SLOVENSKI STANDARD
SIST CR 13714:2001

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Karakterizacija blata - Ravnanje z blati glede na uporabo ali odlaganje

Characterisation of sludges - Sludge management in relation to use or disposal

Charakterisierung von Schlämmen - Management von Schlamm zur Verwertung oder Beseitigung

Caractérisation des boues - Bonne pratique pour la gestion des boues en vue de leur valorisation ou de leur élimination

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This CEN Report has been prepared by Technical Committee CEN/TC 308, "Characterisation of sludges", the secretariat of with is held by AFNOR.

The status of this document as CEN Report has been chosen because the most of its content is not completely in line with practice and regulation in each member state. This document gives recommendations for a good practice but existing national regulations remain in force.

Introduction

The purpose of this CEN report is to assist in finding outlets for sludge which are primarily safe and sustainable but also secure and cost-effective. The challenge is to manage the quality of the sludge so that it is suitable for the outlets available. It follows that a sludge of high quality will provide operational flexibility because it is likely to be suitable for most or all of the outlets available, including those associated with maximum sustainability and minimum environmental pollution.

Sludge quality is central to the development of good practice for sludge production in relation to use or disposal. Sludge quality depends on the composition of the wastewater (or other process water) and also from sludge treatment and the extent of processing it receives during sludge treatment. Sludge quality can be characterised by its different properties ; biological, chemical and physical :

- biological properties include the microbiological stability of the organic matter in the sludge, odour and infectivity ;
- chemical properties include :
  - content of potentially toxic elements (PTEs) which include inorganic (metals, metalloids, and other minerals), and organic micropollutants ;
  - concentrations and form (availability) of plant nutrients and main components ;
- physical properties include whether liquid, semi - solid (pasty) or solid, which is achieved progressively by thickening and dewatering, and aesthetic factors associated for instance with removal of unsightly debris by effective screening. Calorific value will be a quality criterion if the sludge is to be incinerated or used as a fuel. Others physical properties include, thickenability, dewaterability and conditioners demand.

The constancy of these different properties is also an important aspect of the sludge quality.

Standard methods should be used where these are available to measure the quality parameters of sludge. This aspect is being addressed by CEN/TC 308 WG 1. There is a continuing need to develop a full set of standardised and harmonised methods which the manager and operator can use to evaluate the quality of sludge for treatment process design and operational purposes.

The option evaluation (clause 7) is intended to indicate which recycling or disposal options are available in any particular set of circumstances.

The processes to achieve appropriate sludge quality will be those described by the technical committee CEN/TC 165 "Waste water engineering".

The following abbreviated terms necessary for the understanding of this report apply :

BAT : Best Available Technology

BATNEEC : Best Available Technology Not Entailing Excessive Cost

BOD: Biochemical oxygen demand

BPEO : Best Practicable Environmental Option

COD : Chemical oxygen demand

EQO/EQS : Environmental Quality Objectives/Environmental Quality Standards

PTE : Potentially Toxic Elements

1 Scope

This CEN report gives guidance for dealing with the production and control of sludge in relation to inputs and treatment and give a strategic evaluation of recovery and disposal options for sludge according to its properties and the availability of outlets.

This report is applicable for following sludges :

— storm water handling ;

— night soil ;

— urban wastewater collecting systems ;

— urban wastewater treatment plants ;

— treating industrial wastewater similar to urban wastewater (as defined in Directive 91/271/EC) ;

but excluding hazardous sludges from industry.

Annex A gives information on sludges from water supply.

2 References

EN 1085, *Wastewater treatment – Vocabulary.*

EN 12832, *Characterisation of sludges – Utilisation and disposal of sludges - Vocabulary.*

EN 12255–8, *Wastewater treatments plants – Part 8 : Sludge treatment and storage.*

CR 13097, *Characterisation of sludges – Good practice for sludge utilisation in agriculture* [1)].

CR 13767, *Characterisation of sludges – Good practice for sludge incineration with or without grease and screenings* [1)].

CR 13768, *Characterisation of sludges – Good practice for combined incineration of sludge and household waste* [1)].

prEN 13983, *Characterisation of sludges – Good practice for sludge used in land reclamation.*

prEN WI 308044, *Characterisation of sludges – Good practice for the landfill of sludge and sludge treatment residue.*

3 Terms and definitions

For the purposes of this CEN Report, the terms and definitions which apply are those given in :

Directive 91/271/EC (see [1]) (Concerning urban waste water treatment).

Directive 86/278/EEC (see [2]) (On the protection of the environment and in particular of the soil, when sewage sludge is used in agriculture).

1) In preparation.

Directive 75/442/EEC (see [3]) (The Waste Framework Directive) as amended by EU Directive 91/156/EEC (see [4]).

EN 1085 and EN 12832.

4 Waste hierarchy

4.1 General

Sewage sludge is a waste which can be considered as a secondary resource when beneficially reused. The extent to which the recycling option is available depends on the quality and properties of a sludge and on the availability of the outlets. The same principles apply to the management of sewage sludge as to any other waste product.

