SLOVENSKI STANDARD
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Karakterizacija blata - Lastnosti filtriranja - 4. del: Določevanje prepustnosti kosmičenega blata

Characterization of sludges - Filtration properties - Part 4: Determination of the drainability of flocculated sludges

Charakterisierung von Schlämmen - Filtrationseigenschaften - Teil 4: Bestimmung der Entwässerung von geflockten Schlämmen

Caractérisation des boues - Propriétés de filtration - Partie 4 : Détermination de l'aptitude à l'égouttage des boues floculées

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Characterization of sludges - Filtration properties - Part 4: Determination of the drainability of flocculated sludges

Caractérisation des boues - Propriétés de filtration - Partie 4 : Détermination de l'aptitude à l'égouttage des boues floculées

Charakterisierung von Schlämmen - Filtrationseigenschaften - Teil 4: Bestimmung der Entwässerbarkeit geflockter Schlämme

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN 14701-4:2017) has been prepared by Technical Committee CEN/TC 308 "Characterization of sludges", the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 14701-4:2010.

Other parts of this European Standard are:

— Part 1: Capillary suction time (CST);

— Part 2: Determination of the specific resistance to filtration;

— Part 3: Determination of the compressibility.

Introduction

The determination of drainability of flocculated sludge is an important parameter for evaluating their suitability to be thickened by means of a draining process. It also gives indications for the choice of flocculant or their dosage in view of the thickening of the sludge through a filtering medium. These easy and quick tests are the best means to narrow the number of products to be tested in full scale experiments and to adapt the pre-treatment to the sludge variability.

The results obtained are the mass of filtrate collected in a standard time or the time required to recover a given volume of filtrate (commonly 50 % of the water content of the sludge), the maximum volume of filtrate and the corresponding wet and dry mass of the sludge, the undissolved solids remaining in the filtrate and the best flocculant and its optimum dose in the case of comparative tests. In order to ease the comparison of products and their dosing, an adimensional number gathering the different information obtained during a drainage test: kinetics data of filtrate release, filtrate and thickened sludge quality can be used.

1 Scope

This document specifies a method for the determination of drainability of flocculated sludge. It is applicable to sludge 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 suspensions from other origin.

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 872, *Water quality — Determination of suspended solids — Method by filtration through glass fibre filters*

EN 12832, *Characterization of sludge — Utilization and disposal of sludge — Vocabulary*

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

EN 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 and the following apply.

3.1
drainability
ability of treated sludge to separate from sludge liquor by gravity filtration

3.2
flocculation
coagulation by means of inorganic flocculants or organic ones (polyelectrolytes)

4 Sludge conditioning

For flocculation, the sludge will be mixed with flocculant in repeatable and quantified conditions according to EN 14742 for a laboratory preparation or sampled already flocculated.

5 Principle

A given volume of flocculated sludge is poured in a filter cell, the mass of filtrate collected is recorded versus time and the corresponding wet and dry mass of the sludge retained on the filtering medium and the undissolved solids remaining in the filtrate are measured.

6 Apparatus

Ordinary laboratory apparatus and the following (see Annex A, informative):

6.1 Transparent tube (e.g. glass, polyethylene, etc.) of 150 mm diameter and of about 200 mm height. It is supported by a system composed of a filtering medium tightened in a device equipped with an appropriate sealing joint.

6.2 Filtering medium whose characteristics shall be the same of that used in the full scale drainage device and in comparative tests.

6.3 Filtrate draining device fixed under the filtering medium.

6.4 Beaker for the filtrate collection.

6.5 Weighing balance with an accuracy of at least 0,1 g connected to a computer to continuously record the cumulative mass of filtrate collected over time. The software will be able to record data every 0,5 s.

6.6 Apparatus for the determination of dry solids content of the sludge retained on the filtering medium.

6.7 Apparatus for the determination of suspended solids in the filtrate.

To allow a correct interpretation of data, the comparison of flocculation conditions should be made with the same test equipment.

