Bangladesh Standards and Guidelines for Sludge Management

Department of Environment

Dhaka, Bangladesh

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Editorial Committee
Md. Shahjahan, Additional Director General (PRL), DoE
Dr. Md. Sohrab Ali, Deputy Director (Water and Bio.), DoE
Syed Nazmul Ahsan, Deputy Director (Environmental Clearance), DoE
Elke Shrestha, Senior Advisor, GIZ
Tanuja Bhattacharjee, Senior Environmental Advisor, GIZ

Guidelines Development and Compilation
Dr. Stefanie Budewig
Prof. Dr. Peter Hartwig

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Department of Environment
GIZ

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MESSAGE

Like other developed and developing countries, Bangladesh followed the same path "Grow First and Clean Later" which is proved to be much costlier. To attain sustainable growth with minimal environmental cost the world comes up with new idea of "Green Growth" where economic growth and conservation of environment through pollution control could be achieved simultaneously.

Sewage sludge and sludge from industrial enterprises are on the increase due to rapid population as well as industrial growth in Bangladesh. Sludge is a hazardous material that harms human health and the environment as well. Currently, growing volume of sludge from industrial and municipal wastes is disposed off haphazardly.

Environmental protection is our prime concern for our existence and for the future generations as well. Though difficult, but all relevant authorities need to take necessary measures for management and safe disposal of sludge. As per the Bangladesh Environment Conservation Act, 1995 (Amendment 2010) proper management of sludge is mandatory.

The guidelines will benefit the environment through safe disposal of various kinds of sludge.

Dr. Kamal Uddin Ahmed
Secretary
Ministry of Environment and Forests

FOREWORD

Sludge is a hazardous material that harms human health and the environment including soil, air and aquatic systems. Besides, sludge is a complex material with heterogeneous toxic substances that it inherits from a variety of origins/ sources and products. With the growing population, accompanied by industrial development and expansion of city area, the volume of sludge from industrial and municipal wastes are increasing tremendously which is posing adverse and profound environmental impacts. Hence, it has become a dire necessity to identify the nature of toxic contents in the sludge and judicious measures be taken for their safe disposal. As per the Bangladesh Environment Conservation Act, 1995 (Amendment 2010) proper management of sludge is mandatory.

Installation of Effluent Treatment Plant (ETP) has been increasing and are also becoming more advanced now a days. A problem that needs to be considered carefully is the efficient and environmentally sound operation and management of the variety of treatment plants. When processing sludge it is critical not to fall into the trap of simply re- directing the pollution that ultimately affects water, soil and air. Appropriate treatments/disposal routes need to be ascertained.

The guideline provides extensive information on all aspects of sludge management. It is addressed to anyone operating water or wastewater treatment plants or central effluent treatment plants producing sludge, regardless of the origin of the wastewater involved in the classification, management and use or disposal of sludge. This guidelines describe various methods of sludge treatment and disposal. Three chapters are included in the guideline. These are: (i) General requirements for classification and management, (ii) Classification of sludge, and (iii) Sludge management options.

Regarding some specific and very critical questions that may arise, publicly accessible sources are named in the handbook where further information can be found. Some good practices and regulatory guidelines related to sludge treatment and disposal are also given.

We would like to thank all contributors and reviewers of this document who have cooperated to produce this important document.

Md. Raisul Alam Mondal
Director General
Department of Environment

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Last but not the least, I greatly acknowledge active participation of Mr. Syed Nazmul Ahsan, Deputy Director (EC) who played a crucial role in refinement of the guidelines.

Dr. Md. Sohrab Ali
Deputy Director (Water & Bio.)
Department of Environment

ABBREVIATIONS

AOX	=	Adsorbable organically bound halogens
BPLSA	=	Brilliant green-phenol red-saccharose-agar
BTEX	=	Benzol, Toluol, Ethylbenzol and ortho-xylol
CETP	=	Central Effluent Treatment Plant
DAE	=	Department of Agriculture Extension
DG	=	Director General
DOC	=	Dissolved Organic Carbon
DoE	=	Department of Environment
DM	=	Dry Matter
ds	=	dry substance
ECA	=	Environment Conservation Act
ECD	=	Electron Capture Detector
ECHA	=	European Chemicals Agency
MFSU	=	Manufacture, formulation, supply and use
MID	=	Multiple Ion Detection
MKW	=	Petroleum-derived hydrocarbon
m_T	=	dry matter
PAK	=	Polycyclic aromatic hydrocarbons
PCB	=	Polychlorinated biphenyl
RR	=	recovery rate
SRDI	=	Soil Resource Development Institute
TBA	=	Tetrabutyl ammonium hydrogensulphate
TE	=	Toxicity equivalents
TCDD	=	2,3,7,8-Tetrachlorodibenzodioxin — a type of dioxin.
TOC	=	Total Organic Carbon
XLD	=	Xylose-lysin-desoxycholate

CONTENTS

CHAPTER 1: GENERAL CONSIDERATIONS AND REQUIREMENTS FOR SLUDGE MANAGEMENT

GENERAL CONSIDERATIONS

The major priority of these standards and guidelines for sludge management in Bangladesh are to ensure that human health and the environment are strictly protected from any negative impacts of sludge management.

According to the "National 3R Strategy" and the recommendations by the "Textile Sludge Study in Bangladesh" as well as the DWA mission report of phase 1 this guidance will follow the required principles in waste management. An important principle for guidance is the waste hierarchy of reducing, reusing and recycling (3R strategy) followed by disposal. This means that these measures shall be executed according to the state of technology and ecological feasibility before the waste has to be disposed in an end-of-pipe facility. Another central concept in this waste management guideline is to separate and segregate generated waste streams at source and, if possible, treat them directly on site which is also established in the European and German law and executed accordingly.

Challenges for sludge management in Bangladesh, among others, are the following:

- Waste streams are not separated. Complex mixtures are difficult to classify and in consequence, it can be a problem to define an appropriate treatment/disposal route.
- An analysis for all potential pollutants, especially in complex mixtures of wastewater from industry, presents a huge challenge. Besides, the high cost of analysis can result in difficulties guaranteeing the compliance with limit values for certain disposal routes.
- Reusing and recycling technologies may not be available, or may be uneconomic or not having sufficient capacities for the rising amount of waste, specifically sludge being produced.
- Some types of disposal facilities, e.g. incineration or land fill sites do not exist or do not have the necessary capacities or standards for some types of waste (e.g. hazardous) in Bangladesh; suitable disposal facilities are a prerequisite for sustainable sludge management and before a guideline for sludge management can be implemented such facilities or other disposal routes guaranteeing a safe and final disposal need to be planned and built.

SCOPE OF THE STANDARDS AND GUIDELINES

1. This document must be complied with by anyone who-
   a. operates a water or wastewater treatment plant, an effluent treatment plant or a central effluent treatment plant producing sludge, regardless of the origin of the wastewater either from municipalities or industries,
   b. produces sludge in industrial processes.
   c. is involved in the classification, management, transport, handling, use or disposal of sludge from the plants and processes named above.
2. The following shall be excluded from the scope of this document where they are already covered by other legislation:
   a. sludge containing radioactive materials covered by the Nuclear wastes management rules;
   b. sludge containing medical wastes covered by the Medical wastes (Management and Processing) Rules 2008;
   c. sludge containing waste from ship breaking covered by the Hazardous wastes and ship breaking wastes management rules 2011;
3. Specific rules for particular instances or supplementing those of this document on the management of particular categories of waste may be laid down by means of individual documents by the Department of Environment.

DEFINITION OF TERMS

For the purposes of this document the following defined terms shall have the meaning described below:

1. "Collection" means gathering, sorting and/or mixing of waste for the purpose of transport to disposal site/treatment plant;
2. “Controlled landfill” means landfill complying with the requirements in chapter 3.3.4 of this document;
3. "Disposal" means any of the operations provided for in Annex 4;
4. “Industrial sludge” is sludge originating in industry, for the purposes of this document sludge originating in industries listed in Annex 3 may be considered as comparable to sludge from municipal wastewater;
5. "Management" means collection, transport, recovery, treatment and disposal of sludge, including the supervision of such operations and after-care of disposal sites;
6. "Producer" means anyone whose activities produce sludge ("original producer") and/or anyone who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste; "holder" shall mean the producer of the sludge or the natural or legal person who is in possession of it;
7. "Recovery" means any of the operations provided for in Annex 4 Section B;
8. "Sewage sludge" means sludge, also de-watered or dried or treated in any other form, accruing from the treatment of wastewater in wastewater treatment plants, or sewage treatment plants including associated plants for further-reaching wastewater purification. Crude sludge shall be understood to mean sludge that is withdrawn in an untreated state from wastewater treatment plants. The de-watering of crude sludge shall not be considered as a treatment of sludge. Sewage sludge within the scope of this document shall be deemed to include sludge composts, sludge digestates and sludge mixtures. Sludge mixtures shall be understood to mean mixtures produced from sludge and other suitable substances specified in Annex 7 or in fertilizer legislation as last amended. Sludge composts shall be understood to mean composted sludge mixtures, sludge digestated to mean digested sludge or sludge mixtures.
9. “Sludge” means the residual, semi-solid material left from industrial and municipal wastewater and sewage treatment processes.
10. “Wastewater” means water that has been used for human consumption, domestic purposes, industrial processes or any other purpose that results in a change of the water quality. The wastewater may originate from municipalities or industries.
11. “Wastewater treatment plants” means plants for the treatment of wastewater, irrespective of capacity and treatment type, including central effluent treatment plants (CETP).

GENERAL REMARKS

1. The producer of the sludge is responsible for the correct classification of the sludge as described in these guidelines.
2. The classification of the sludge must be finalized
   a. During the first six months of operation of a new treatment plant.
   b. Six months after the gazette notification of the guideline for an existing plant.
   c. During the first three months after changes regarding the origin of the wastewater, classified as in Annex 2B, or the treatment of the wastewater occur.
3. The producer of the sludge shall take the necessary measures to ensure the sludge management fulfills the requirements of this document.
4. The producer shall take necessary measures to ensure that the sludge is recovered or disposed of without endangering human health by pathogens or pollutants and without using processes or methods which could harm the environment, in particular present a risk to water, air, soil and plants and animals or cause a nuisance through noise or odours.
5. The bodies concerned shall work towards:
   a. the prevention or reduction of sludge production and its harmfulness, in particular by:
      - the development and use of clean technologies more sparing in their use of natural resources,
      - the technical development and marketing of products designed to minimize waste and pollution hazards during manufacture, use and final disposal;
   b. the recovery of waste by means of recycling, re-use or reclamation or any other process with a view to utilizing resources or extracting secondary raw materials, or
   c. the use of waste as a source of energy.

GENERAL REQUIREMENTS FOR SLUDGE MANAGEMENT

1. The responsibility for sludge management as described in this document lies with the producer of the sludge. The holder of the sludge must also comply with the requirements in this document.
2. The producer of the sludge is required to submit a sludge management plan to the Department of Environment as part of the environmental clearance information required for wastewater treatment plants and CETP or if relevant changes such as the origin of the wastewater or the treatment process have occurred and may only proceed to use or dispose of the sludge with written permission of the DoE.
3. Depending on the category of the sludge specific sludge management options in compliance with the requirements given in this document may be chosen. These include anaerobic digestion, land application, thermal incineration, controlled landfill and recycling in making construction materials. Sludge from municipal wastewater or comparable industry may be composted and used in agriculture. Sludge from hazardous industries/ CETP must either be treated using thermal incineration or landfilled to protect human health and the environment, other options are not feasible, for further information see table 1. The obligation to dispose of sludge from hazardous industries/ CETP by thermal incineration or landfilling according to the requirements of this document will enter into force, until then alternative disposal options may be employed with prior consent of the Department of Environment.

4. The sludge management plan submitted to the Department of Environment must include:

    a. Company and address of the producer, if the wastewater originates in industry, company and address of the industry or in the case of central effluent treatment plants the same from industries producing the wastewater,
    b. The amount of sludge that is to be expected per year in tonnes dry matter (t DM/yr),
    c. The amount of sludge produced in the previous year in tonnes in dry matter (t DM/yr),
    d. The origin of the wastewater classified as in Annex 2B,
    e. The class of sludge as described in Chapter 2 of this document,
    f. Planned option for safe disposal or use as described in Chapter 3 of this document,
    g. Documentation on fulfillment of requirements relevant for this option as described in Chapter 3,
    h. Company and address of further parties involved in sludge management including collection, transport, recovery and disposal of sludge, including the supervision of such operations and after-care of disposal sites,
    i. Documentation on suitability of recovery or disposal plant or site,
    j. Company and address of the laboratory accredited by the appropriate authority

k. commissioned to conduct any analysis, if applicable.
Evidence of sufficient, qualified and appropriate independent laboratory facilities, if applicable.