It is not possible to eliminate the production of this particular waste. In order that the management of waste be conducted in an increasingly sustainable manner, the EU encourages a waste hierarchy as a framework by which Member States should develop their strategy for waste management (EU Directive 75/442/EEC (see [3]) as amended by 91/156/EEC(see [4])). In order of preference, this hierarchy encourages :

a) firstly, the prevention or reduction of waste production and its harmfulness, in particular by :

- the development of clean technologies more sparing in their use of natural resources ;
- the technical development and marketing of products designed so as to make no contribution or to make the smallest possible contribution, by the nature of their manufacture, use or final disposal, to increasing the amount or harmfulness of waste and pollution hazards ;
- the development of appropriate techniques for the final disposal of dangerous substances contained in waste destined for recovery ;

b) secondly :

- the recovery of waste by means of recycling, re-use or reclamation or any other process with a view to extracting secondary raw materials ; or
- the use of waste as a source of energy.

Three of the stages within the hierarchy can be applied to sludges, namely reduction, recovery and disposal. Obviously, the latter is the least desirable and efforts should be made to minimise the proportion of sludge which is disposed of, by the adoption of reduction and recovery strategies.

The waste hierarchy can be applied equally to activities upstream of wastewater treatment facilities as to the processes employed within a treatment works. These are discussed separately below. In considering what management options should be selected, all stages in the sequence of sludge production and its ultimate fate should be scrutinised.

The demand for prevention and reduction applies to the management of the effluents which contribute to wastewater (EU Directive 91/21/EEC (see [1]).

4.2 Measures upstream of wastewater treatment facilities

Reduction

As a general rule, sewage sludge comes from three sources in varying proportions:

1) domestic wastewater ;

2) industrial wastewater from large- and small-scale industries ;

3) stormwater containing pollutants washed out of the air and the soil.

Minimisation of the wastewater load can be achieved by :

a) reduction of industrial wastewater :

— minimisation of the volume and waste load of water ;

— industrial wastewater pre-treatment ;

— internal recycling of water within the industry ;

b) reduction in flow of collected stormwater by using alternative techniques ;

c) reduction of infiltration water ;

d) reduction of domestic wastewater when possible, e.g. by domestic devices better designed.

The control of industrial discharges to the sewer is discussed in Clause 5.

4.3 Measures at sites of sludge production and processing

4.3.1 Reduction

4.3.1.1 Wastewater treatment

When selecting wastewater treatment processes, consideration should be given to the quantity and type of sludge that will be produced and its characteristics relative to the proposed ultimate use or disposal of the sludge.

Proper operating procedures can help to keep sludge production at a low level (e.g. operation at high sludge residence time in the biological processes, optimisation of chemical dosages).

4.3.1.2 Sludge treatment

All recommendations have to be adapted to the local context and constraints associated to the outlets :

a) water content reduction.

The reduction in the volume of water present in a sludge by thickening and dewatering is the primary route by which sludge quantity may be reduced following treatment.

Apart from producing sludge cake, dewatering generates a liquor requiring treatment by recirculation through the wastewater treatment works.

There is a limit to the amount of water that can be removed from sludge by mechanical means, and most dewatered sludge (for instance by belt press, filter press, centrifuge, etc.) have dry solids content in the range 15 % to 40 %.

Thermal drying of sludge will reduce the volume of sludge by evaporating water that cannot be removed mechanically to as high as 95% dry solids. However, considerable energy is used to dry sludge to this degree and local circumstances will dictate whether any environmental benefit is gained from thermal drying over the transport of large volumes of wet sludge for recycling or disposal purposes. It is essential for such factors to be appraised in the strategic evaluation of options (Clause 7). It is necessary to remember that most of the evaporated water has to be recycled to the wastewater plant after the condensing step of the exhaust gases. Storage design has to take the risk of self-ignition into account ;

b) water and organic solids content reduction.

Reduction of sludge mass rate can be achieved through **biological stabilisation**. Digestion typically achieves a 40 % to 50% volatile matter reduction and aerobic stabilisation will achieve a volatile matter reduction of 30 % to 40 %. These processes partly reduce also the pathogen content of the sludge and its odour potential.

Incineration (see CR 13767) is in essence a reduction option carried out by a combustion of organics sludge at high temperature. It produces an ash (about 20 % to 50 % of sludge dry weight) which has to be disposed of unless a use can be found for it. A positive aspect is the opportunity for energy recovery through waste-to-energy facilities and these should preferentially be employed over incineration with no energy recovery. With the improvement in sludge dewatering and incineration techniques, modern fluidised bed incinerators are autothermic in operation, only requiring support fuel at start-up, and when coupled with gas cleaning systems, have very low emissions to the atmosphere. Co-incineration (see CR 13768) with other organic wastes, such as municipal solid waste, may also be an option under some circumstances.

