1 °C. The pH values of the soil-mix suspension are measured and recorded after each addition stage with a calibrated pH-meter.

The pH value of at least 12,4 results from the free lime remaining in the soil-lime mixture suspension.

A graph plotting recorded pH values (y-axis) vs lime additions (x-axis) is established and allow the determination of the c_{LFP}.

An alternative method consists in the preparation of 12 beakers of identical soil suspensions and proceed in each beaker to a unique lime addition, ranging from 0 % to 5 %.

A graph plotting recorded pH values (y-axis) vs lime additions (x-axis) is established and allow the determination of the c_{LFP}.

5 Reagents

5.1 Lime

Quicklime, hydrated lime or lime slurry are defined in EN 459-1. Preferably, the lime foreseen to be provided for site operations will be used for the test. If this is not the case or if unknown, then calculations will be done, from respective available CaO of testing lime and provided lime on site, in order to correlate determined c_{LFP} from the test and for the site.

The safety precautions to be taken during the lime manipulation in laboratory shall be followed according to the Safety Data Sheet provided by the lime manufacturer.

5.2 Water

Demineralized or deionized water will be used.

6 Apparatus

6.1 *Balances,* with a maximum permissible measurement error less than 0,3 % of the weighed mass;

6.2 *Test sieves,* which shall conform to ISO 3310-1 or ISO 3310-2, of 63 µm, 50 mm and 5 mm aperture, with guard sieve (if necessary);

6.3 *Beakers, glass or plastic,* capacity 500 ml minimum (main test) or 250 ml minimum (alternative test);

6.4 *Agitators*: impeller agitator having a rotational speed allowing to obtain a permanent whirl inside the beaker (main test method); magnetic rods and magnetic stirrer(s) able to ensure the simultaneous stirring of 12 beakers and obtain similar whirl (alternative test method);

6.5 *Ventilated oven,* thermostatically controlled to maintain a temperature of 105 °C ± 5 °C, or microwave oven, of 1,5 kW minimal rated power;

6.6 *pH-meter,* equipped with reference electrode and glass pH-sensitive electrode, and capable of displaying 0,01 pH units at 0,1 pH accuracy, over a range from 4 to 14. Buffer solutions will be used for preliminary pH-meter calibration, for example pH 4, 7, 10, 11, 12.

7 Preparation of the test portions

7.1 If D_{max} is greater than 50 mm

Sample 10 kg of the fraction 0/50 mm, then apply procedure of 7.2.

7.2 If D_{max} is ranging between 5 mm and 50 mm

Prepare a mass of wet material greater than 200 × D_{max} (mass in grams, D_{max} in millimetres). Sieve, if necessary by washing, the particle fraction 0/5 mm of the sample.

Washing procedure for materials > 5 mm

Materials concerned: materials that after dry sieving visually present a significant amount of elements less than 5 mm glued on the refusal obtained as a result of this sieving.

Step 1 – Brushing:

The first step is to perform a dry brushing of the refusal obtained to recover the elements less than 5 mm glued or agglomerated. If at the end of this operation, an important amount of elements smaller than 5 mm persists, it is then necessary to carry out a washing.

Step 2 – Washing:

The procedure is:

1/ soaking the refusal to 5 mm;

2/ washing (using a brush, a paintbrush or other non-metallic adapted tool) on a 5 mm sieve, using water as least as possible (if possible without adding water after the soaking phase or a quick rinsing with clean water after washing with the water charged with soaking);

3/ decantation then siphoning (if feasible);

4/ drying at a temperature not exceeding 50 °C; the materials should not be dried completely;

5/ blend of the 2 fractions 0/5 mm obtained by the initial sieving and the washing operation;

6/ homogenization and sampling of the test sample by quartering.

Determine the weight proportion C (%) of the dry fraction 0/5 mm contained in the material (or into the 0/50 mm fraction if D_{max} > 50 mm).

Then apply the procedure of 7.3.

7.3 If D_{max} is smaller than or equal at 5 mm

Prepare a mass of wet material greater than 200 × D_{max} (mass in grams, D_{max} in millimetres).