7 Procedure

a) Prepare the balance and the software to record the mass of filtrate as soon as the first drops of filtrate are collected.

b) Measure the water content of the flocculated sludge.

c) Gently pour (without shaking) 1 l ± 0,2 l of flocculated sludge (record the exact mass) in the centre of the cell for the sludge to recover the whole surface of the filtering medium.

d) Record the cumulative mass of filtrate collected over time every 0,5 s at least during the first 30 s.

e) Stop the test when the mass of filtrate to initial mass of sludge ratio is constant to within 0,1 g or after 10 min.

f) Measure the concentration of suspended solids in the filtrate (see EN 872) and the wet and dry mass of the sludge retained on the filter medium (see EN 12880).

g) Repeat steps a) to f) for at least two times if repeatability measurements are needed.

8 Expression of results

Plot adimensional mass versus time: $\frac{M}{M_0} = f(t)$

where

M is the mass of filtrate, in g;

M_0 is the initial mass of sludge, in g;

t is the time of experiment, in s.

Record the following data obtained for each test:

a) adimensional mass of filtrate recovered at t = 30 s, t = 90 s and at the end of the test;

b) time necessary to collect a volume of filtrate corresponding to 50 % of the water content of the sludge;

c) dryness of the cake retained on the filtering medium;

d) dry mass of suspended solids per unit volume of filtrate.

NOTE The optimal operating conditions are those for which the drainage is the fastest to remove the maximal drainable quantity of water, the mass of wet and dry solids retained on the filter medium is the highest, and the mass of suspended solids in the filtrate is the lowest.

The time required to recover 90 % of the total mass of filtrate determined as illustrated Figure 1, the final sludge dryness after thickening and the solids content in the filtrate allow the calculation of the drainability index (E_g) which is the ratio of 3 parameters:

— Solids concentration factor assessed by the ratio of the thickened sludge dryness at the end of the test and the initial solids content of the sludge. $P_1 = \frac{Si_f}{Si_0}$

— Drainage kinetics parameter assessed by the measurement of the time required to recover 90 % of the total mass of filtrate as illustrated Figure 1. An adimensional number was defined by dividing this time by a sizing parameter of belt thickener which is equal to 60 s for classical industrial machines. $P_2 = \frac{t_{90}}{60}$

— The filtrate quality parameter (P_3) defined, as the ratio between the residual concentration of suspended matters in the filtrate and the initial solids content of the sludge. $P_3 = \frac{SM_r}{Si_0}$