Wet oxidation is also a reduction option involving thermal degradation, hydrolysis and oxidation of sludge organic matter in aqueous phase in a single-stage reaction at high temperature and pressure. The technique does not require the complex gas cleaning equipment which is needed in many combustion processes. During the process, some of the organic matter is solubilised and it produces ashes and high COD and BOD liquors that are to be treated.

Vitrification is a technique for further reducing the volume of incinerator ash and to make an environmentally inert material. Landfill disposal can be avoided since it is possible to use this technique to make environmentally inert construction materials. The temperature required for vitrification is much higher than for incineration and consequently has a high energy cost ;

c) hygienisation.

Appropriate treatment practice should be used to control the pathogen risks. More information are given in the CEN documents dealing with the application.

4.4 Measures for recovery and disposals

4.4.1 General

There are opportunities for recovery of the resource value of sludge at the site of sludge production (e.g. biogas) or downstream of the site of sludge production (e.g. nutrients content of the sludge).

Sludge can be used in liquid dewatered, composted or dried or incinerated and even vitrified form. The level of processing employed should be the optimum necessary to ensure the quality of the sludge for the selected end use.

All these activities should be conducted according to the relevant legislation in place in the relevant Member States, and other CEN guidance documents.

4.4.2 Application to land (see CR 13097 and prEN 13983)

The most common method of sludge recycling is application to land. Sludge may be beneficially used to supply plant nutrients and add organic matter and/or lime to soil in agricultural, land reclamation, forestry operations, landscaping, amenity horticulture and horticulture.

Detailed information on quality should ensure that each type and source of sludge is used appropriately according to its quality. For example, the nitrogen release characteristics of a digested liquid sludge differ from those of a digested dewatered cake, and the manner of their use should reflect this to minimise the risk of nitrate leaching losses.

Recycling to land involves the processing of waste materials to produce a usable, secondary raw material. Sludge may be recycled in a range of ways which vary in the degree of processing and energy required.

There are several sludge processing techniques that involve the addition of materials in order to produce a more stable, easily handled material for land application.

One such technique is lime addition for stabilisation, disinfection, dewatering and storage purposes.

Composting. It is an aerobic controlled process (biological oxidation of organic matters with heat generation) to produce a stable and disinfected product of value as soil amendment. A composting process can be characterised by the maximum temperature and duration. The composting of sludge can be optimised by the addition of bulking agent such as straw, wood chips, bark or garden and park wastes. Selection of the bulking agent should avoid any negative impact in the quality of the composted product due to the presence of any contaminants in the bulking agent.

Sludge criteria which should be considered for the composting process include :

a) sludge fermentability ;

b) sludge type and treatment prior composting ;

c) sludge rheology.

Factors which should be considered in the design of a composting plant are listed in prEN 12255-8.

Operated correctly, composting will give rise to a highly stabilised and humus like material which can be beneficially used in agricultural, land reclamation and forestry operations as well as in horticulture. Composting activities should be conducted in a manner which complies with the relevant legislation and ensures minimum nuisance to site neighbours from traffic, noise, and dust and odour.

Extended storage using vegetative processes may also produce aerobically composted material suitable for land application.

4.4.3 Others uses

Sludge and incinerator ash can be used in the production of construction materials, such as fibre board, bricks, lightweight blocks, paving blocks, etc. Such processes are high cost but may be the Best Practicable Environmental Option (BPEO) in some circumstances.

4.4.4 Energy Recovery

Useful energy can be recovered from :

a) methane from anaerobic digestion of sludge :

- gas from anaerobic digestion contains about 2/3 CH_4 by volume, 1/3 CO_2 by volume and small amounts of N_2, H_2, H_2S, water vapour and other gases. Total gas production can fluctuate over a wide range, depending on the volatile solids content of the sludge feed and the biological activity of the digester. Typical values vary from 0,75 m^3/kg to 1,12 m^3/kg of volatile solids destroyed. Because digester gas is typically about 65 percent methane, the low calorific value of digester gas is about 22400 kJ/m^3 (by comparison, methane has a low calorific value of approximately (37300) kJ/m^3). Combined heat and power plants make efficient use of methane for digester heating, air compression, and electrical power for use on the treatment plant or for export. As digester gas contains hydrogen sulphide, particulates, and water vapour, the gas frequently has to be cleaned in dry or wet scrubbers before it is used in internal combustion engines ;

b) dedicated or co-incineration with other wastes (see CR 13767 and CR 13768) :

- energy may be recovered as heat to be used for space heating or raising steam for power generation. The energy value of sludge ranges widely depending on the type of sludge, water content and the volatile solids content. The energy value of untreated primary sludge is the highest. Because of the water content, this value is low if there is no drying ;

c) co-combustion with other fuels in power stations ;

d) use as a fuel in an industrial process, such as cement and asphalt production. Conventional fuel can be supplemented by substituting sludge to fuel.

For the c) and d) uses, the level of sludge addition depends of the particular application, the quality of the gas being produced during incineration, and the specific atmospheric emission standards to be achieved :

e) other high temperature treatment options exist such as gasification with or without wastes to produce fuels.