Developments of European Standardisation on Sludge: Guidelines for Good Practice

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ABSTRACT: Need for a safe utilisation/disposal of sludge is well recognised by European Countries which consider development of standardized characterization and management procedures to properly perform sludge operations necessary. To this purpose, CEN established the TC308 whose main objectives are to contribute to development of European Directives on sludge, give orientation to producers/users on how to meet legislation requirements, and give a larger diffusion to the standards thus favouring the global market. Within this framework, many standard methods for sludge characterization have been published together with Guidelines for good management practice whose content is outlined in this paper.

INTRODUCTION

SLOUDGE MANAGEMENT is a critical issue facing modern society due to rapid increase in its production as a result of extended sewerage, new work installations, and up-grading of existing facilities. Characterization is an important step in sludge management. This is recognized by European Union Countries which consider it necessary to develop standardized characterization procedures for properly performing sludge operations and to correctly comply with legal requirements.

The European Committee for Standardization (CEN) established Technical Committee 308 (TC308) whose main tasks are production of standards for chemical, biological, and physical characterization of sludge, of guidelines for good practice, or Technical Reports for different methods of sludge use and disposal and for operational practices. These documents are intended to (1) harmonise sludge practices across Europe, (2) promote and enable sustainable development, (3) support production and revision of European Directives relevant to sludge, and (4) support European stakeholders and provide orientation to producers and users on how to meet legislation requirements.

Scope of CEN/TC308 includes sewage sludge and all other sludge types potentially having similar adverse environmental effects. CEN/TC308 also cooperates with other CEN and ISO programmes. Work of CEN/TC308 has been organized in 3 working groups respectively dealing with the (1) standardization of methods for determining chemical, biological, and physical sludge parameters (WG1); (2) preparation of guidelines of good practice for different options of sludge use and disposal (WG2); and (3) preparation of documents on current and future needs in sludge management (WG3). Present status of work is reported in CEN/TC308 [1,2].

Further, to improve comparability of standards developed by different CEN/TCs for measuring the same parameters in different contexts and thus avoiding unnecessary duplication of work, CEN/TC308 promoted development of the “Horizontal” project with the objective of developing “horizontal and harmonised European standards” in the fields of sludge, treated bio-waste, and soils.

CEN/TC308 DOCUMENTS

CEN/TC308 documents include standard methods and guidelines or Technical Reports. They are extensively discussed in the following.

Standard Methods

Regarding agricultural use of sewage sludge following the European Directive 86/278/EEC, whose update is expected for many years but not yet available, determination of nutrients and so-called pollutants (heavy

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metals and organic substances) has been one of the basic goals of CEN/TC308. Methods for determination of heavy metals via aqua regia digestion and for that of phosphorus and nitrogen compounds were developed as well as for sampling, water content, dry residue, and organic carbon content. Work on determination of organic micropollutants covered development of methods for PAH (polycyclic aromatic hydrocarbons), PCB (polychlorinated biphenyls), NP/NPE (nonylphenol and its ethoxylates), LAS (linear alkylsulfonates), phthalates, and AOX (adsorbable organic halogenated substances).

Another important aspect regarding management of sludge is that relevant to evaluation of its biological stability because it strongly influences sludge handling (e.g., risks of development of bad odours, effective acceptability in a landfill, and possible reuse for environmental purposes). Regarding the aforementioned reasons, development of a standardised procedure for evaluating biological stability of sludge has just started.

Evaluation of physical properties is also of great importance as this knowledge allows for prediction of sludge behaviour when handled and submitted for almost all treatment, storage, and utilization/disposal operations. Regarding these properties, standards for determination of Capillary Suction Time (CST, also useful for qualitative evaluation of sludge centrifugability) [3,4], specific resistance to filtration, compressibility, settleability, thickenability, calorific value, and drainability (to evaluate sludge suitability to be thickened by means of a draining process) have been published.

Physical consistency is another physical parameter of fundamental importance as it strongly affects almost all treatments, utilization, and disposal operations (e.g., pumping, transportation, dewatering, drying, and landfilling) [5]. A technical report on this subject has been published [6] and standards relevant to determination of flowability through an Extrusion tube viscometer and to that of solidity through a Vane shear apparatus have been submitted for the formal approval procedure which includes carrying out of round-robin tests for evaluating repeatability/reproducibility of measurements. However, alternative validation procedures must be considered when circulation of samples may involve alteration of characteristics thus avoiding reliable comparison of results or when large quantity samples are needed like in the case of most physical parameters. One could consists in examination of “synthetic sludge” samples to be on-site prepared on the basis of a defined recipe and ingredients (a technical report CEN/TR 16394 has been prepared). Another could involve circulation of “analysts” and not of “samples” thus allowing analysts from participating laboratories to meet in a common location close to a place where samples are collected. A validation procedure for physical parameters has been adopted by CEN/TC308 [7] and successfully applied when needed.

