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SLOVENSKI STANDARD
SIST EN 14701-2:2013

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Nadomešča:
SIST EN 14701-2:2006

Karakterizacija blata - Filtracijske lastnosti - 2. del: Določanje specifične odpornosti do filtriranja

Characterisation of sludges - Filtration properties - Part 2: Determination of the specific resistance to filtration

Charakterisierung von Schlämmen - Filtrationseigenschaften - Teil 2: Bestimmung des spezifischen Filtrationswiderstands

Caractérisation des boues - Propriétés de filtration - Partie 2: Détermination de la résistance spécifique à la filtration

Ta slovenski standard je istoveten z: EN 14701-2:2013

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EUROPEAN STANDARD

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Characterisation of sludges - Filtration properties - Part 2: Determination of the specific resistance to filtration

Caractérisation des boues - Propriétés de filtration - Partie 2: Détermination de la résistance spécifique à la filtration

Charakterisierung von Schlämmen - Filtrationseigenschaften - Teil 2: Bestimmung des spezifischen Filtrationswiderstands

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Foreword

This document (EN 14701-2:2013) has been prepared by Technical Committee CEN/TC 308 "Characterization of sludges", 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of an identical text or by endorsement, at the latest by October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

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

This document supersedes EN 14701-2:2006.

Other parts of EN 14701 are:

— *Part 1: Capillary suction time (CST)*;

— *Part 3: Determination of the compressibility*;

— *Part 4: Determination of the drainability of flocculated sludges*.

Most significant changes made since the latest edition:

— "Part 4 …" added to Foreword;

— Introduction modified;

— CEN/TR 14742 added to Normative References;

— Clause "Principle" modified and better specified;

— List Entry 5.1.3 modified and better specified;

— List Entry 5.8 added;

— Clause 6 better specified;

— In Formula (1), "m" instead of "C_o";

— Table 1 simplified;

— text added in Clause 7;

— List Entry c) added in Clause 9;

— former Annex A deleted;

— bibliographical references added.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

The specific resistance to filtration is a parameter which indicates the suitability of sludge to be filtered. The value of the specific resistance to filtration has great importance in filtration processes as it can be useful for estimating the performance of full-scale filtering devices, mainly pressure filters, and comparing filterability characteristics of sludges produced in different plants. Specific resistance measurements can also give indications on both the optimal type and dosage of conditioner to be used (CEN/TR 14742).

This revised version only includes editorial changes that do not influence the original, validated method.

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1 Scope

This European Standard specifies a method for determining the specific resistance to filtration of conditioned and non-conditioned sludges, provided that no sedimentation occurs during filtration (i.e. single phase suspension with particles in suspension).

This European Standard is applicable to sludges and sludge suspensions from:

— storm water handling;

— urban wastewater collecting systems;

— urban wastewater treatment plants;

— industrial wastewater that has been treated similarly to urban wastewater (as defined in Directive 91/271/EEC);

— water supply treatment plants.

This method is also applicable to sludge and sludge suspensions of other origins.

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 12832:1999, *Characterization of sludges — Utilization and disposal of sludges — Vocabulary*

EN 12880, *Characterization of sludges — Determination of dry residue and water content*

CEN/TR 14742, *Characterization of sludges — Laboratory chemical conditioning procedure*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12832:1999 and the following apply.

3.1
specific resistance to filtration
property representing the resistance to filtration of a layer of particles having a unit mass of dry solids deposited on a unit filtering area

4 Principle

This method is based on the flow of a liquid through a porous medium in accordance with Darcy's law (see Annex A). The specific resistance to filtration is determined by pouring a suitable volume of sludge into a filtering device, allowing the liquid to be filtered under constant vacuum or pressure, whilst recording the amount of filtrate over time.

Considering that for sludges this parameter is affected by pressure value, this standard has been validated for the determination of specific resistance to filtration at pressure values (50 ± 5) kPa, (150 ± 10) kPa and (300 ± 15) kPa, as specifically indicated in Clause 6.

If necessary, as in the case of tests intended to size or optimise industrial filters, tests may be carried out at different pressures, provided results have been validated in advance.