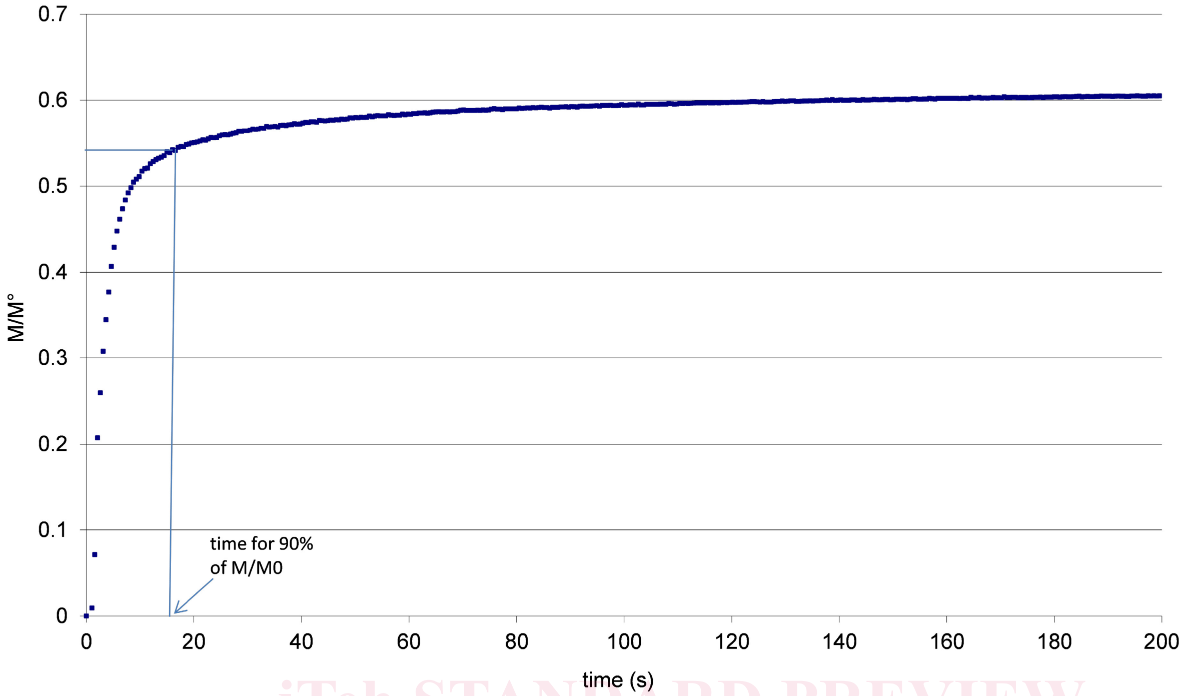

Figure 1 — Determination of t_{90} with a classical drainage curve

The drainage index (E_g) is expressed by the following formula as discussed in [2]:

$$E_g = \ln\left(\frac{P_1}{P_2^{\alpha} \times P_3^{\beta}}\right) = \ln\left(\frac{\dfrac{Si_f}{Si_0}}{\left(\dfrac{t_{90}}{60}\right)^3 \times \left(\dfrac{SM_r}{Si_0}\right)^{\frac{1}{4}}}\right)$$

Annex D gives information about the use of drainability index for drainage process optimization.

9 Test report

The test report shall contain the following information:

a) reference to this document;

b) identification of the sludge (origin, type, identification, concentration, method of sampling and storage);

c) identification of the flocculation conditions and preparation;

d) identification of the operating conditions (initial mass and water content of sludge, reference and supplier of the filtering medium);

e) adimensional mass recovered versus time with at least the volume of filtrate collected at t = 30 s, at t = 90 s and at the end of the test

f) time (in seconds) corresponding to the collection of 50 % of the initial water content of the sludge;

g) dry mass of the suspended solids per unit volume of filtrate (in mg/l);

h) dryness (mass fraction in %) of sludge cake retained on the filtering medium;

i) drainability index;

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

10 Precision

Full results of validation trials, which 3 types of sludge (i.e. digested sewage sludge, raw sewage sludge, and waterworks sludge) were used for, are reported in Annex C (informative).

All sludge types considered, average values of relative *repeatability* standard deviation were 4,6 % for adimensional mass of filtrate at 30 s, 3,5 % for adimensional mass of filtrate at 90 s, 2,0 % for adimensional mass of filtrate at test end, 20 % for the time to collect 5/10 of sludge water content, 1,8 % for dryness of cake, and 14 % for suspended matter in the filtrate. Minimum value was 1,4 % for dryness of cake of both digested sewage sludge and waterworks sludge, while maximum one was 22 % for the time to collect 5/10 of water content of digested sewage sludge.

All sludge types considered, average values of relative *reproducibility* standard deviation were 4,3 % for adimensional mass of filtrate at 30 s, 3,2 % for adimensional mass of filtrate at 90 s, 2,6 % for adimensional mass of filtrate at test end, 20 % for the time to collect 5/10 of sludge water content, 2,3 % for dryness of cake, and 31 % for suspended matter in the filtrate. Minimum value was 1,0 % for adimensional mass of filtrate at test end of digested sewage sludge, while maximum one was 37 % for suspended matter in the filtrate of raw sewage sludge.

At least the precision data given as averages should be reached in the analysis of sludge.