Guidelines for Good Practice

Seen in Table 1, Guidelines for good practice for different methods of sludge use and disposal published by CEN/TC308 are listed according to year of publication. If not differently stated, guidelines are applicable to sludges from urban wastewater treatment plants, treatment plants for industrial wastewater similar to urban wastewater, and water supply treatment plants.

Further, a basic scheme is necessary for deciding on which sewage sludge use/disposal options to choose. Relevant CEN/TC308 guidance documents have been drafted and are seen in Figure 1. Contents of guidelines or technical reports published by CEN/TC308 are summarized in the following.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
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<tbody>
<tr>
<td>EN 12832: 1999 (known as Guide 1)</td>
<td>Utilisation and disposal of sludges—Vocabulary (under review)</td>
</tr>
<tr>
<td>CR 13846: 2000</td>
<td>Guide to preserve and extend sludge utilization and disposal routes</td>
</tr>
<tr>
<td>CR 13983: 2003 (known as Guide 5)</td>
<td>Good practice for sludge utilization and land reclamation</td>
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<tr>
<td>CR 15126: 2005 (known as Guide 8)</td>
<td>Good practice for the landfill of sludge and sludge treatment residues</td>
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<td>CEN/TR 15473: 2007 (known as Guide 9)</td>
<td>Good practice for sludges drying</td>
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<td>CEN/TR 15584: 2007</td>
<td>Guide to risk assessment especially in relation to use and disposal of sludges</td>
</tr>
<tr>
<td>CEN/TR 13097: 2010 (known as Guide 4)</td>
<td>Good practice for sludge utilisation in agriculture</td>
</tr>
<tr>
<td>CEN/TR 13714: 2010 (known as Guide 2)</td>
<td>Good practice for sludges management in relation to use or disposal</td>
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Guide 1 (EN 12832:1999)

The first guide dealt with sludge “Vocabulary” to ensure uniformity of expression in all European Countries. This guide is now under systematic review but to avoid any possible contradiction revision will be completed only when the general “Glossary of wastewater engineering terms” in preparation by CEN/TC 165 is published. All terms and definitions in the Glossary above at that time will be adopted by CEN/TC308 unless it is necessary to introduce new specific concepts or terms not currently contained in the glossary.

Evolution regarding the term “sludge” within this framework often replaced by the term “biosolids” has to be considered. It is true that sludge disposal industry has great difficulty convincing the public that a material with an ugly name such as “sludge” could actually be beneficial so the term “biosolids” was introduced. However, this does not change the substance. The name change, although useful as a public relations tool, could create misunderstandings if wrongly used. A similar evolution of the terminology has also not found a wide acceptance in other languages mainly due to translation difficulties.

Therefore, it should be time to definitely clarify the word “sludge” has to be used when speaking of solids within a wastewater treatment plant and out of it when it is disposed of without any utilization. We could revert to using “biosolids” only during the moment the solids in whatever form are destined for some form of beneficial use.

Figure 1. Basic scheme for deciding applicability of CEN/TC 308 Guidelines.
**Guide 2 (CEN/TR 13714:2010)**

The purpose of this guide is to outline management of sludge both upstream and downstream of the treatment process to ensure it is suitable for available outlets. The guide refers to all types of sludges covered by CEN/TC 308 including those from treating industrial wastewater similar to urban wastewater and from water treatment supply plants. This document gives recommendations for good practice but existing national regulations remain in force.

Considering likely quality of sludges, it should be noted that municipal wastewater sludge is composed of materials that have already been disposed of and are consequently likely to be more variable than many industrial sludges that arise from sourced materials or water treatment sludges arising from surface water or groundwater.

This guide considers management of sludges against a waste hierarchy, management of sludge quality, and an optional evaluation process for determining available methods. Sludge quality is central to the development of good practice for sludge production in relation to its final destination (use or disposal). Sludge quality depends on composition of upstream materials and type of treatment including post-treatment storage. As a general rule a sludge of high quality is likely to be acceptable to a large range of outlets given greater operational flexibility. High quality sludges are likely to be suitable for those outlets associated with maximum sustainability and minimum environmental pollution.

Consistency of different sludge properties is a critical aspect of sludge quality and of the ability to determine its end destination. Therefore, standard methods should be used when available to measure quality parameters of sludge.

**Guide 4 (CEN/TR 13097:2010)**

This Guide describes a good practice for use of sludge in agriculture where permitted. It is applicable to all sludges that may be used on land as a source of plant nutrients, soil improver, and/or amendment for crop production.