CHAPTER 2: CLASSIFICATION OF SLUDGE

Depending on the origin of the wastewater sludge can be classified as

Category A: Municipal sludge including comparable sludge
Category B: Sludge from industry including sludge from CETP
Category C: Sludge from industry including sludge from CETP belonging to the category of hazardous waste.

In cases where wastewater producing a sludge classified as Category C is mixed with other types of wastewater and treated together, for example in a CETP, the resulting sludge is to be classified as Category C. In cases where wastewater producing a sludge classified as Category B is mixed with wastewater producing sludge classified as Category A and treated together, the resulting sludge is to be classified as Category B. If different classes of sludge are mixed during collection, transport, treatment or other stages of sludge management the method of classification described above is to be applied.

Category A + Category B	=	**Category B**
Category A + Category C	=	**Category C**
Category B + Category C	=	**Category C**
Category A + Category B + Category C	=	**Category C**

Depending on the classification of the sludge different management options are permissible. An overview and detailed requirements regarding the management options are presented in Chapter 3.

To facilitate classification of a specific sludge the criteria and the steps to be followed to classify are described on the following pages. In view of the protection of the environment, it is forbidden to mix Category A sludge with Category C sludge.

The criteria for Sludge Classification are listed below:

Criteria of Category A sludge:

- If the sludge is produced in a sewage treatment plant treating only domestic or urban wastewater, it may be counted as municipal sludge and classified as Category A.
- If the sludge is produced in a sewage treatment plant treating wastewater comparable to domestic or urban wastewaters as described in Annex 3, it may be counted as municipal or comparable sludge and classified as Category A.

Criteria of Category B sludge:

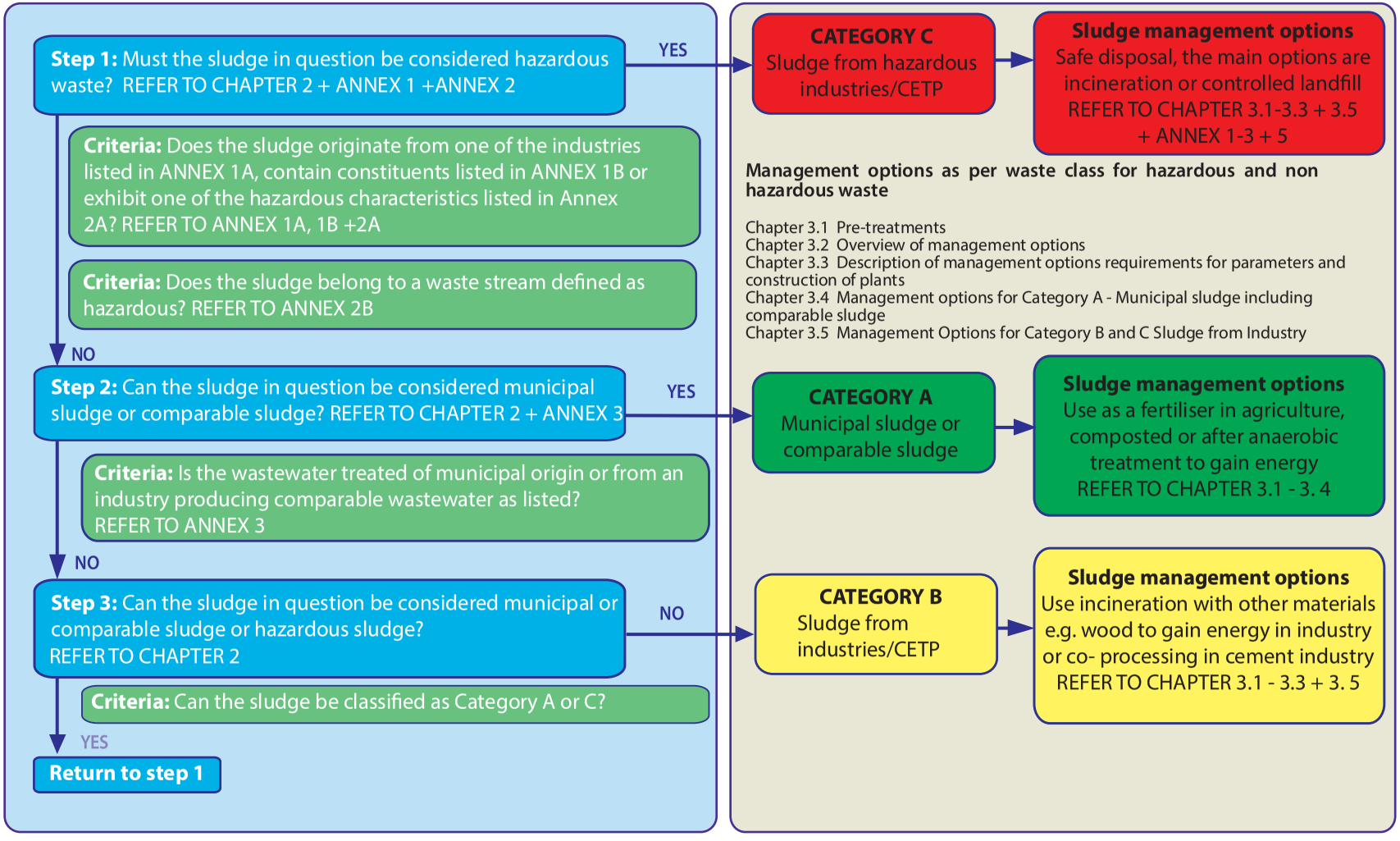
- If the sludge cannot be classified as Category A or Category C sludge, it is automatically classified as Category B.

Criteria of Category C sludge:

- If the sludge or the wastewater fulfills the criteria in Annex 1A or Annex 1B it must be counted as hazardous waste and classified as Category C unless the producer provides evidence that it does not possess any hazardous characteristics as described in Annex 2A.
- If the sludge possesses at least one of the hazardous characteristics as described in Annex 2A it must be counted as hazardous waste and classified as Category C.
- If the sludge is marked as hazardous in Annex 2B by cross mark (x), it must be counted as hazardous waste and classified as Category C.
- If the sludge is marked as hazardous and non-hazardous (mirror entry) in Annex 2B it must be counted as hazardous waste and classified as Category C unless the producer proves the sludge possesses no hazardous characteristics as defined in Annex 2A.

It lies in the responsibility of the producer to classify the waste in question as hazardous and use, treat or dispose it as required for hazardous waste, prior consent of the Department of Environment must be obtained by the producer.

Overview of Classification and Management Options for Municipal & Industrial Sludge from Wastewater Treatment Plants/ CETP Plants in Bangladesh



DECISION TREE FOR CLASSIFICATION OF SLUDGE		
Must the sludge be considered as hazardous waste and classified as a category C sludge?		
Does the sludge or wastewater originate from an industry listed in Annex 1A?	YES	→ **Category C** Producer may provides evidence that it does not possess any hazardous characteristics as described in Annex 2A[1], then classification as Category B is possible.
	NO	→ **NEXT STEP**
Does the sludge contain constituents listed in Annex 1B?	YES	→ **Category C** Producer may provides evidence that it does not possess any hazardous characteristics as described in Annex 2A[1], then classification as Category B is possible.
	NO	→ **NEXT STEP**
Does the sludge possess hazardous characteristics as listed in Annex 2A?	YES	→ **Category C** No other classification is possible
	NO	→ **NEXT STEP**
Is the sludge marked as hazardous in Annex 2B?	YES	→ **Category C** No other classification is possible
	NO	→ **NEXT STEP**
Is the sludge marked as hazardous and non-hazardous (mirror entry) in Annex 2B?	YES	→ **Category C** Producer may provides evidence that it does not possess any hazardous characteristics as described in Annex 2A [1], then classification as Category B is possible
	NO	→ **NEXT STEP**
Can the sludge in question be considered municipal sludge or comparable sludge and classified as a Category A sludge?		
Is the sludge produced in a sewage treatment plant treating only domestic or urban wastewater?	YES	→ **Category A**
	NO	→ **NEXT STEP**
Is the sludge produced in a treatment plant treating wastewater listed in Annex 3?	YES	→ **Category A**
	NO	→ **NEXT STEP**
Can the sludge in question be considered neither municipal nor comparable sludge or hazardous sludge and classified as a Category B sludge?		
Is it possible to classify the sludge in the steps above?	NO	→ **Category B**

[1]Procedure is described in Annex 2 List of hazardous characteristics and waste streams

CHAPTER 3: SLUDGE MANAGEMENT OPTIONS

3.1 PRE-TREATMENTS

Before the sludge is disposed of, it is required to apply pre-treatment in order to implement the "3R-principle" (reduce, reuse and recycle) which is a central component of the National 3R Strategy for Bangladesh (DoE). The main goal of pre-treatment is to minimize the volume and the organic matter of the sludge in order to reduce waste volume that must be disposed of and to enable a safer disposal. If the waste has to be transported e.g. to a central disposal facility, a pre-treatment would ensure better characteristics.

Possible treatment types for industrial wastewater and sludge from industrial wastewater are the following:

- mechanical treatment: e.g. sedimentation, thickening
- physico/chemical treatment: e.g. use of ferrous sulphate, lime and polyelectrolyte in coagulation, flocculation,
- ozonation, chemical oxidation (wet oxidation or wet peroxidation), adsorption of non- biodegradables on activated carbon
- biological treatment: e.g. (aerobic) activated sludge treatment, anaerobic digestion
- further sludge treatment: e.g. dewatering and drying by use of several aggregates (filter presses and centrifuges)

3.2 OVERVIEW OF MANAGEMENT OPTIONS

Table 1: Management options per waste class

Management option	Waste class		
	A	B	C
3.1 Anaerobic digestion (co-fermentation)	X[1]	X[1]	**
3.2 Aerobic digestion (composting)	X[1]		
3.3 Agricultural use	X		
3.4 Controlled landfill *	X	X	X
3.5 Thermal incineration	X[1]	X[1]	X[1]
3.6 Land application (filling material e.g. for flood prevention)	X	X[2]	**
3.7 Recycling in brick, cement or asphalt making	X	X[3]	**

[1]Residues will remain that have to be disposed of, fulfilling the requirements applicable to the category, on an alternative route e.g. by landfill.
[2]Inert material (low organic matter required)
[3]Availability and capacity limited by local conditions. Accepted sludge volume limited due to a loss of compressibility of the product
* Requirements for the landfill class (Chapter 3.3.4) vary depending on category of the sludge.
**As described in Chapter 2, the producer may provide evidence that sludge categorized as category C sludge according to Annex 1A or 1B does not possess any hazardous characteristics; in this case it may be categorized as category B sludge and the management options of anaerobic digestion (co-fermentation), land application (filling material e.g. for flood prevention), recycling in brick, cement or asphalt making are permissible.

3.3 DESCRIPTION OF MANAGEMENT OPTIONS INCLUDING DESIGN PARAMETER

3.3.1 Anaerobic digestion (biogas recovery)

It may be beneficial to add sludge from the biological treatment based on activated sludge treatment to an anaerobic digestion plant or conduct co-fermentation with municipal sewage sludge and other suitable materials to collect biogas for energy production and save emissions. In addition, nutrients in the residue can be used as a fertilizer if the input materials all may be used in agriculture (Category A sludge fulfilling the requirements in Chapter 3.4).

Especially when sludge from industries are used, it is necessary to keep in mind, that some substances may have an inhibiting effect on the microorganisms to optimize the digestion process. The inhibitors commonly present in anaerobic digesters include ammonia, sulfide, light metal ions, heavy metals, and organics.

For reasons of climate protection the organic matter in the residue should be as low as possible to prevent uncontrolled biodegradation leading to emissions and leachate when it is used in landfill application. Requirements for landfill application are described in Table 3.

Anaerobic digestion is not permissible for Category C sludge from hazardous industries/CETP in any case as the risk of toxic substances causing emissions that are harmful for human beings and the environment is high.

3.3.2 Aerobic digestion (composting)

Composting can be used to produce fertilizer for application in agriculture. To gain a suitable compost, carbon-rich material is required and an optimized C:N ratio would be 25 – 30:1. As not all sludge ensures this ratio, so co-composting material like green waste, sawdust, woodchip, rice and straw can be added. The major advantages of promoting composting are an increase of the C:N, a reduction of salt, heavy metal and leaching of hazardous and (phyto-) toxic substances.

Therefore, this option should be prohibited for the use of hazardous waste (Category C) and even for non-hazardous waste from industries (Category B) when the product is intended to be used in agriculture.

3.3.3 Agricultural use

Table 2: Parameter limits of sludge for use as compost/fertilizer[2]

Parameter	in sludge mg/kg dry substance	in soil* mg/kg dry substance
Pb (Lead)	900	100
Cd (Cadmium)	10	1.5
Cr (Chromium)	900	100
Cu (Copper)	800	60
Ni (Nickel)	200	50
Hg (Mercury)	8	1
Zn (Zinc)	2500	200

*Soil of the agricultural land before application of sludge

The quantity is limited:

< 3 t dry substance sewage sludge per ha in 3 years
< 10 t dry substance sludge compost per ha in 3 years

Detailed requirements can be found in Chapter 3.4 – Municipal sludge including comparable sludge

3.3.4 Controlled Landfill

Controlled landfill describes the possibility to deposit the sludge in the ground. To establish a controlled landfill site it is necessary to obtain prior approval from the DoE, which is responsible for granting an environmental clearance certificate.

