SVENSK STANDARD
SS-EN 17183:2019

Fastställd/Approved: 2019-01-04
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 13.030.20

Karaktärisering av slam – Bedömning av slamdensitet

Characterization of sludge – Evaluation of sludge density

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The European Standard EN 17183:2018 has the status of a Swedish Standard. This document contains the official version of EN 17183:2018.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 17183

December 2018

ICS 13.030.20

English Version

Characterization of sludge - Evaluation of sludge density

Caractérisation des boues - Evaluation de la masse volumique des boues

Beurteilung der Schlammdichte

This European Standard was approved by CEN on 19 October 2018.

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

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Ref. No. EN 17183:2018 E

Contents

Page

European foreword

This document (EN 17183:2018) has been prepared by Technical Committee CEN/TC 308 “Characterization and management of sludge”, 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of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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

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Introduction

Knowledge of density is critical to most unit operations in both (i) wastewater treatments which are affected by the difference of density between solid and liquid, e.g. sedimentation, floatation, and (ii) sludge management operations which are affected by bulk density, e.g. centrifugation, storage, spreading. In particular, the effectiveness of secondary clarifiers and sludge thickeners is enhanced by higher sludge floc density which also increases the dewatered cake concentration at the end of mechanical dewatering.

Density also affects the (i) sludge volume and, therefore, the transport costs, and (ii) the sludge fluid-dynamic behaviour and, consequently, the head losses in a pipeline or the thermal coefficient in case of turbulent flow, being the Reynolds number depending from it.

Density is also useful in modelling sewage bio-reactor, such as biofilm reactor (biofiltration, fluidzed beds).

Densities of the dry solids and of the liquid phase should also allow the sludge origin and its degree of decomposition or stabilization to be roughly evaluated, and density of the liquid could give useful indications on the soluble substrate concentration and on the presence of other substances lighter than water [6].

1 Scope

This document specifies a method for the determination of the sludge (bulk) density. The procedure to determine density of the liquid and of the solid fractions of a suspension is described in Annex C.

This document is applicable to sludge suspensions from:

— storm water handling;

— urban wastewater collecting systems;

— urban wastewater treatment plants;

— treating industrial wastewater similar to urban wastewater [7];

— water supply treatment plants.

This method is also applicable to sludge suspensions from other origin, provided the necessary verifications are done.

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 16720-1, *Characterization of sludges - Physical consistency - Part 1: Determination of flowability - Method by extrusion tube apparatus*

3 Terms and definitions

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 http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
(bulk) density
mass of material divided by the total volume it occupies

3.2
pycnometer
instrument for measuring the density of substances/materials, consisting in a volume-calibrated glass container, often provided with a thermometer and/or a close-fitting ground glass stopper

3.3
relative density
ratio of the density of a substance/material to that of a standard substance/material (usually water)

4 Principle

This method is based on the measurement of the weight and the volume of the sample under examination in standard conditions.

The density of any matter depends on its temperature. Nevertheless, in the case of sludge, this effect is covered by measurement uncertainty. In the case of distilled water, the effect of temperature between 15 °C and 25 °C is shown in Annex A.

5 Interferences

There are not particular interferences in the evaluation of the sludge density, but the possible presence of air or gas bubbles shall be avoided.

6 Apparatus

6.1 **Pycnometer** or wide opening bottle of known volume, or graduated cylinder (see Annex B).

6.2 **Balance** with precision of 0,001 g at least.

6.3 **Graduated cylinders and other conventional lab equipment/accessories.**

6.4 **Thermometer** with precision of 0,1 °C at least.

7 Procedure

During the test the temperature shall be kept constant (e.g. thermostat controlled room or bath) and the value given in the test report.

7.1 Note or verify/determine the net volume capacity V, in cm^3, of the pycnometer by using a control liquid, normally distilled water, of known density, ρ_W.

7.2 Determine weight P_P, in g, of the empty pycnometer, after drying.

7.3 Fill the pycnometer with the sludge suspension not above the marked limit of volume of the instrument.

In case of highly concentrated or low flowable suspensions (see EN 16720-1), whose transfer to the measuring instrument is difficult, wide opening pycnometers or graduated cylinders shall be used and this fact mentioned in the test report.

NOTE In above cases methods for evaluating density of soils could also be used, e.g. EN ISO 17892-2 or EN ISO 17892-3.

7.4 Determine weight P_S, in g, of (sludge + pycnometer).

7.5 Complete, if necessary, filling of the pycnometer with the control liquid (usually distilled water) and determine weight P_T, in g, of (sludge + control liquid + pycnometer).

7.6 Repeat steps 7.1 to 7.5 for 3 times. The density of a sample shall be obtained by averaging these 3 values.

8 Expression of results

The sludge (bulk) density (ρ_S) is given by:

$$\rho_S = \{(P_S - P_P) / [\rho_W * V - (P_T - P_S)]\} * \rho_W \qquad (g/cm^3 \text{ or } 10^3 \text{ kg/m}^3)$$

9 Precision

Results of validation trials are summarized in Annex D.

Measured mean values of bulk Density were 998,5 kg/m^3 for Thickened biological sewage sludge at 2,69 % solids concentration (sludge A), 997,9 kg/m^3 for Waterworks sludge at 0,52 % (sludge B), 1122,8 kg/m^3 for Inorganic sludge at 19 % (sludge C), and 1320,9 kg/m^3 for concentrated Inorganic sludge at 40 % (sludge D).

The Repeatability standard deviation of sludges A, B and C ranged 0,212 % for sludge B to 0,897 % for sludge A. Mean value resulted 0,487 %.

Sludge D, due to its high solids concentration (40 %), evidenced difficulties in filling the pycnometer (7.3). It resulted a Repeatability standard deviation of 2,620 %.

The Reproducibility standard deviation of sludges A, B and C ranged 0,250 % for sludge B (Waterworks sludge, 0,52 % solids concentration) to 1,146 % for sludge A (Thickened biological sewage sludge, 2,69 %). Mean value resulted 0,625 %.

Similarly to previous case, sludge D (concentrated Inorganic sludge at 40 % solids concentration), confirmed difficulties in filling the pycnometer (7.3). It resulted a Reproducibility standard deviation of 3,804 %.

10 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 sludge sample;

c) details of sample preparation;

d) results of the determination according to Clause 8;

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