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5 Apparatus

5.1 Filtration apparatus with a capacity of 250 ml, and filter diameters between 60 mm and 90 mm (see Annex B).

5.1.1 Apparatus for filtration under reduced pressure (see Figure B.1).

5.1.2 Apparatus for filtration under pressure up to 1 MPa (see Figure B.2 a)).

5.1.3 Apparatus for filtration under pressure up to 1 MPa with a piston (see Figure B.2 b)) equipped with a pressure sensor under the piston to measure the actual applied pressure.

If this set-up is not given, piston friction is not taken into account in the pressure measurement and air filtration is preferred.

5.2 Graduated cylinders with a capacity of 100 ml and 250 ml.

5.3 Vacuum pump, or air pressure system, or hydraulic system for pressure application, including pressure adjustment system (regulator or reducer) and pressure gauge.

5.4 Chronometer, e.g. stopwatch, computer.

5.5 Beaker with a capacity of 500 ml.

5.6 Pipettes.

5.7 Filtering medium, filter paper (extra fast, ash-free), with a particle retention between 20 µm and 25 µm and a filtration flow rate of about 100 ml/min and a thickness of 0,22 mm (e.g. Whatman 41[®1])).

Synthetic, or stainless metallic cloth may also be used if they can be shown to lead to the same results.

5.8 Filtering medium support.

5.9 Apparatus for determining sludge dry residue and water content (see EN 12880).

5.10 Thermostatic cell, for determinations at non-ambient temperatures.

6 Procedure

6.1 General

Measure the dry residue of the sludge, C_o, in accordance with EN 12880 and assume that the dry residue measured in g/kg is equivalent to the concentration measured in g/l. Prior to measuring, ensure the sludge is at room or test temperature.

If sludge has to be conditioned, this operation shall be carried out according to CEN/TR 14742.

6.2 Reduced pressure (Figure B.1)

6.2.1 Keep the valve between filter (5.1) and vacuum/pressure system (5.3) closed during the procedure, maintaining the system at an absolute pressure of (50 ± 5) kPa.

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1) This information is given for the convenience of users of this document and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

6.2.2 Put the filtering medium (5.7) in the funnel, moisten it with water and avoid any air entrance into the filter.

6.2.3 Measure the temperature, put (100 ± 1) ml of non-conditioned sludge or (200 ± 2) ml of conditioned, or of easily filterable sludge into the funnel after gentle homogenisation by pouring the sludge 3 times to 4 times from one beaker to another (only in case of non-conditioned sludge), open the valve and start filtration.

6.2.4 Record filtrate volumes, V, and corresponding times, t, only after collecting at least 10 % of the initial filtrate volume. Recording depends on flow rate and could range from every 5 s at the beginning until every 60 s or more (for sludge of low filterability) at the end. Stop the filtration when one of the following conditions occurs:

— pressure drops down (breaking of cake);

— filtrate flow rate instantaneously drops down;

— plot t/V vs. V deviates from linearity;

— filtration time exceeds 60 min.

6.2.5 Measure the dry mass of the cake after filtration in accordance with EN 12880, and measure the dynamic viscosity of the filtrate at test temperature.

6.3 Under pressure (Figure B.2 a))

6.3.1 While keeping the valve between the filter (5.1) and the air pressure system (5.3) closed, adjust the system to (50 ± 5) kPa, or (150 ± 10) kPa, or (300 ± 15) kPa above atmospheric pressure. The pressure shall be constantly maintained during the whole procedure.

6.3.2 Put the filtering medium (5.7) into the filtration cell, moisten it with water and avoid any air entrance into the filter.

6.3.3 Measure the temperature and put 100 ml of non-conditioned sludge or 200 ml of conditioned, or of easily filterable sludge into the apparatus after gentle homogenisation by pouring the sludge 3 times to 4 times from one beaker to another (only in case of non-conditioned sludge).

6.3.4 Close the sludge inlet, open the valve of the air pressure system and start the filtration process.

6.3.5 Record filtrate volumes, V, and corresponding times, t, only after collecting at least 10 % of the initial filtrate volume. Recording depends on flow rate and could range from every 5 s at the beginning until every 60 s or more (for sludge of low filterability) at the end. Stop the filtration when one of the following conditions occurs:

— pressure drops down (breaking of cake);

— instantaneous filtrate flow rate drops down;

— plot t/V vs. V deviates from linearity;

— filtration time exceeds 60 min.