The sludge has to be stabilized by reducing the organic fraction to prevent uncontrolled degrading processes. To have a better control of greenhouse emissions (methane) and leachate, the waste (sludge) has to be deposited in dedicated landfill sites. Categories exist for different kinds of waste depending on its hazardous potential or pollutants, which have different requirements for the construction, the pollutants (measure in leachate) and monitoring.

[2] Source: German Sewage Sludge Ordinance, July 2002

Basic requirements for the location of a landfill site:

- The over flooding level should be > 2.0 m of the maximum expected water level of the surrounding water bodies
- > 500 m distance to populated areas
- no construction in protected areas
- no construction in flood plains and areas with a high risk of natural disasters
- the underground has to resist mechanical stresses, has to hold back or prevent leachate and pollutants
- water impermeability
- buoyancy safety has to be considered

Controlled landfill sites in Bangladesh are proposed to be categorized in 3 classes, inert landfill (class 0), non-hazardous landfill (class 1 and class 2) and hazardous landfill (class 3) depending on requirements for the acceptance of waste and for the construction. The definition of the landfill classes for the purpose of this document is based on the types of waste (i.e. inert, non-hazardous and hazardous) that may be accepted and the binding limit values the waste in question must comply with. These are listed in Table 3. It is recommended that the operator shall maintain a list of approved wastes that can be disposed.

Table 3: Landfill classes[3]

Designation	Unit	Landfill class 0 (inert)	Landfill class 1 (non hazardous)	Landfill class 2 (non hazardous)	Landfill class 3 (hazardous and non hazardous)
Investigation on original substance					
water soluble part	%	0.4	3	6	10
extractable lipophilic substances	%	0.1	0.4	0.8	4
total BTEX[4]	mg/kg d.s.	6			
total PCB's[5]	mg/kg d.s.	1			
total PAK's[6]	mg/kg d.s.	30			
MKW[7] C_{10} -C_{40}	mg/kg d.s.	500			
acid neutralisation capacity	mmol/kg				
calorific	kJ/kg	6000	6000	6000	6000
breathability (AT_4[8])	mg/g O_2 d.s.	5	5	5	5

[3]Landfill class 0, 1, 2 and 3 are overground sites characterized by types of wastes (i.e. inert, non-hazardous and hazardous) and its limiting values allowed to be disposed as provided in the table. Detailed information about construction and maintenance of landfill of each class can be found in German Landfill Ordinance
[4]BTEX = Benzol, Toluol, Ethylbenzol and ortho-xylol
[5]PCB = Polychlorinated biphenyl
[6]PAK = Polycyclic aromatic hydrocarbons
[7]MKW = Petroleum-derived hydrocarbon
[8]AT_4 = Breathability according to DIN ISO 16072

Designation	Unit	Landfill class 0 (inert)	Landfill class 1 (non hazardous)	Landfill class 2 (non hazardous)	Landfill class 3 (hazardous and non hazardous)
Investigation on dry residue					
total organic carbon (TOC)	%	1	1	3	6
loss on ignition 550°C	%	3	3	5	10
Leachate with distilled water					
pH*	mg/l	5.5 - 13	5.5 - 13	5.5 - 13	4.0 - 13
weak acid dissociable cyanide	mg/l	0.01	0.1	0.5	1
Fluoride (F)	mg/l	1	5	15	50
Phenols	mg/l	0.1	0.2	50	100
dissolved organic carbon (DOC)**	mg/l	50	50	80	100
Arsenic (As)	mg/l	0.05	0.2	0.2	2.5
Lead (Pb)	mg/l	0.05	0.2	1	5
Cadmium (Cd)	mg/l	0.004	0.05	0.1	0.5
Copper (Cu)	mg/l	0.2	1	5	10
Nickel (Ni)	mg/l	0.04	0.2	1	4
Mercury (Hg)	mg/l	0.001	0.005	0.02	0.2
Zinc (Zn)	mg/l	0.4	2	5	20
Barium (Ba)	mg/l	2	5	10	30
Chromium (Cr), total	mg/l	0.05	0.3	1	7
Molybdenum (Mo)	mg/l	0.05	0.3	1	3
Antimony (Sb)***	mg/l	0.006	0.03	0.07	0.5
Antimony C0 value	mg/l	0.01	0.12	0.15	1
Selenium (Se)	mg/l	0.01	0.03	0.05	0.7
Chloride (Cl)	mg/l	80	1500	1500	2500
Sulphate (SO_4)****	mg/l	100	2000	2000	5000

*Divergent pH values alone shall not represent an exclusion criterion. Where pH values are too high or too low, the cause shall be examined.
** The allocation value for DOC shall also be satisfied if the waste or the landfill replacement construction material fails to satisfy the allocation value at its own pH value, but does satisfy the allocation value at a pH value between 7.5 and 8.0. With the approval of the competent authority, excessive values of DOC up to 200 mg/l shall be permissible if the public welfare is not impaired and up to max. 300 mg/l if they are based on inorganically bound carbon.
*** Antimony values that exceed the values given for "Antimony (Sb)" shall be permissible if the Concentration value of the percolation test provided for "Antimony C0 Value" is not exceeded.
**** Excessive sulphate values up to 600 mg/l shall be permissible if the Co value of the percolation test does not exceed 1,500 mg/l where the liquid/solid ratio = 0.1 l/kg.

3.3.5 Thermal (co-) incineration

Currently available and applied co-incineration technologies[9] are listed below. The sludge coming from the biological treatment with volatile moisture content is added to the incineration chamber. Before energy can be produced the sludge has to be dried in the chamber. It is possible that the incineration consumes more energy for drying than it produces.

A range of incineration methods, as described below, may be applied.

- Dried sewage sludge (~90% d.s.) is blown as dust into the furnace.
- Drained sewage sludge (~20 - 30% d.s.) is supplied separately through sprinklers into the incineration chamber and distributed on a grate. The sludge is integrated into the bed material by overturning the waste on the grates. Operational experiences show up to 20 mass-% sludge (at 25% d.s.). Other experiences have shown that if the sludge ratio is too high (e.g. >10%.), high fly ash content or unburnt material in bottom ash may occur.
- Drained, dried or semi-dried (~50 - 60% d.s.) sludge is mixed with the remaining waste or fed together into the incineration chamber. This can occur in the waste bunker through targeted doses by the crane operator, or controlled in a feeding hopper by pumping dewatered sludge into the hopper or by spreading systems into the bunker.

The average dry matter content identified by the Textile Sludge Study in Bangladesh is about 30 to 40%. So it can be characterized as drained sewage sludge and an appropriate incineration technique can be chosen.

Although this technique enables a recovery of energy, it is only discussed as an alternative if other disposal routes are restricted or too expensive. In the use of incineration the observation of emission limits is very important. Besides furans, dioxins and a number of other flue gas components about 5 to 10 % of the total chromium is converted from chromium (Cr^{+3}) to the carcinogenic chromium (Cr^{+6}). These have a harmful impact on human health and the environment and therefore, the installation of expensive pollutant filters are required. In coincineration in existing plants these filter systems need to be given as well.

The temperature has to be at least over 800°C to avoid noxious smells. The water content of the sludge has an impact on the efficiency and in some cases an additional drying step is required. An absence of control systems would only lead to a shift of pollutants which violates the principle of sustainability.

The following value limits to exhaust emissions by incineration plants need to be observed to guarantee a safe incineration and to avoid harmful impacts on human health.

[9] Reference Document on the Best Available Techniques for Waste Incineration, August 2006

Table 4: Limiting values for exhaust parameters of incineration plants

Substances, or group of substances	Concentration µg/m³	Averaging period for the calculation of the value*	Permissible excess frequency per year**
Benzene	5	Year	-
Lead and inorganic compounds contained in suspended particulate matter (PM_{10}), to be indicated as Pb	0.5	Year	-
Particulate matter (PM_{10})	40 50	Year 24 hours	- 35
Sulphur dioxide	50 125 350	Year 24 hours 1 hour	- 3 24
Nitrogen dioxide	40 200	Year 1 hour	- 18
Tetrachloroethylene (PER)	10	Year	-

* Integrated time used to calculate the standard. For example, for particulates, the filter will collect material for 24 hours and then analyzed. The annual integration will be an integration of the daily values.
** Refers to the number of times the concentration measured can exceed the standard limiting value. Similar permission is allowed for ambient air in the Bangladesh Air Quality Standards (Bangladesh Govt. Gazette S.R.O. No: 220-Law/2005 of 16 July 2005).

These averaging times reflect exposure periods of public health concern. Stack sampling duration may be different from averaging period. Stack tests only provide a snapshot of emissions during the period of the test. The methods may include continuous monitoring to measure actual emissions; or extrapolation of results from short-term emissions tests.

- For periodic emission tests, the sampling period should ideally be of one hour.
- For 24 hour averaging period under continuous measurement, average of all valid hourly averages will be used to calculate concentration. For 24 hour averaging period under periodic measurement, average of three one-hourly averages taken on the same day will be used to calculate concentration.
- For calculating yearly concentration, at least 3 samplings should take place each year. The following table outlines specific instructions for each of the substances. As an example, yearly concentration of Sulphur Dioxide can be calculated using average of three 24-hour sampling averages or using average of three one-hour sampling averages taken at three different times over a year.

Substances, or group of substances	Using this average time (year)
Benzene	3-run average (1 hour minimum sample time per run)
Lead and inorganic compounds contained in suspended particulate matter (PM_{10}), to be indicated as Pb	3-run average (collect a minimum volume of 1 dry standard cubic meters)
Particulate matter (PM_{10})	3-run average (collect a minimum volume of 1 dry standard cubic meters)
Sulphur dioxide	3-run average (1 hour minimum sample time per run)
Nitrogen dioxide	3-run average (1 hour minimum sample time per run)
Tetrachloroethylene (PER)	3-run average (1 hour minimum sample time per run)

Other techniques like pyrolisis or gasification to generate useful products are under development and may be used as and when suitable.

3.3.6 Land application

Land application includes a wide variety of uses such as filling material for flood prevention, material/ substrate for re-cultivation of mining sites or covering landfill sites. Land application does not include agricultural use.

It can be assumed that sludge appropriate for agricultural use is also suitable for land application, but when using large amounts, nutrient content must be taken into consideration to minimize leaching. Requirements for land application depend on the specific use and should be decided on an individual basis only with permission of the responsible authority in agreement with the Soil Resource Development Institute (SRDI) and the Department of Environment (DoE).

3.3.7 Recycling

An accepted recycling option is to replace raw materials with dried sludge (or sludge from thermal treatment) in the production of cement, bricks, tiles, ceramics, glass and asphalts. Some clays are deficient in organic content which is why an addition of sludge is desirable. The oxidation of this material during the brick-firing process improves the quality of the resulting bricks.

The use of sludge from physico-chemical treatment seems more suitable than from a biological treatment as the organic content from biological treatment may be too high for optimal use in production of bricks when replacing high amount of raw material.

The amount of replaced raw material can vary from 10 to 70% but a decrease in compressive sludge depending on the sludge content has to be considered. High sludge content may be possible if the product is used in non-structural-building.

The application of this disposal route depends on the demand of brick making companies. If they cannot match with the quantities of the sludge production this alternative is limited and additional options need to be found.

The recycling of sludge from class C needs a specific evaluation whether the harmful components are stable and long term bound into the final material.

3.4 MANAGEMENT OPTIONS FOR CATEGORY A – MUNICIPAL SLUDGE INCLUDING COMPARABLE SLUDGE

3.4.1 Scope of chapter 3.4

(1) This chapter must be observed by anyone who

1. operates wastewater treatment plants and surrenders or intends to surrender sewage sludge for application on soil used for agriculture or horticultural ,
2. applies or intends to apply sewage sludge on soil used for agriculture or horticulture

(2) The provisions under fertilizer legislation shall remain unaffected.

(3) The bodies concerned shall work towards ensuring that the limit values specified in this document are as far as possible not overstepped. The soil limit values specified in this document have been defined for the specific conditions of agricultural sewage sludge utilization. It shall not be possible to derive general cultivation restrictions or restrictions of any other type from these values being attained or exceeded.

3.4.2 Conditions permitting application

(1) Sewage sludge may only be applied on soil used for agriculture or horticulture in such a way that it does not adversely affect the common wellbeing, and that the manner, quantity and time of application is adjusted to the nutrient requirements of the plants, allowing for the nutrients and organic substance available in the soil as well as for site related and growing conditions. The application of sewage sludge shall, moreover, be subject to the provisions laid down in Fertilizer Law accordingly.