Despite differences in statutory controls between sewage sludge and other sludges, use of all types of sludge should follow good practice to maximise benefits for crops or soils; to minimise potential risks of environmental contamination; and adverse impacts on plant, animal, and human health to ensure sustainability, energy efficiency, and cost-effectiveness.

Sludge producers should be aware that if a sludge is used as a fertilising or alkaline amendment, national or European fertiliser or liming regulations may apply. The document assumes an evaluation of sludge utilisation has already been made and a decision was made that use of sludge within a land spreading policy is the best option. For evaluation and decisions for use of sludges other documents have been developed (see CR 13714, CR 13846).

Many countries and/or local administrations have regulations and/or standards and/or codes of practice applicable to the use of some of the types of sludge that are within the scope of this guide. However, it cannot and does not attempt to summarise or take account of these regulations because of their very wide range. It is thus essential this document is read in the context of conditions that prevail locally.


This guide helps one to indicate what sludge utilisation within reclamation programmes of disturbed land aiming to address in a general qualitative way key issues which will determine in each particular case whether, how much, and which type of sludge may be used. Status of a technical report for this document has been chosen because most of its content is not completely in line with practice and regulation for each member state.

Because of the wide range of reclamation sites where sludge use as a soil ameliorate or source of plant nutrients is beneficial, different potential final uses of these sites and recommendations for applications should be considered on a site by-site basis. It is far beyond the scope of these guidelines to describe all possible situations and individual ways in which sludge may be used. The aim is to address in a general qualitative way key issues which determine in each particular case whether, how much, and which type of sludge may be used. Planning considerations are emphasised due to the fact a general scheme can be adopted as a common procedure in nearly all situations.

**Guides 6 (CR 13767: 2004) and 7 (CR 13768: 2004)**

Purpose of original guides 6 and 7 is to describe a good practice for sludge incineration and co-incineration, respectively, to ensure safe and economical operations. The status of technical report also in this case has been chosen because most of their content is not completely in line with practice and regulation in each
member state. Recommendations for a good practice are given but existing national regulations concerning the subject remain in force. In particular, the purpose of guide 6 is to describe a good practice for sludge incineration to ensure a safe and economical operation. The main goals are to:

- describe principal design parameters relevant to different process schemes;
- assess operating procedures able to perform optimal energy consumption, emissions control, and equipment durability;
- provide responsible authorities with well-established and easily applicable protocols for control purposes; and
- promote diffusion of this practice and favouring the formation of a public opinion consensus.

Potential advantages of high temperature processes include reduction of volume and mass of sludge, destruction of toxic organic compounds if present, and energy recovery. Priority should be given to reduction of pollutants at the origin and to recover if technically and economically feasible valuable substances (phosphorous and potassium) in sludge and derived products. This guide is not applicable to co-incineration of sludge and other wastes either urban or hazardous and for use of sludge in cement kilns.

Guide 7 constitutes a framework within which the combined incineration process may be proposed in addition to and/or as a substitution for field spreading, waste site disposal (landfilling), specific incineration, or any other process. Combined incineration should abide by the European Directives and should comply with relevant regulations and recommendations in force within each member state to reduce as far as possible negative effects on the environment such as pollution of air, ground, surface, underground waters, and on human and animal health. This concern therefore relates to pre-treatment of sludge in plants, transfer of material to a treatment centre, destruction process, treatment of gaseous discharge into the atmosphere, future of different by-products stemming from combustion, and treatment of liquid effluents potentially resulting from the process.

Priority should be given also in this case to reduction of pollutants at the origin and or to recovery of valuable substances (e.g. phosphorus) in sludge and derived products if technically and economically feasible. Regarding a process and company quality approach, relevant issues are:

- exploiting operational data and statutory inspections carried out;
- rendering the process reliable, optimising and perpetuating it, and guaranteeing a permanent development; and
- maintaining a climate of confidence between authorities, sludge producers, transporters, incineration plants, and waste disposal site operators allowing services be provided on a contractual basis.

When necessary a distinction can be made between existing facilities and new incineration plants. Considering that increasing energy costs and needs for development of sustainable energy production have resulted in a growing application not only of sludge incineration but also for other thermal processes it has been decided that it is best to unify and update the above guides by considering in a new guide (numbered as Guide 13) all options (e.g. incineration, gasification, pyrolysis) available for thermally processing sludge. Possibility of recovering phosphorus out of the ashes is playing a fundamental role.

Within this framework it is also to be considered that European legislation in this field is now deeply changing. In particular, existing regulations on thermal treatment of waste especially directives on incineration of wastes (2000/76/CE) and on integrated pollution prevention and control (2008/1/CE) have been merged in the recent Directive 2010/75/EU on industrial emissions.