6.3.6 Measure the dry mass of the cake after filtration in accordance with EN 12880 and measure the dynamic viscosity of the filtrate at test temperature.

6.4 Under pressure with a piston (Figure B.2 b))

6.4.1 Follow the procedure as described in 6.3.1 to 6.3.3.

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6.4.2   Close the sludge inlet.

6.4.3   Insert the piston into the filtration cell. Make sure that the piston is in close contact with the sludge surface by purging the air through the air outlet.

6.4.4   Close the air outlet and close the filtration system.

6.4.5   Open the pressure system valve and start filtration.

6.4.6   Record filtrate volumes, V, and corresponding times, t, only after collecting at least 10 % of the initial filtrate volume. Recording depends on flow rate and could range from every 5 s at the beginning until every 60 s or more (for sludge of low filterability) at the end. Stop the filtration when one of the following conditions occurs:

— pressure measured by the sensor drops down (beginning of the compression phase);

— plot t/V vs. V deviates from linearity;

— filtration time exceeds 60 min.

6.4.7   Measure the dry mass of the cake after filtration in accordance with EN 12880 and dynamic viscosity of filtrate at test temperature.

NOTE   In 6.2 to 6.4, it is assumed that the volume of the cake can be neglected.

In 6.2 to 6.4, results of tests carried out at different pressures have to be validated in advance.

7   Expression of results

For the calculation of the specific resistance to filtration, r, Formula (1) is used:

$$r = \frac{2 \cdot \Delta p \cdot A^2 \cdot b}{\mu \cdot m}$$

(1)

where

Δp is the pressure drop across the filter;

A is the filtration area;

b is the slope of the linear part of the curve obtained by plotting t/V vs. V;

μ is the viscosity of filtrate at the temperature of the sludge (if not known, use water viscosities as a function of temperature as reported in Table C.1 by assuming that filtrate viscosity is equal to water viscosity);

m is the mass of solids deposited on the filtering medium per unit volume of filtrate.

NOTE   It is assumed that filtrate viscosity is equal to water viscosity.

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The following measurement units apply:

Table 1 — Measurement units

r	m/kg
A	m^2
μ	Pa · s
m	kg/m^3
C_o	kg/m^3
b	s/m^6
Δp	Pa
t	s
V	m^3

The slope of the linear part of the curve obtained by plotting t/V vs. V is to be determined between the point where linearity begins (i.e. when the regression coefficient of $t/V = f(V)$ becomes constant) and the point where filtration ends (see 6.2.4 or 6.3.5 or 6.4.6).

The procedure described is limited for extremely compressible materials such as biological sewage sludge. Specific resistance can be defined only when Formula (1) is valid, i.e. when the curve $t/V = f(V)$ is a straight line without slope variation or presents a linear part during the removal of the most important part of filtered volume, i.e.:

— the pressure drop remains constant during filtration (Δp constant);

— no sedimentation (sedimentation velocity at least < 1 mm/s) occurs (m constant);

— the initial clogging of the filtering medium does not increase during filtration (R_m constant);

— no migration of fines, deformation of particles or cracking of cake occurs during filtration (r constant).

In case of fast tests, it is possible to replace m by C_o, the initial dry residue of the sludge, provided that the sludge concentration is low (dry solids mass < 1 % of sludge mass) and mass of water in the cake inferior to mass of solids so that the mass of the cake is very low compared to the mass of the sludge. Correlation between m and C_o is given by Formula (2):

$$m = \frac{\dfrac{\rho_l}{\rho_{susp}} \cdot C_o}{1 - \left(1 + \dfrac{\rho_l}{\rho_s} \cdot \dfrac{\varepsilon}{1 - \varepsilon}\right) \cdot \dfrac{C_o}{\rho_{susp}}} \tag{2}$$

where

$\rho_{susp}, \rho_s, \rho_l$ are the respective volumetric masses of each respective suspension (solids and liquids);

ε is the cake porosity.

A sludge can be considered as filterable on industrial scale when its specific resistance to filtration is lower than 5×10^{12} m/kg at 50 kPa.