(2) Before applying sewage sludge on soil used for agriculture or horticulture for the first time, the operator of a wastewater treatment plant shall undertake to have their content of lead, cadmium, chromium, copper, nickel, mercury and zinc analyzed on the basis of soil analyses performed by a body appointed by the Director General (DG), DoE.

(3) The soil analyses specified above shall be repeated at intervals of 10 years. The responsible authority shall order that the soil analyses be repeated at shorter intervals if it is feared that the values set down in chapter 3.4.3, sub-section 8 will be exceeded. This decision shall be based on the result of sewage sludge and soil analyses conducted and after allowing for the application volume and for other causes of heavy-metal pollution and must be in agreement with the responsible specialized agricultural authority. The responsible authority shall be able to restrict the additional soil analyses to specific units of land and heavy metals

(4) Sewage sludge may only be applied if the soil has been analyzed in relation to its pH value, content of plant- available phosphate, potassium and magnesium. The costs of conducting this soil analysis shall be borne by the operator of the wastewater treatment plant.

(5) Sewage sludge may only be surrendered for application on agricultural or horticultural soil or applied on such if samples of the sewage sludge are analyzed at intervals of at most six months by a body appointed by the responsible authority to establish the contents of lead, cadmium, chromium, copper, nickel, mercury, arsenic and zinc, the sum of organic halogen compounds as absorbed organically bound halogens (AOX), total and ammonia nitrogen, phosphate, potassium, magnesium as well as the dried residue, organic substance, basifying substances, the pH value, salmonella and helminth ova. The responsible authority shall be able to extend the analysis to cover further constituents. It shall be able to reduce the interval between sewage sludge analyses down to two months. In doing so, it shall be able to restrict the analyses to specific heavy metals.

(6) Sewage sludge may only be surrendered for application on agricultural or horticultural soil or applied on such if prior to the first time of application and thereafter, at intervals of at most two years samples of the sewage sludge are analyzed for the contents of the organic persistent pollutants polychlorinated biphenyls and polychlorinated dibenzodioxins (PCDDs) and dibenzofurans (PCDFs). Sub-section 5, sentence 3 shall apply accordingly. The analysis must be conducted by one of the bodies approved of by the Director General, Department of Environment.

(7) The operators of wastewater treatment plants must conduct the sampling and analyses specified in sub-sections 2, 3, 5 and 6, or have such conducted, in accordance with the instruction contained in Annex 5 of this Document.

(8) In cases where sludge from small-scale treatment plants of an agricultural undertaking is applied on arable land owned by that undertaking, it shall not be necessary to observe the provisions contained in sub-sections 2 to 7. Before they are applied for the first time, sludge from such plants must be analyzed for the parameters specified in sub-section 5. The results must be submitted without delay to the Department of Environment and to the responsible specialized agricultural authority SRDI.

(9) Regarding the application of sewage sludge from wastewater treatment plants for the treatment of domestic wastewater, municipal wastewater or comparable wastewater with a capacity of less than 1,000 population equivalents, it shall, after an initial analysis under chapter 3.4.2, be possible to dispense with the analyses specified in sub-sections 3 and 6. The analyses specified in subsection 5 shall be performed at intervals of at most two years; the responsible authority shall be able to shorten the interval between analyses to six months or lengthen it to 48 months as well as extend the analysis to cover further constituents.

(10) In respect of small-scale treatment plants of individual households, analyses under sub-sections 2 to 7 must only be performed upon instruction of the responsible authority if there is reason to fear harmful impacts on human health or the environment.

(11) A laboratory may be appointed as a body named in sub-section 2, sub-section 5, sentence 1 and sub-section 6, sentence 3 if the applicant is sufficiently qualified, independent and reliable and has the required technical equipment. The appointment

shall be effected by the competent authority, the Department of Environment. The granting of an appointment may be subject to a proviso of revocation, to a time limit, specific conditions or obligations or to the proviso that obligations could be imposed subsequently.

3.4.3 Application bans and restrictions

(1) It shall be prohibited on soil used for agricultural or horticulture to apply crude sludge or sludge from wastewater treatment plants other than for the treatment of domestic wastewaters, municipal wastewaters or comparable wastewater classified as category A.

(2) It shall be prohibited to apply sewage sludge on areas of land used for the growing of fruit and vegetables. On arable land also used for growing field vegetables, it shall be prohibited to grow field vegetables in the year in which the sewage sludge is applied as well as in the year thereafter.

(3) On arable land used for growing field forage or for growing plants with the edible parts that are used as feedstuff, it shall only be permissible to apply sewage sludge prior to sowing and with subsequent deep-turn tillage.

(4) It shall be prohibited to apply sewage sludge on permanent grassland.

(5) It shall be prohibited to apply sewage sludge on soil used for purposes of forestry.

(6) It shall be prohibited to apply sewage sludge in parks, playgrounds and similar areas, where humans, especially children, have immediate contact with the soil. To protect the community from possible vectors and odours, sludge should not be applied to land within 500 m from dwellings.

(7) To protect groundwater and surface water from pollution, the following buffer zones are recommended between the area of application and the water receptor:

- Depth to aquifer => 5 m
- Distance from surface water/borehole => 200 m shall be prohibited.

Further-reaching regulations in water legislation must be complied with.

(8) It shall be prohibited to apply sewage sludge on agricultural or horticultural soil if the soil analyses under chapter 3.4.2, sub-section 2 or 3 shows that the contents of the following heavy metals exceed at least one of the following values:

Heavy metal	mg/kg of dry matter
Lead	100
Cadmium	1.5
Chromium	100
Copper	60
Nickel	50
Mercury	1
Zinc	200
Arsenic	40

In the case of soil that are classified as light soil within the scope of soil rating and the clay content of which falls below 5 per cent or whose analysis under chapter 3.4.2, sub- section 4 has shown a pH value of more than 5 and less than 6, it shall also be prohibited to apply sewage sludge in so far as the following values exceed for the heavy metals of cadmium and zinc:

Heavy metals	mg/kg of dry matter
Cadmium	1
Zinc	150

(9) It shall be prohibited to apply sewage sludge on agriculturally or horticulturally used soils if the soil analysis under chapter 3.4.2, sub-section 4 produces a pH value of 5 or less. Soil that does not reach a pH value of 5 shall require a lime dressing with liming material prior to the application of sewage sludge. For the calculation of needed quantity of lime it is important to consider the basifying components that have been applied subsequently to the sewage sludge.

(10) It shall be prohibited to apply sewage sludge on agriculturally or horticulturally used soils if the sewage sludge analyses under chapter 3.4.2, sub-section 6 shows that the contents of the following organic persistent pollutants exceed at least one of the following values:

- **polychlorinated biphenyls (PCB):** in each case 0.2 milligrams per kilogram of sludge dry matter for component numbers 28, 52, 101, 138, 153, 180;
- **polychlorinateddibenzodioxins/dibenzofurans (PCDD/PCDF):** 100 nanograms of TCDD toxicity equivalents (see example for calculation provided in Annex 5 Section 1.3.3.2) per kilogram of sludge dry matter.

(11) It shall be prohibited to apply sewage sludge to agriculturally or horticulturally used soils if the sewage sludge analyses under chapter 3.4.2, sub-section 5 show that the sum of halogen organic compounds, expressed as the sum parameter AOX, exceeds 500 mg/kg of sludge dry matter.

(12) It shall be prohibited to apply sewage sludge to agriculturally or horticulturally used soils if the sewage sludge analyses under chapter 3.4.2, sub-section 5 show that the contents of the following heavy metals exceed limit values in at least one case:

Heavy metal	mg/kg of dry matter
Lead	900
Cadmium	10
Chromium	900
Copper	800
Nickel	200
Mercury	8
Zinc	2500
Arsenic	40

In the case of soil classified as light soil within the scope of soil rating and whose clay content is below 5 per cent or whose analysis under chapter 3.4.2, sub-section 4 has revealed a pH value exceeding 5 and less than 6, the following values must be read in sentence 1 for cadmium and zinc:

Heavy metals	mg/kg of dry matter
Cadmium	5
Zinc	2000

It shall be prohibited to apply sewage sludge to agriculturally or horticulturally used soils if the sewage sludge analyses under chapter 3.4.2, sub-section 5 show that the contents of the following pathogens exceed limit values in at least one case:

Pathogen	mg/kg of dry matter
Salmonella	none
Helminth ova (Total viable ova/g dry matter)	< 0.25 (or one viable ova/4g)

(13) When producing sewage sludge composts, digestates and sewage sludge mixtures, the limit values contained in chapter 3.4.2, sub-sections 10, 11, and 12 must apply to the sewage sludge and additives used prior to mixing. In addition the limit values must apply to the produced compost, digestate or mixture. The pollutant load of a mixture produced

by using sewage sludge must not exceed the product of the pollutant contents permissible under sub-sections 10, 11 and 12 and the application quantity permissible under chapter 3.4.4, sub-section 1.

(14) Sewage sludge may only be stored on or in the vicinity of the area of application in so far as such is necessary for the application.

3.4.4 Application quantity

(1) It shall be permissible within a period of 3 years to apply on those soil specified in chapter 3.4.1 no more than 5 tonnes of sewage sludge dry matter per hectare. Sewage sludge composts may be applied within a period of 3 years at a rate of up to 10 tonnes of dry matter per hectare if the pollutant contents of the sewage sludge compost do not exceed 50 % of heavy metal contents permissible under chapter 3.4.3, sub-chapter 3.4.12 and 50 % of the contents of organic pollutants permissible under chapter 3.4.3, subsection 10.

(2) In the event of a mixture containing sewage sludge being applied, the application quantity permissible under sub-section 1 shall refer to the sewage sludge used and not to the mixture. The proportion of sewage sludge must be verified by the supplier and made known to the user. Chapter 3.4.3, sub-section 13, sentence 2 shall apply irrespectively hereof.

3.4.5 Obligations to furnish verification

(1) At the latest two weeks before surrendering the sewage sludge, the operator of the wastewater treatment plant or an authorized third party e.g. the farmer using the sludge shall give notice of the intended application to the authority responsible for the application area and to the specialized agricultural authority by submitting a carbon copy of the completed delivery note as per the example presented in Annex 6 of this document.

(2) The operator of the wastewater treatment plant shall record on the delivery note the time at which the sewage sludge is surrendered and hand the delivery note to the forwarder. The delivery note must be held available in the vehicle during the period of transportation. The delivery and application of sewage sludge must be confirmed by the recipient.

(3) The recipient and the forwarder shall each retain a carbon copy of the delivery note, a further carbon copy shall be sent by the forwarder to the authority responsible for the wastewater treatment plant and to the authority responsible for the application area, the top copy to the operator of the wastewater treatment plant. The latter shall be required to preserve the top copy for a period of 30 years as from the time of hand-over and present such to the responsible authorities upon their request. In implementation of subsections 1 and 2 and of sentence 1, it shall be possible to use the facilities of electronic data processing.

(4) The obligations specified in sub-sections 1 to 3 shall also be effective if operators of wastewater treatment plants apply sewage sludge or have sewage sludge applied on their

own property.

(5) Operators of wastewater treatment plants shall keep a register containing the following information:

a volumes of sludge generated and the volumes of sludge supplied to agriculture (in tonnes of dry matter),

b properties of the sewage sludge in accordance with Chapter 3.4.2, sub-section 5,

c mode of treatment of the sewage sludge,

d name and address of the recipients of sludge, plot- specific designation of the area of land on which the sludge is applied,

e results of the soil analyses, broken down by plot and arranged in the order of land record number. The operators of wastewater treatment plants shall submit these details at the beginning of the following year for the previous calendar year to the responsible authorities.

(6) The operators of wastewater treatment plants for the treatment of domestic wastewater, municipal wastewater or comparable wastewater and with a capacity of less than 1,000 population equivalents shall be excluded from the obligations specified in sub-sections 1 to 5.

