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Karakterizacija blata ï Filtracijske lastnosti ï 2. del: Doloļ anje specifiļ ne odpornosti do filtriranja

Characterization 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 en filtration - Partie 2 : Détermination de la résistance specifique a la filtration

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Foreword

This document (EN 14701-2:2006) 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of an identical text or by endorsement, at the latest by December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006.

Other parts of this European Standard are:

— Part 1: Capillary suction time (CST);

— Part 3: Determination of the compressibility.

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

Introduction

The specific resistance to filtration is a parameter, which indicates the suitability of sludge to be dewatered by means of a filtration process. The value of the specific resistance to filtration has great importance in the dewatering processes as it can be useful for estimating the performance of full-scale filtering devices, mainly pressure filters, and comparing dewaterability 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 (prCEN/TR 14742).

1 Scope

This document specifies a method for determining the specific resistance to filtration of sludges, conditioned or non-conditioned.

This document is applicable to sludges and sludge suspensions from:

— storm water handling;

— urban wastewater collecting systems;

— urban wastewater treatment plants;

— treating industrial wastewater similar 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 referenced documents are indispensable for the application 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 12880, *Characterization of sludges — Determination of dry residue and water content*

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

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

The principle of the method is based on the flow of a liquid through a porous medium according to Darcy's law, determined by pouring a reasonable volume of sludge into a filtering device and recording the amount of filtrate with time.

5 Apparatus

Ordinary laboratory apparatus and the following:

5.1 Filtration apparatus able to contain a maximum sludge volume of 250 ml and filter diameter between 60 mm and 90 mm (see Annex A)

5.1.1 Filtration apparatus for determining under reduced pressure (see Figure A.1)

5.1.2 Filtration apparatus for determining under pressure up to 1 MPa (see Figure A.2)

5.1.3 Filtration apparatus for determining under pressure up to 1 MPa with a piston (see Figure A.3)

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

5.3 Vacuum pump, or pressure air system

5.4 Chronometer

5.5 Conventional beakers with a capacity of 500 ml

5.6 Pipettes

5.7 Filter paper, extra fast, ashless, with a particle retention between 20 µm to 25 µm and a filtration speed of about 54 s/100 ml and a thickness of 0,22 mm (e.g. Whatman 41[1)])

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

6 Procedure

6.1 Reduced pressure (Figure A.1)

6.1.1 Measure the dry residue of the sludge after filtration or centrifugation, 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.

6.1.2 Keeping closed the valve of connection between filter (5.1) and vacuum system (5.3), put the system at an absolute pressure of (50 ± 5) kPa. The pressure shall be constantly maintained during the whole procedure.

6.1.3 Put the filter paper (5.7) in the funnel, make it wet with water and avoid any air entrance into the filter.

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

6.1.5 Record filtrate volumes, V and corresponding times, t only after collecting a filtrate volume at least equal to 10 % of the initial one. Stop the filtration when one of the following conditions occurs:

— pressure drops down (breaking of cake);

— plot t/V versus V deviates from linearity;

— filtration time is longer than 60 min.

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 Under pressure (Figure A.2)

6.2.1 Measure the dry residue of the sludge after filtration or centrifugation, 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.

6.2.2 Keeping closed the valve of connection between filter (5.1) and air pressure system (5.3), adjust the system to (50 ± 5) kPa above atmospheric pressure. The pressure shall be constantly maintained during the whole procedure.

6.2.3 Put the filter paper (5.7) in the funnel, make it wet with water and avoid allowing any air into the filter.

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

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

6.2.6 Record filtrate volumes, V and corresponding times, t only after collecting a filtrate volume at least equal to 10 % of the initial one. Stop the filtration when one of the following conditions occurs:

— pressure drops down (breaking of cake);

— plot t/V versus V deviates from linearity;

— filtration time is longer than 60 min.

6.3 Under pressure with a piston (Figure A.3)

6.3.1 Follow the procedure as described under 6.2.1 to 6.2.4.

6.3.2 Close the sludge inlet.

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

6.3.4 Close the outlet and close the filtration system.

6.3.5 Open the air pressure valve and start filtration.

6.3.6 Record filtrate volumes, V and corresponding times, t only after collecting a filtrate volume at least equal to 10 % of the initial one. Stop filtration when one of the following conditions occurs:

— plot t/V versus V deviates from linearity;

— filtration time is longer than 60 min.

NOTE In all cases (subclauses 6.1 to 6.3) it is assumed that the volume of the cake can be neglected.

7 Expression of results

For the calculation of the specific resistance to filtration, r the following equation, valid for constant pressure drop filtration is used:

$$r = (2 \times \Delta p \times A^2 \times b) / (\mu \times C_o) \quad (1)$$

where

Δp is the pressure drop across the filter;

A is the filtration area;

μ is the viscosity of filtrate at the temperature of the sludge (water viscosities as a function of temperature are reported in Table B.1);

C_o is the initial dry residue of the sludge;

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

The following measurement units apply:

Table 1 — Measurement units

r[a]	s^2/g	m/kg
A	cm^2	m^2
μ	g/cm × s	Pa × s
C_o	g/cm^3	kg/m^3
b	s/cm^6	s/m^6
Δp	g/cm^2	Pa
t	s	s
V	cm^3	m^3
a (m/kg) = 9,81 m/s^2 x 10^3 x (s^2/g)		

NOTE A sludge can be considered as filterable on industrial scale when its specific resistance to filtration is lower than 5 x 10^{12} m/kg (or 5 x 10^8 s^2/g).

8 Precision

Results of validation trials are summarized in Annex C (informative).

9 Test report

The test report shall include the following information:

a) reference to this document;

b) all information necessary for the complete identification of the sample;

c) method used 6.1,6.2 or 6.3 with a reference to this document;

d) test results obtained with the respective method used;

e) any details not specified in this document or which are optional and any other factor which may have affected the results.