Regarding European regulation, an incineration plant is dedicated for thermal treatment of wastes with or without recovery of combustion heat generated. This includes incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification, or plasma processes in so far as substances resulting from treatment are subsequently incinerated. This is not applicable if gases resulting from the thermal treatment of waste (pyrolysis or gasification) are purified to such an extent that they are no longer a waste and cause emissions no higher than those resulting from burning of natural gas. Incineration of liquid and solid waste whether hazardous or non-hazardous is covered by this directive whose deadline for its full applicability has been set for January of 2014.

Guide 8 (CR 15126:2005)

This technical report describes a good practice for disposal of sludges and sludge treatment residues into a landfill where national regulations permit. All rec-
ommendations from this document constitute a framework within which the landfilling process may be proposed as a substitution for field spreading or in addition for specific or combined incinerations or for any other process.

This document should be read in context of the requirements of Directive 1999/31/EC. Landfill of waste applies to the landfill of sludge and any other relevant regulations, standards, and codes of practice that may prevail locally within member states.

Guide 9 (CEN/TR 15473:2007)

This Guide gives guidance on (1) drying processes, (2) characteristics of dried sludge products, and (3) recycling or disposal of dried sludge products from urban wastewater treatment plants. Sludges of other origin like sludge from water supply or industrial treatment plants are not exactly in the scope of this guide. However, handling of most of those sludges will comply to a large extent with advice given in this guide.

Status of this document as a technical report has been chosen because much of its content is not completely in line with practice and regulations for each member state. Therefore, this document gives recommendations for good practice concerning drying of sludges. However, existing national regulations remain in force.

Various directives will apply to thermally dried sludge products depending on the use to which they are to be ascribed including Directive 86/278/EEC for recycling to land, Directive 1999/31/EC for disposal to a landfill, Directive 2000/76/EC for incineration and energy recovery, and Directive 94/9 for equipment intended for use in potentially explosive atmospheres. This document should be read in the context of the requirements of these directives and any other relevant regulations, standards, and codes of practice that may prevail locally within member states.

Guide 10 (CEN/TR 15809:2008)

Guide 10 provides guidance on good practice for hygienic aspects of use of sludges on land. It concerns microbiological life as an important part of the management of sludge in accordance with environmental requirements (human, animal, and plant health). It applies to all utilizations of sludge in the environment (e.g., agriculture supplement, land reclamation, cover for landfills, manufacturing of soil, and more). It also provides information about existing treatment processes for meeting hygienic requirements.

Status as a technical report in this case has been chosen because most of its content is not completely in line with practice and regulations for each member state so existing national regulations remain in force.

This technical report is applicable to sludge produced by urban wastewater treatment plants and systems. Sludges of other origin are not exactly in the scope of the document but handling of most of these sludges will comply to a large extent with advice provided in this document.

Guide 11 (WI 308069) (in publication)

It is recognized everywhere that sludge management is a major problem regarding water and wastewater treatment as it can account for up to 50% of total operational costs. Effectiveness and cost of sludge treatment and disposal operations are strongly affected by volume and consequently by water content or solids concentration. Therefore, thickening and dewatering are important steps in the total sludge processing work flow and have serious impact on subsequent operations.

This guide now submitted for the formal approval procedure describes good practices for sludge conditioning, thickening and dewatering, technical and operational aspects, and characterization methodologies.

This Report is applicable for sludges from urban wastewater treatment plants, treatment plants for industrial wastewater similar to urban wastewater, and water supply treatment plants. This document may also be applicable to sludges of other origin.

CONCLUSIONS

A number of requirements such as guide and/or limit values are contained in sludge regulations but methods for determining respective parameters are often not described. Therefore, a definition for standardized procedures and methods are a necessary support for sludge management as they allow not only prediction of the behaviour of sludge when handled and submitted to different management operations but also correct fulfillment of legal requirements, comparison and consistency of application, and improvement of stakeholder and public confidence.

To provide necessary support for development of European Directives directly or indirectly involving sludge, the European Committee for Standardization (CEN) established Technical Committee 308 (TC308) whose scope is standardization of methods and proce-
dures employed for sludge characterization and production of guidelines for good practice.

CEN/TC308 activities have been addressed regarding production of (1) standardised methods for evaluation of chemical, biological, and physical properties/parameters and (2) several Guidelines of good practice and Technical Reports on different aspects of sludge management.

Contents of Guidelines of good practice dealing with sludge vocabulary, management in relation to use or disposal, utilization in agriculture, utilization for land reclamation purposes, incineration and co-incineration, landfilling, drying, hygienic aspects, and thickening and dewatering have been outlined and may provide useful information to those dealing with sludge and/or biosolids.

REFERENCES