3.4.6 Administrative offences

An administrative offence shall be deemed to have been committed by anyone who willfully or negligently:

1. applies sewage sludge without the prescribed soil analysis (chapter 3.4.2 sub-section 4, sentence 1),
2. applies sewage sludge or surrenders sewage sludge for application contravenes without the prescribed analysis of the sewage sludge (chapter 3.4.2, sub-section 5, sentence 1 or sub-section 6, sentence 1),
3. fails to analyze sewage sludge or to submit the results to the responsible authorities (chapter 3.4.2, sub-section 8, sentence 2 or 3),
4. applies sewage sludge or surrenders sewage sludge for application contravenes without the prescribed analysis of the sewage sludge (chapter 3.4.2, sub-section 9, sentence 9 c),
5. fails to meet an enforceable order altogether, correctly or in good time (chapter 3.4.2, sub- section 10),
6. applies sewage sludge without complying with the application bans and restrictions required in this document (chapter 3.4.3, sub-section 1, 2, sentence 1, sub- section 4 or 5, or sub-sections 6 to 11

7. fails to comply with the requirements for growing the plants specified in the chapters named below or by failing to subject the soil to deep-turn tillage (chapter 3.4.3 sub-section 2, sentence 2 in conjunction with subsection 3, sentence 1),
8. fails to work the sewage sludge into the soil prior to sowing (chapter 3.4.3, sub-section 3, sentence 2),
9. applies sewage sludge on agriculturally or horticulturally used soils (chapter 3.4.3, sub- section12),
10. applies sewage sludge mixtures that do not comply with limit values and pollutant loads (chapter 3.4.3, sub-section 13, sentence 2),
11. stores sewage sludge on or in the vicinity of the application area (chapter 3.4.3, sub-section 14),
12. chapter 3.4.4 applies more than the specified quantities of dry matter of sewage sludge, sewage sludge composts, digestate or a mixture produced by using sewage sludge (chapter 3.4.4),
13. fails to provide notification of application of sewage sludge altogether or in good time (chapter 3.4.5, sub-section 1),
14. fails to hold the delivery note available in the vehicle during the period of transportation (chapter 3.4.5, sub-section 2, sentence 2),
15. fails to complete the delivery note presented in Annex 6 of this document altogether, correctly or in full, or fails in contravention of chapter 3.4.5, sub-section 3, sentence 2 to preserve a copy of the delivery note for a period of 30 years, or fails to present the said delivery note for examination to the responsible authority upon its request,
16. fails to keep the register altogether, correctly or in a complete state, or by fails to submit the information altogether or in good time (chapter 3.4.5, sub-section 5).

3.5 MANAGEMENT OPTIONS FOR CATEGORY B AND C SLUDGE FROM INDUSTRY

3.5.1 Scope and general requirements

(1) This chapter must be observed by anyone who operates wastewater treatment plants or CETP treating wastewater from industry or is involved in any aspect of sludge management of sludge originating in industry.

(2) The provisions under legislation on hazardous waste shall remain unaffected.

(3) The bodies concerned shall work towards ensuring that the limit values specified in this document are as far as possible not overstepped. Best available techniques as described in Chapter 3.5.2 shall be taken into consideration by the producer of the sludge and their applicability is to be assessed as part of the sludge management plan, aiming to minimize pollutants at the source and apply suitable recycling and recovery technologies where possible.

3.5.2 Obligations to furnish verification

(1) At the latest two weeks before surrendering the sewage sludge, the operator of the wastewater treatment plant or an authorized third party e.g. the person transporting the sludge shall give notice of the intended transport and treatment or disposal to the authority responsible for the wastewater treatment plant by submitting a carbon copy of the completed delivery note as per the example presented in Annex 8 of this document.

(2) The operator of the wastewater treatment plant shall record on the delivery note the time at which the sewage sludge is surrendered and hand the delivery note to the forwarder. The delivery note must be held available in the vehicle during the period of transportation. The delivery of sewage sludge must be confirmed by the recipient.

(3) The recipient and the forwarder shall each retain a carbon copy of the delivery note, a further carbon copy shall be sent by the forwarder to the authority responsible for the wastewater treatment plant and if applicable to the authority responsible for the treatment or disposal facilities, the top copy to the operator of the wastewater treatment plant. The latter shall be required to preserve the top copy for a period of 30 years as from the time of hand-over and present such to the responsible authorities upon their request. In implementation of subsections 1 and 2 and of sentence 1, it shall be possible to use the facilities of electronic data processing.

(4) The obligations specified in sub-sections 1 to 3 shall also be effective if operators of wastewater treatment plants treat or dispose of sewage sludge on their own property.

(5) Operators of wastewater treatment plants shall keep a register containing the following information:

a. volumes of sludge generated and the volumes of sludge supplied to agriculture (in tonnes of dry matter),

b. mode of treatment and / or disposal of the sewage sludge,

c. name and address of the recipients of sludge,

(6) The operators of wastewater treatment plants shall submit these details for the previous year along with the first quarterly ETP monitoring report of the following year to the responsible authorities.

3.5.3 Administrative offences

An administrative offence shall be deemed to have been committed by anyone willfully or negligently and administrative measures shall be taken following ECA'1995.

1. fails to fulfill the general requirements for sludge management (chapter 1),
2. fails to provide notification of treatment or disposal of sewage sludge altogether or in good time (chapter 3.4.5, sub-section 1),
3. fails to hold the delivery note available in the vehicle during the period of transportation (chapter 3.4.5, sub-section 2, sentence 2),
4. fails to complete the delivery note presented in Annex 6 of this document altogether, correctly or in full, or fails in contravention of chapter 3.4.5, sub-section 3, sentence 2 to preserve a copy of the delivery note for a period of 30 years, or fails to present said delivery note for examination to the responsible authority upon its request,
5. fails to keep the register altogether, correctly or in a complete state, or fails to submit the information altogether or in good time (chapter 3.4.5, sub-section 5).

3.5.4 Examples of best available techniques (example textile industry)

Examples of wastewater treatment with in some cases included recovery from the waste streams and associated disposal routes will be presented in this chapter referring to the Reference Documents for Best Available Techniques for the Textiles Industry, July 2003 and for the Tanning of Hides and Skins, 2003. A wide range of waste streams and appropriate treatment have been covered and described by experts. These are publicly available at http://www.epa.ie/pubs/advice/bat/BAT%20Guidance%20Note%20for%20Textiles%20Processing%20Sector.pdf. The treatment options named below are examples, other methods not described here may be equally suited.

(1) Origin of wastewater: Mixed textile wastewater with partial recycling of water and on-site treatment

Wastewater from textile dyeing industry must be treated by the effluent treatment plant (ETP). The treated wastewater can be recycled.

The wastewater treatment contains the following stations:

- Equalization/neutralization,
- activated sludge treatment with added lignite coke powder for bio-degradation,
- absorption stage with added lignite coke powder to remove dyestuffs and other hardly or non-biodegradable compounds,
- flocculation/precipitation and removal of the sludge by flotation (aluminium sulphate and an anionic polyelectrolyte are added as flocculants),
- filtration to remove suspended solids,
- reverse osmosis plant (option)

Sludge is taken from the activated sludge treatment and from the flotation. It gets dewatered in a thickener and decanter and is then thermally regenerated in a rotary kiln (kiln is about 450 °C) and the flue-gas is submitted to post-combustion (about 850 °C).

(2) Origin of wastewater: Recycling of residual dyestuff from padding liquors and printing paste residues

In the dyeing and printing process printing pastes and padding liquors (for dyeing) with a high organic content are used. The residues can be treated in anaerobic digesters preferably in co-fermentation together with the sludge from the biological treatment from municipal wastewater treatment plants.

In the process the Azo-groups are irreversibly destroyed but will still absorb light and a slight yellowish colour remains.

The water-soluble cleavage products (the ones with sulphonic groups) are present in the water phase and reach the activated sludge treatment both as overflow from the anaerobic digester and as filtrate from sludge dewatering.

The more-substituted naphthalene derivatives are hardly biodegradable and may still be present in the final effluent. For this reason, the supernatant needs to be subsequently treated in an activated sludge system.

Separation of the residual padding liquors from other streams at source in order to keep them concentrated.

Dosage of reactive printing paste should not exceed 10 g/kg sludge (inhibition effects).

Padding liquors and printing pastes with heavy metal-containing dyestuffs should be separated unless the sludge resulting from the anaerobic treatment is incinerated or disposed of in appropriate landfill, which is also recommended for all kinds of residues from dyestuff treated in anaerobic digestion.

(3) Origin of wastewater: Wastewater containing pigment paste

The technique is membrane based and allows complete reuses of the resulting permeate. The wastewater contains pigment printing pastes with high organic compounds. In the cleaning process a coagulation, a precipitation and microfiltration of the precipitation need to be done. The suspended solids in the concentrate are removed in a tube settler by dosage of flocculants.

The produced sludge needs to be treated in a physico-chemical plant before it is sent for incineration.

(4) Origin of wastewater: Mixed and coloured wastewater

As a first pre-treatment step a flocculation/precipitation needs to be done. For a maximized COD elimination and colour removal the precipitation can be removed by a dissolved air flotation after an equalization. Therefore, the dosage of flocculants (e.g. for a mixed effluent with COD of ca. 1000 mg/l) is about:

aluminium sulphate:	400 - 600 mg/l
cationic organic flocculants:	50 - 200 mg/l
anionic polyelectrolyte:	1 - 2 mg/l

The use of sulphates is preferred to chloride when the sludge is about to be incinerated. Also, sulphates are easier to remove from water.

Operational data:

- The expected specific sludge production is 0.7 - 1 kg of dry matter per m^3 of treated wastewater
- The expected specific sludge production is 0.5 kg of removed COD per 3 kg sludge produced
- The sludge will be dewatered in a chamber filter press up to a dry matter content of 35 - 40%

The resulting sludge is supposed to be incinerated.

(5) Origin of wastewater: Partial stream containing organic solvents from a solvent recovery system

For the treatment of textiles organic solvents are sometimes used. In the solvent recovery system, a stream with a high content of PER (Perchloroethylene) (150 – 250 mg/l) is produced and gives rise to an emission of 75 - 125 g/h PER. This substance is known to be carcinogenic (category 2a according to IARC) and therefore a hazardous waste. The solvent is not biodegradable and should not be mixed with the effluent stream to be treated in the biological stage because it would accumulate and last indefinitely. Thus, a segregation and treatment by stripping and absorption through active charcoal cartridges that is periodically changeable and rechargeable is possible. The system is able to ensure a residual PER content into the draining water not higher than 1 mg/l (emission in the water ≤ 0.5 g/h PER).

For small effluent streams with a wastewater flow up to 0.5 m^3/h, an advanced oxidation process (e.g. Fenton process) on site would also be an appropriate treatment.

The remaining sludge has a high water content and a high PER concentration which makes it very difficult to manage the waste. Landfill is almost no option because it creates soil or aquifer contaminations and PER is released to the atmosphere in landfill gas.

A solution would be to redesign the distilling group (forced circulation type) and especially the sludge distiller (thin layer evaporator) so that the solvent residue is reduced to 1% and a thick, dry sludge is produced.

A thermal co-incineration is possible when the incineration plant contains filters that can absorb the PER emissions and furan and dioxin emissions that appear in the thermal treatment.

(6) Origin of wastewater: Wool scouring

In the wool scouring process the wool fibres are washed in a series of bowls with detergent and a high organic effluent stream is produced.

Evaporator:

Concentrate/sludge from the evaporator contains suint, a natural grease of sheep that dries on the wool, consisting of fatty matter and potassium salts, as well as dirt and other grease. The presence of suint alters the physical properties of the sludge. It can be liquid at high temperatures and solid at low temperature, which makes it difficult to handle and dispose evaporator sludge. One option can be to transport the sludge in a heated tank to its final disposal location.

Coagulation/ˌocculation:

Sludge from coagulation/flocculation contains only dirt and grease because suint is highly water- soluble and is not flocculated. Depending on the water content the consistency varies from resembling moist earth to semi-liquid mud.

Composting and application to agricultural land:

For this disposal route a pre-treatment, such as composting or anaerobic digestion, is required.

For composting an optimized C:N ratio would be 25 – 30:1 so that wool scour sludge needs an addition of carbon-rich material e.g. green waste, sawdust, woodchip and straw with a grain size up to 50 mm to allow the ready ingress of air. Optimum moisture content of the material for composting is 50 – 60%.

The composting process happens in 2 stages:

- earlier thermophilic (45 – 60°C)
- later mesophilic (20 – 45°C)

and is controlled by the aeration.

For industrial sludge enclosed or in-vessel composting systems are recommended.

Advantages:

- better control of process
- higher temperature → higher rate
- control of odours, dust and leachate

The disadvantage is higher investment costs. Additionally the product must be allowed to mature for a number of weeks to make it more suitable compost.

Use of wool scouring sludge in brick-making:

Clay for brick-making should contain a certain amount of organic material. The oxidation of this material during the brick-firing process improves the quality of the resulting bricks. Some clay are deficient in organic content and an addition is desirable. Wool scour sludge is excellent in this application.

Besides these methods described above, any other suitable method (if available) could be followed to treat wastewater.

ANNEXES

ANNEX 1: HIGHLY HAZARDOUS WASTE GENERATING INDUSTRIES

Industries producing the waste streams named Y1 to Y18 (Annex 1A) or waste streams having the constituents named in Y19 to Y45 (Annex 1B) as stated in annex I of the Basel Convention are to be categorized as wastes to be controlled according to the Basel Convention. Sludge originating from the industries listed below or containing the constituents listed below has a high potential to produce waste streams exhibiting hazardous characteristics as listed in Annex 2A and as such, must be controlled according to the requirements of the Basel Convention and the Environment Conservation Rules, 1997.

ANNEX 1A: HIGHLY HAZARDOUS WASTE GENERATING INDUSTRIES

Y1 Clinical wastes from medical care in hospitals, medical centers and clinics
Y2 Wastes from the production and preparation of pharmaceutical products
Y3 Waste pharmaceuticals, drugs and medicines
Y4 Wastes from the production, formulation and use of biocides and phytopharmaceuticals
Y5 Wastes from the manufacture, formulation and use of wood preserving chemicals
Y6 Wastes from the production, formulation and use of organic solvents
Y7 Wastes from heat treatment and tempering operations containing cyanides
Y8 Waste mineral oils unfit for their originally intended use
Y9 Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11 Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13 Wastes from production, formulation and use of resins, latex, plasticizers and glues/adhesives
Y14 Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known
Y15 Wastes of an explosive nature not subject to other legislation
Y16 Wastes from production, formulation and use of photographic chemicals and processing materials
Y17 Wastes resulting from surface treatment of metals and plastics
Y18 Residues arising from industrial waste disposal operations

ANNEX 1B: WASTE HAVING HIGHLY HAZARDOUS CONSTITUENTS

Y19 Metal carbonyls
Y20 Beryllium; beryllium compounds
Y21 Hexavalent chromium compounds
Y22 Copper compounds
Y23 Zinc compounds
Y24 Arsenic; arsenic compounds
Y25 Selenium; selenium compounds
Y26 Cadmium; cadmium compounds
Y27 Antimony; antimony compounds
Y28 Tellurium; tellurium compounds
Y29 Mercury; mercury compounds
Y30 Thallium; thallium compounds
Y31 Lead; lead compounds
Y32 Inorganic fluorine compounds excluding calcium fluoride
Y33 Inorganic cyanides
Y34 Acidic solutions or acids in solid form
Y35 Basic solutions or bases in solid form
Y36 Asbestos (dust and fibres)
Y37 Organic phosphorus compounds
Y38 Organic cyanides
Y39 Phenols; phenol compounds including chlorophenols
Y40 Ethers
Y41 Halogenated organic solvents
Y42 Organic solvents excluding halogenated solvents
Y43 Any congener of polychlorinated dibenzo-furan
Y44 Any congenor of polychlorinated dibenzo-p-dioxin
Y45 Organohalogen compounds other than substances named in Y1- 44

ANNEX 2: LIST OF HAZARDOUS CHARACTERISTICS AND WASTE STREAMS

To facilitate classification, Annex 2B (List of processes) comprises waste streams identified as hazardous, marked by X.

In cases where waste streams are not marked as hazardous in Annex 2B, but possess at least one of the characteristics as described in the list of hazardous characteristics (Annex 2A) below, they will be treated as hazardous and will be disposed of as required in Chapter 3.2.

In cases where waste streams are not marked as hazardous in Annex 2B, but fulfill the criteria in Annex 1 (top hazardous waste generating industries), they will be treated as hazardous and will be disposed of accordingly.

Sludge with an origin from hazardous industries as described in Annex 1A or containing the constituents listed in Annex 1B, has an increased potential for possessing at least one of the hazardous characteristics as described in the list of hazardous characteristics below and must be categorized as a hazardous waste stream for the purposes of this document. This assumption is made solely to ensure a high level of protection for human health and the environment and reflects a precautionary approach. The producer may demonstrate a specific sludge does not exhibit any characteristics listed in Annex 2A using the criteria in the national legislation and can be exempted from a classification as hazardous waste. Alternatively this may, for example, be shown by descriptions of the processes from industry and the chemicals/substances used, classified using the data in information on chemicals provided by the European Chemicals Agency (ECHA) (http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database).

ANNEX 2A: LIST OF HAZARDOUS CHARACTERISTICS

(Basel Convention, consolidated version from January 2011)

H1 Explosive

An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

H3 Flammable liquids

The word “flammable” has the same meaning as ”inflammable”. Flammable liquid is liquid, or mixtures of liquids, or liquids containing solid in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a fl ammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations

varying from the above figures to make allowance for such differences would be within the spirit of this definition)

H4.1 Flammable solids
Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.

H4.2 Substances or wastes liable to spontaneous combustion
Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.

H4.3 Substances or wastes, which in contact with water emit flammable gases
Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

H5.1 Oxidizing
Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.

H5.2 Organic Peroxides
Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.

H6.1 Poisonous (Acute)
Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.

H6.2 Infectious substances
Substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans.

H8 Corrosives
Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.

H10 Liberation of toxic gases in contact with air or water
Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

H11 Toxic (Delayed or chronic)
Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.

H12 Ecotoxic
Substances or wastes which if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.

H13 Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

ANNEX 2B: LIST OF WASTE PROCESSES

The following list considers all processes according the European Waste list as far as sludge production is concerned (this is the reason why the numbers are not continuous). When classifying waste described by so called mirror entries in Annex 2B, meaning two entries for a specific waste stream, one of which is marked as hazardous, and one of which is not marked as hazardous, the waste stream is to be classified as hazardous unless the producer proves the sludge possesses no hazardous characteristics as defined in Annex 2A. Waste streams classified as hazardous are marked by X.

Number Code of the Table	
01	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
04	Wastes from the leather, fur and textile industries
05	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06	Wastes from inorganic chemical processes
07	Wastes from organic chemical processes
08	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks
09	Wastes from the photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14	Waste organic solvents, refrigerants and propellants (except 07 and 08)
15	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16	Wastes not otherwise specified in the list
17	Construction and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19	Wastes from waste management facilities, off-site wastewater treatment plants and the preparation of water intended for human consumption and water for industrial use
20	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

01	**WASTES RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS**	
01 01	**wastes from mineral excavation**	
01 01 01	wastes from mineral metalliferous excavation	
01 01 02	wastes from mineral non-metalliferous excavation	
01 03	**wastes from physical and chemical processing of metalliferous minerals**	
01 03 04	acid-generating tailings from processing of sulphide ore	X
01 03 05	other tailings containing dangerous substances	X
01 03 06	tailings other than those mentioned in 01 03 04 and 01 03 05	
01 03 07	other wastes containing dangerous substances from physical and chemical processing of metalliferous minerals	X
01 03 08	dusty and powdery wastes other than those mentioned in 01 03 07	
01 03 09	red mud from alumina production other than the wastes mentioned in 01 03 07	
01 03 99	wastes not otherwise specified	
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**	
01 04 07	wastes containing dangerous substances from physical and chemical processing of non-metalliferous minerals	X
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07	
01 04 09	waste sand and clays	
01 04 10	dusty and powdery wastes other than those mentioned in 01 04 07	
01 04 11	wastes from potash and rock salt processing other than those mentioned in 01 04 07	
01 04 12	tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11	
01 04 13	wastes from stone cutting and sawing other than those mentioned in 01 04 07	
01 04 99	wastes not otherwise specified	
01 05	**drilling muds and other drilling wastes**	
01 05 04	freshwater drilling muds and wastes	
01 05 05	oil-containing drilling muds and wastes	X
01 05 06	drilling muds and other drilling wastes containing dangerous substances	X
01 05 07	barite-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06	
01 05 08	chloride-containing drilling muds and wastes other than those mentioned in 0105 05 and 01 05 06	
01 05 99	wastes not otherwise specified	
02	**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**	
02 01	**wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**	
02 01 01	sludge from washing and cleaning	
02 01 02	animal-tissue waste	
02 01 03	plant-tissue waste	
02 01 04	waste plastics (except packaging)	
02 01 06	animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site	
02 01 07	wastes from forestry	
02 01 08	agrochemical waste containing dangerous substances	X

02 01 09	agrochemical waste other than those mentioned in 02 01 08	
02 01 10	waste metal	
02 01 99	wastes not otherwise specified	
02 02	**wastes from the preparation and processing of meat, fish and other foods of animal origin**	
02 02 01	sludge from washing and cleaning	
02 02 02	animal-tissue waste	
02 02 03	materials unsuitable for consumption or processing	
02 02 04	sludge from on-site effluent treatment	
02 02 99	wastes not otherwise specified	
02 03	**wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation**	
02 03 01	sludge from washing, cleaning, peeling, centrifuging and separation	
02 03 02	wastes from preserving agents	
02 03 03	wastes from solvent extraction	
02 03 04	materials unsuitable for consumption or processing	
02 03 05	sludge from on-site effluent treatment	
02 03 99	wastes not otherwise specified	
02 04	**wastes from sugar processing**	
02 04 01	soil from cleaning and washing beet	
02 04 02	off-specification calcium carbonate	
02 04 03	sludge from on-site effluent treatment	
02 04 99	wastes not otherwise specified	
02 05	**wastes from the dairy products industry**	
02 05 01	materials unsuitable for consumption or processing	
02 05 02	sludge from on-site effluent treatment	
02 05 99	wastes not otherwise specified	
02 06	**wastes from the baking and confectionery industry**	
02 06 01	materials unsuitable for consumption or processing	
02 06 02	wastes from preserving agents	
02 06 03	sludge from on-site effluent treatment	
02 06 99	wastes not otherwise specified	
02 07	**wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)**	
02 07 01	wastes from washing, cleaning and mechanical reduction of raw materials	
02 07 02	wastes from spirits distillation	
02 07 03	wastes from chemical treatment	
02 07 04	materials unsuitable for consumption or processing	
02 07 05	sludge from on-site effluent treatment	
02 07 99	wastes not otherwise specified	
03	**WASTES FROM WOOD PROCESSING AND PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD**	
03 01	**wastes from wood processing and the production of panels and furniture**	
03 01 01	waste bark and cork	
03 01 04	sawdust, shavings, cuttings, wood, particle board and veneer containing dangerous substances	X

03 01 05	sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04	
03 01 99	wastes not otherwise specified	
03 02	**wastes from wood preservation**	
03 02 01	non-halogenated organic wood preservatives	X
03 02 02	organochlorinated wood preservatives	X
03 02 03	organometallic wood preservatives	X
03 02 04	inorganic wood preservatives	X
03 02 05	other wood preservatives containing dangerous substances	X
03 02 99	wood preservatives not otherwise specified	
03 03	**wastes from pulp, paper and cardboard production and processing**	
03 03 01	waste bark and wood	
03 03 02	green liquor sludge (from recovery of cooking liquor)	
03 03 05	de-inking sludge from paper recycling	
03 03 07	mechanically separated rejects from pulping of waste paper and cardboard	
03 03 08	wastes from sorting of paper and cardboard destined for recycling	
03 03 09	lime mud waste	
03 03 10	fibre rejects, fibre-, filler- and coating-sludges from mechanical separation	
03 03 11	sludge from on-site effluent treatment other than those mentioned in 03 03 10	
03 03 99	wastes not otherwise specified	
04	**WASTES FROM LEATHER, FUR AND TEXTILE INDUSTRIES**	
04 01	**wastes from the leather and fur industry**	
04 01 01	fleshings and lime split wastes	
04 01 02	liming waste	
04 01 03	degreasing wastes containing solvents without a liquid phase	X
04 01 04	tanning liquor containing chromium	X
04 01 05	tanning liquor free of chromium	
04 01 06	sludge, in particular from on-site effluent treatment containing chromium	
04 01 07	sludge, in particular from on-site effluent treatment free of chromium	
04 01 08	waste tanned leather (blue sheeting, shavings, cuttings, buffing dust) containingchromium	
04 01 09	wastes from dressing and finishing	
04 01 99	wastes not otherwise specified	
04 02	**wastes from the textile industry**	
04 02 09	wastes from composite materials (impregnated textile, elastomer, plastomer)	
04 02 10	organic matter from natural products (for example grease, wax)	
04 02 14	wastes from finishing containing organic solvents	X
04 02 15	wastes from finishing other than those mentioned in 04 02 14	
04 02 16	dyestuffs and pigments containing dangerous substances	X
04 02 17	dyestuffs and pigments other than those mentioned in 04 02 16	
04 02 19	sludge from on-site effluent treatment containing dangerous substances	X
04 02 20	sludge from on-site effluent treatment other than those mentioned in 04 02 19	
04 02 21	wastes from unprocessed textile fibres	
04 02 22	wastes from processed textile fibres	

04 02 99	wastes not otherwise specified	
05	**WASTES FROM PETROLEUM REFINING, NATURAL GAS PURIFICATION AND PYROLYTIC TREATMENT OF COAL**	
05 01	**wastes from petroleum refining**	
05 01 02	desalter sludges	X
05 01 03	tank bottom sludges	X
05 01 04	acid alkyl sludges	X
05 01 05	oil spills	X
05 01 06	oily sludges from maintenance operations of the plant or equipment	X
05 01 07	acid tars	X
05 01 08	other tars	X
05 01 09	sludge from on-site effluent treatment containing dangerous substances	X
05 01 10	sludge from on-site effluent treatment other than those mentioned in 05 01 09	
05 01 11	wastes from cleaning of fuels with bases	X
05 01 12	oil containing acids	X
05 01 13	boiler feed water sludges	
05 01 14	wastes from cooling columns	
05 01 15	spent filter clays	X
05 01 16	sulphur-containing wastes from petroleum desulphurisation	
05 01 17	bitumen	
05 01 99	wastes not otherwise specified	
05 06	**wastes from the pyrolytic treatment of coal**	
05 06 01	acid tars	X
05 06 03	other tars	X
05 06 04	waste from cooling columns	
05 06 99	wastes not otherwise specified	
05 07	**wastes from natural gas purification and transportation**	
05 07 01	wastes containing mercury	X
05 07 02	wastes containing sulphur	
05 07 99	wastes not otherwise specified	
06	**WASTES FROM INORGANIC CHEMICAL PROCESSES**	
06 01	**wastes from the manufacture, formulation, supply and use (MFSU) of acids**	
06 01 01	sulphuric acid and sulphurous acid	X
06 01 02	hydrochloric acid	X
06 0103	hydrofluoricacid	X
06 0104	phosphoric and phosphorous acid	X
06 01 05	nitric acid and nitrous acid	X
06 01 06	other acids	X
06 01 99	wastes not otherwise specified	
06 02	**wastes from the MFSU of bases**	
06 02 01	calcium hydroxide	X
06 02 03	ammonium hydroxide	X
06 02 04	sodium and potassium hydroxide	X
06 02 05	other bases	X
06 02 99	wastes not otherwise specified	
06 03	**wastes from the MFSU of salts and their solutions and metallic oxides**	

06 03 11	solid salts and solutions containing cyanides	X
06 03 13	solid salts and solutions containing heavy metals	X
06 03 14	solid salts and solutions other than those mentioned in 06 03 11 and 06 03 13	
06 03 15	metallic oxides containing heavy metals	X
06 03 16	metallic oxides other than those mentioned in 06 03 15	
06 03 99	wastes not otherwise specified	
06 04	**metal-containing wastes other than those mentioned in 06 03**	
06 04 03	wastes containing arsenic	X
06 04 04	wastes containing mercury	X
06 04 05	wastes containing other heavy metals	X
06 04 99	wastes not otherwise specified	
06 05	**sludge from on-site effluent treatment**	
06 05 02	sludges from on-site effluent treatment containing dangerous substances	X
06 05 03	sludges from on-site effluent treatment other than those mentioned in 06 05 02	
06 06	**wastes from the MFSU of sulphur chemicals, sulphur chemical processes and desulphurisation processes**	
06 06 02	wastes containing dangerous sulphides	X
06 06 03	wastes containing sulphides other than those mentioned in 06 06 02	
06 06 99	wastes not otherwise specified	
06 07	**wastes from the MFSU of halogens and halogen chemical processes**	
06 07 01	wastes containing asbestos from electrolysis	X
06 07 02	activated carbon from chlorine production	X
06 07 03	barium sulphate sludge containing mercury	X
06 07 04	solutions and acids, for example contact acid	X
06 07 99	wastes not otherwise specified	
06 08	**wastes from the MFSU of silicon and silicon derivatives**	
06 08 02	waste containing dangerous silicones	X
06 08 99	wastes not otherwise specified	
06 09	**wastes from the MSFU of phosphorous chemicals and phosphorous chemical processes**	
06 09 02	phosphorous slag	
06 09 03	calcium-based reaction wastes containing or contaminated with dangerous substances	X
06 09 04	calcium-based reaction wastes other than those mentioned in 06 09 03	
06 09 99	wastes not otherwise specified	
06 10	**wastes from the MFSU of nitrogen chemicals, nitrogen chemical processes and fertilizer manufacture**	
06 10 02	wastes containing dangerous substances	X
06 10 99	wastes not otherwise specified	
06 11	**wastes from the manufacture of inorganic pigments and opacificiers**	
06 11 01	calcium-based reaction wastes from titanium dioxide production	
06 11 99	wastes not otherwise specified	
06 13	**wastes from inorganic chemical processes not otherwise specified**	
06 13 01	inorganic plant protection products, wood-preserving agents and other biocides	X

06 13 02	spent activated carbon (except 06 07 02)	X
06 13 03	carbon black	
06 13 04	wastes from asbestos processing	X
06 13 05	soot	X
06 13 99	wastes not otherwise specified	
07	**WASTES FROM ORGANIC CHEMICAL PROCESSES**	
07 01	**wastes from the manufacture, formulation, supply and use (MFSU) of basic organic chemicals**	
07 01 01	aqueous washing liquids and mother liquors	X
07 01 03	organichalogenated solvents, washing liquids and mother liquors	X
07 01 04	other organic solvents, washing liquids and mother liquors	X
07 01 07	halogenated still bottoms and reaction residues	X
07 01 08	other still bottoms and reaction residues	X
07 01 09	halogenated filter cakes and spent absorbents	X
07 01 10	other filter cakes and spent absorbents	X
07 01 11	sludge from on-site effluent treatment containing dangerous substances	X
07 01 12	sludge from on-site effluent treatment other than those mentioned in 07 01 11	
07 01 99	wastes not otherwise specified	
07 02	**wastes from the MFSU of plastics, synthetic rubber and man-made fibers**	
07 02 01	aqueous washing liquids and mother liquors	X
07 02 03	organichalogenated solvents, washing liquids and mother liquors	X
07 02 04	other organic solvents, washing liquids and mother liquors	X
07 02 07	halogenated still bottoms and reaction residues	X
07 02 08	other still bottoms and reaction residues	X
07 02 09	halogenated filter cakes and spent absorbents	X
07 02 10	other filter cakes and spent absorbents	X
07 02 11	sludge from on-site effluent treatment containing dangerous substances	X
07 02 12	sludge from on-site effluent treatment other than those mentioned in 07 02 11	
07 02 13	waste plastic	
07 02 14	wastes from additives containing dangerous substances	X
07 02 15	wastes from additives other than those mentioned in 07 02 14	
07 02 16	waste containing dangerous silicones	X
07 02 17	waste containing silicones other than those mentioned in 07 02 16	
07 02 99	wastes not otherwise specified	
07 03	**wastes from the MFSU of organic dyes and pigments (except 06 11)**	
07 03 01	aqueous washing liquids and mother liquors	X
07 03 03	organichalogenated solvents, washing liquids and mother liquors	X
07 03 04	other organic solvents, washing liquids and mother liquors	X
07 03 07	halogenated still bottoms and reaction residues	X
07 03 08	other still bottoms and reaction residues	X
07 03 09	halogenated filter cakes and spent absorbents	X
07 03 10	other filter cakes and spent absorbents	X
07 03 11	sludge from on-site effluent treatment containing dangerous substances	X
07 03 12	sludge from on-site effluent treatment other than those mentioned in 07 03 11	

07 03 99	wastes not otherwise specified	
07 04	**wastes from the MFSU of organic plant protection products (except 02 0108 and 02 01 09), wood preserving agents (except 03 02) and other biocides**	
07 04 01	aqueous washing liquids and mother liquors	X
07 04 03	organichalogenated solvents, washing liquids and mother liquors	X
07 04 04	other organic solvents, washing liquids and mother liquors	X
07 04 07	halogenated still bottoms and reaction residues	X
07 04 08	other still bottoms and reaction residues	X
07 04 09	halogenated filter cakes and spent absorbents	X
07 04 10	other filter cakes and spent absorbents	X
07 04 11	sludge from on-site effluent treatment containing dangerous substances	X
07 04 12	sludge from on-site effluent treatment other than those mentioned in 07 04 11	
07 04 13	solid wastes containing dangerous substances	X
07 04 99	wastes not otherwise specified	
07 05	**wastes from the MFSU of pharmaceuticals**	
07 05 01	aqueous washing liquids and mother liquors	X
07 05 03	organichalogenated solvents, washing liquids and mother liquors	X
07 05 04	other organic solvents, washing liquids and mother liquors	X
07 05 07	halogenated still bottoms and reaction residues	X
07 05 08	other still bottoms and reaction residues	X
07 05 09	halogenated filter cakes and spent absorbents	X
07 05 10	other filter cakes and spent absorbents	X
07 05 11	sludge from on-site effluent treatment containing dangerous substances	X
07 05 12	sludge from on-site effluent treatment other than those mentioned in 07 05 11	
07 05 13	solid wastes containing dangerous substances	X
07 05 14	solid wastes other than those mentioned in 07 05 13	
07 05 99	wastes not otherwise specified	
07 06	**wastes from the MFSU of fats, grease, soaps, detergents, disinfectants and cosmetics**	
07 06 01	aqueous washing liquids and mother liquors	X
07 06 03	organichalogenated solvents, washing liquids and mother liquors	X
07 06 04	other organic solvents, washing liquids and mother liquors	X
07 06 07	halogenated still bottoms and reaction residues	X
07 06 08	other still bottoms and reaction residues	X
07 06 09	halogenated filter cakes and spent absorbents	X
07 06 10	other filter cakes and spent absorbents	X
07 06 11	sludge from on-site effluent treatment containing dangerous substances	X
07 06 12	sludge from on-site effluent treatment other than those mentioned in 07 06 11	
07 06 99	wastes not otherwise specified	
07 07	**wastes from the MFSU of fine chemicals and chemical products not otherwise specified**	
07 07 01	aqueous washing liquids and mother liquors	X
07 07 03	organichalogenated solvents, washing liquids and mother liquors	X

07 07 04	other organic solvents, washing liquids and mother liquors	X
07 07 07	halogenated still bottoms and reaction residues	X
07 07 08	other still bottoms and reaction residues	X
07 07 09	halogenated filter cakes and spent absorbents	X
07 07 10	other filter cakes and spent absorbents	X
07 07 11	sludge from on-site effluent treatment containing dangerous substances	X
07 07 12	sludge from on-site effluent treatment other than those mentioned in 07 07 11	
07 07 99	wastes not otherwise specified	
08	**WASTES FROM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS), ADHESIVES, SEALANTS AND PRINTING INKS**	
08 01	**wastes from MFSU and removal of paint and varnish**	
08 01 11	waste paint and varnish containing organic solvents or other dangerous substances	X
08 01 12	waste paint and varnish other than those mentioned in 08 01 11	
08 01 13	sludge from paint or varnish containing organic solvents or other dangerous substances	X
08 01 14	sludge from paint or varnish other than those mentioned in 08 01 13	
08 01 15	aqueous sludge containing paint or varnish containing organic solvents or other dangerous substances	X
08 01 16	aqueous sludge containing paint or varnish other than those mentioned in 08 01 15	
08 01 17	wastes from paint or varnish removal containing organic solvents or other dangerous substances	X
08 01 18	wastes from paint or varnish removal other than those mentioned in 08 01 17	
08 01 19	aqueous suspensions containing paint or varnish containing organic solvents or other dangerous substances	X
08 01 20	aqueous suspensions containing paint or varnish other than those mentioned in 08 01 19	
08 01 21	waste paint or varnish remover	X
08 01 99	wastes not otherwise specified	
08 02	**wastes from MFSU of other coatings (including ceramic materials)**	
08 02 01	waste coating powders	
08 02 02	aqueous sludge containing ceramic materials	
08 02 03	aqueous suspensions containing ceramic materials	
08 02 99	wastes not otherwise specified	
08 03	**wastes from MFSU of printing inks**	
08 03 07	aqueous sludge containing ink	
08 03 08	aqueous liquid waste containing ink	
08 03 12	waste ink containing dangerous substances	X
08 03 13	waste ink other than those mentioned in 08 03 12	
08 03 14	ink sludge containing dangerous substances	X
08 03 15	ink sludge other than those mentioned in 08 03 14	
08 03 16	waste etching solutions	X
08 03 17	waste printing toner containing dangerous substances	X

08 03 18	waste printing toner other than those mentioned in 08 03 17	
08 03 19	disperse oil	X
08 03 99	wastes not otherwise specified	
08 04	**wastes from MFSU of adhesives and sealants (including waterproofing products)**	
08 04 09	waste adhesives and sealants containing organic solvents or other dangerous substances	X
08 04 10	waste adhesives and sealants other than those mentioned in 08 04 09	
08 04 11	adhesive and sealant sludge containing organic solvents or other dangerous substances	X
08 04 12	adhesive and sealant sludge other than those mentioned in 08 04 11	
08 04 13	aqueous sludge containing adhesives or sealants containing organic solvents or other dangerous substances	X
08 04 14	aqueous sludge containing adhesives or sealants other than those mentioned in 08 04 13	
08 04 15	aqueous liquid waste containing adhesives or sealants containing organic solvents or other dangerous substances	X
08 04 16	aqueous liquid waste containing adhesives or sealants other than those mentioned in 08 04 15	
08 04 17	rosin oil	X
08 04 99	wastes not otherwise specified	
08 05	**wastes not otherwise specified in 08**	
08 05 01	waste isocyanates	X
09	**WASTES FROM THE PHOTOGRAPHIC INDUSTRY**	
09 01	**wastes from the photographic industry**	
09 01 01	water-based developer and activator solutions	X
09 01 02	water-based offset plate developer solutions	X
09 01 03	solvent-based developer solutions	X
09 01 04	fixer solutions	X
09 01 05	bleach solutions and bleach fixer solutions	X
09 01 06	wastes containing silver from on-site treatment of photographic wastes	X
09 01 07	photographic film and paper containing silver or silver compounds	
09 01 08	photographic film and paper free of silver or silver compounds	
09 01 10	single-use cameras without batteries	
09 01 11	single-use cameras containing batteries included in 16 06 01, 16 06 02 or 16 06 03	X
09 01 12	single-use cameras containing batteries other than those mentioned in 09 01 11	
09 01 13	aqueous liquid waste from on-site reclamation of silver other than those mentioned in 09 01 06	X
09 01 99	wastes not otherwise specified	
10	**WASTES FROM THERMAL PROCESSES**	
10 01	**wastes from power stations and other combustion plants (except 19)**	
10 01 01	bottom ash, slag and boiler dust (excluding boiler dust mentioned in 10 01 04)	
10 01 02	coal fly ash	
10 01 03	fly ash from peat and untreated wood	

10 01 04	oil fly ash and boiler dust	X
10 01 05	calcium-based reaction wastes from flue-gas desulphurisation in solid form	
10 01 07	calcium-based reaction wastes from flue-gas desulphurisation in sludge form	
10 01 09	Sulphuric acid	X
10 01 13	fly ash from emulsified hydrocarbons used as fuel	X
10 01 14	bottom ash, slag and boiler dust from co-incineration containing dangerous substances	X
10 01 15	bottom ash, slag and boiler dust from co-incineration other than those mentioned in 10 01 14	
10 01 16	fly ash from co-incineration containing dangerous substances	X
10 01 17	fly ash from co-incineration other than those mentioned in 10 01 16	
10 01 18	wastes from gas cleaning containing dangerous substances	X
10 01 19	wastes from gas cleaning other than those mentioned in 10 01 05, 10 01 07 and10 01 18	
10 01 20	sludge from on-site effluent treatment containing dangerous substances	X
10 01 21	sludge from on-site effluent treatment other than those mentioned in 10 01 20	
10 01 22	aqueous sludge from boiler cleansing containing dangerous substances	X
10 01 23	aqueous sludge from boiler cleansing other than those mentioned in 10 01 22	
10 01 24	sands from fluidized beds	
10 01 25	wastes from fuel storage and preparation of coal-fired power plants	
10 01 26	wastes from cooling-water treatment	
10 01 99	wastes not otherwise specified	
10 02	**wastes from the iron and steel industry**	
10 02 01	wastes from the processing of slag	
10 02 02	unprocessed slag	
10 02 07	solid wastes from gas treatment containing dangerous substances	X
10 02 08	solid wastes from gas treatment other than those mentioned in 10 02 07	
10 02 10	mill scales	
10 02 11	wastes from cooling-water treatment containing oil	X
10 02 12	wastes from cooling-water treatment other than those mentioned in 10 02 11	
10 02 13	sludge and filter cakes from gas treatment containing dangerous substances	X
10 02 14	sludge and filter cakes from gas treatment other than those mentioned in 10 02 13	
10 02 15	other sludge and filter cakes	
10 02 99	wastes not otherwise specified	
10 03	**wastes from aluminum thermal metallurgy**	
10 03 02	anode scraps	
10 03 04	primary production slags	X
10 03 05	waste alumina	
10 03 08	salt slags from secondary production	X
10 03 09	black drosses from secondary production	X

10 03 15	skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities	X
10 03 16	skimmings other than those mentioned in 10 03 15	
10 03 17	tar-containing wastes from anode manufacture	X
10 03 18	carbon-containing wastes from anode manufacture other than those mentioned in 10 03 17	
10 03 19	flue-gas dust containing dangerous substances	X
10 03 20	flue-gas dust other than those mentioned in 10 03 19	
10 03 21	other particulates and dust (including ball-mill dust) containing dangerous substances	X
10 03 22	other particulates and dust (including ball-mill dust) other than those mentioned in 10 03 21	
10 03 23	solid wastes from gas treatment containing dangerous substances	X
10 03 24	solid wastes from gas treatment other than those mentioned in 10 03 23	
10 03 25	sludge and filter cakes from gas treatment containing dangerous substances	X
10 03 26	sludge and filter cakes from gas treatment other than those mentioned in 10 03 25	
10 03 27	wastes from cooling-water treatment containing oil	X
10 03 28	wastes from cooling-water treatment other than those mentioned in 10 03 27	
10 03 29	wastes from treatment of salt slags and black drosses containing dangerous substances	X
10 03 30	wastes from treatment of salt slags and black drosses other than those mentioned in 10 03 29	
10 03 99	wastes not otherwise specified	
10 04	**wastes from lead thermal metallurgy**	
10 04 01	slags from primary and secondary production	X
10 04 02	dross and skimmings from primary and secondary production	X
10 04 03	calcium arsenate	X
10 04 04	flue-gas dust	X
10 04 05	other particulates and dust	X
10 04 06	solid wastes from gas treatment	X
10 04 07	sludge and filter cakes from gas treatment	X
10 04 09	wastes from cooling-water treatment containing oil	X
10 04 10	wastes from cooling-water treatment other than those mentioned in 10 04 09	
10 04 99	wastes not otherwise specified	
10 05	**wastes from zinc thermal metallurgy**	
10 05 01	slags from primary and secondary production	
10 05 03	flue-gas dust	X
10 05 04	other particulates and dust	
10 05 05	solid waste from gas treatment	X
10 05 06	sludge and filter cakes from gas treatment	X
10 05 08	wastes from cooling-water treatment containing oil	X
10 05 09	wastes from cooling-water treatment other than those mentioned in 10 05 08	

10 05 10	dross and skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities	X
10 05 11	dross and skimmings other than those mentioned in 10 05 10 wastes	
10 05 99	not otherwise specified	
10 06	**wastes from copper thermal metallurgy**	
10 06 01	slags from primary and secondary production	
10 06 02	dross and skimmings from primary and secondary production	
10 06 03	flue-gas dust	X
10 06 04	other particulates and dust	
10 06 06	solid wastes from gas treatment	X
10 06 07	sludge and filter cakes from gas treatment	X
10 06 09	wastes from cooling-water treatment containing oil	X
10 06 10	wastes from cooling-water treatment other than those mentioned in 10 06 09	
10 06 99	wastes not otherwise specified	
10 07	**wastes from silver, gold and platinum thermal metallurgy**	
10 07 01	slags from primary and secondary production	
10 07 02	dross and skimmings from primary and secondary production	
10 07 03	solid wastes from gas treatment	
10 07 04	other particulates and dust	
10 07 05	sludge and filter cakes from gas treatment	
10 07 07	wastes from cooling-water treatment containing oil	X
10 07 08	wastes from cooling-water treatment other than those mentioned in 10 07 07	
10 07 99	wastes not otherwise specified	
10 08	**wastes from other non-ferrous thermal metallurgy**	
10 08 04	particulates and dust	
10 08 08	salt slag from primary and secondary production	X
10 08 09	other slags	
10 08 10	dross and skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities	X
10 08 11	dross and skimmings other than those mentioned in 10 08 10	
10 08 12	tar-containing wastes from anode manufacture	X
10 08 13	carbon-containing wastes from anode manufacture other than those mentioned in 10 08 12	
10 08 14	anode scrap	
10 08 15	flue-gas dust containing dangerous substances	X
10 08 16	flue-gas dust other than those mentioned in 10 08 15	
10 08 17	sludge and filter cakes from flue-gas treatment containing dangerous substances	X
10 08 18	sludge and filter cakes from flue-gas treatment other than those mentioned in10 08 17	
10 08 19	wastes from cooling-water treatment containing oil	X
10 08 20	wastes from cooling-water treatment other than those mentioned in 10 08 19	
10 08 99	wastes not otherwise specified	

10 09	**wastes from casting of ferrous pieces**	
10 09 03	furnace slag	
10 09 05	casting cores and moulds which have not undergone pouring containing dangerous substances	X
10 09 06	casting cores and moulds which have not undergone pouring other than those mentioned in 10 09 05	
10 09 07	casting cores and moulds which have undergone pouring containing dangerous substances	X
10 09 08	casting cores and moulds which have undergone pouring other than those mentioned in 10 09 07	
10 09 09	flue-gas dust containing dangerous substances	X
10 09 10	flue-gas dust other than those mentioned in 10 09 09	
10 09 11	other particulates containing dangerous substances	X
10 09 12	other particulates other than those mentioned in 10 09 11	
10 09 13	waste binders containing dangerous substances	X
10 09 14	waste binders other than those mentioned in 10 09 13	
10 09 15	waste crack-indicating agent containing dangerous substances	X
10 09 16	waste crack-indicating agent other than those mentioned in 10 09 15	
10 09 99	wastes not otherwise specified	
10 10	**wastes from casting of non-ferrous pieces**	
10 10 03	furnace slag	
10 10 05	casting cores and moulds which have not undergone pouring, containing dangerous substances	X
10 10 06	casting cores and moulds which have not undergone pouring, other than those mentioned in 10 10 05	
10 10 07	casting cores and moulds which have undergone pouring, containing dangerous substances	X
10 10 08	casting cores and moulds which have undergone pouring, other than those mentioned in 10 10 07	
10 10 09	flue-gas dust containing dangerous substances	X
10 10 10	flue-gas dust other than those mentioned in 10 10 09	
10 10 11	other particulates containing dangerous substances	X
10 10 12	other particulates other than those mentioned in 10 10 11	
10 10 13	waste binders containing dangerous substances	X
10 10 14	waste binders other than those mentioned in 10 10 13	
10 10 15	waste crack-indicating agent containing dangerous substances	X
10 10 16	waste crack-indicating agent other than those mentioned in 10 10 15	
10 10 99	wastes not otherwise specified	
10 11	**wastes from manufacture of glass and glass products**	
10 11 03	waste glass-based fibrous materials	
10 11 05	particulates and dust	
10 11 09	waste preparation mixture before thermal processing, containing dangerous substances	X
10 11 10	waste preparation mixture before thermal processing, other than those mentioned in 10 11 09	
10 11 11	waste glass in small particles and glass powder containing heavy metals (for example from cathode ray tubes)	X
10 11 12	waste glass other than those mentioned in 10 11 11	

10 11 13	glass-polishing and -grinding sludge containing dangerous substances	X
10 11 14	glass-polishing and -grinding sludge other than those mentioned in 10 11 13	
10 11 15	solid wastes from flue-gas treatment containing dangerous substances	X
10 11 16	solid wastes from flue-gas treatment other than those mentioned in 10 11 15	
10 11 17	sludge and filter cakes from flue-gas treatment containing dangerous substances	X
10 11 18	sludge and filter cakes from flue-gas treatment other than those mentioned in10 11 17	
10 11 19	solid wastes from on-site effluent treatment containing dangerous substances	X
10 11 20	solid wastes from on-site effluent treatment other than those mentioned in 10 11 19	
10 11 99	wastes not otherwise specified	
10 12	**wastes from manufacture of ceramic goods, bricks, tiles and construction products**	
10 12 01	waste preparation mixture before thermal processing	
10 12 03	particulates and dust	
10 12 05	sludge and filter cakes from gas treatment	
10 12 06	discarded moulds	
10 12 08	waste ceramics, bricks, tiles and construction products (after thermal processing)	
10 12 09	solid wastes from gas treatment containing dangerous substances	X
10 12 10	solid wastes from gas treatment other than those mentioned in 10 12 09	
10 12 11	wastes from glazing containing heavy metals	X
10 12 12	wastes from glazing other than those mentioned in 10 12 11	
10 12 13	sludge from on-site effluent treatment	
10 12 99	wastes not otherwise specified	
10 13	**wastes from manufacture of cement, lime and plaster and articles and products made from them**	
10 13 01	waste preparation mixture before thermal processing	
10 13 04	wastes from calcination and hydration of lime	
10 13 06	particulates and dust (except 10 13 12 and 10 13 13)	
10 13 07	sludge and filter cakes from gas treatment	
10 13 09	wastes from asbestos-cement manufacture containing asbestos	X
10 13 10	wastes from asbestos-cement manufacture other than those mentioned in 10 13 09	
10 13 11	wastes from cement-based composite materials other than those mentioned in 1013 09 and 10 13 10	
10 13 12	solid wastes from gas treatment containing dangerous substances	X
10 13 13	solid wastes from gas treatment other than those mentioned in 10 13 12	
10 13 14	waste concrete and concrete sludge	
10 13 99	wastes not otherwise specified	
10 14	**waste from crematoria**	
10 14 01	waste from gas cleaning containing mercury	X
11	**WASTES FROM CHEMICAL SURFACE TREATMENT AND COATING OF METALS**	

	AND OTHER MATERIALS; NON-FERROUS HYDROMETALLURGY	
11 01	**wastes from chemical surface treatment and coating of metals and other materials (for example galvanic processes, zinc coating processes, pickling processes, etching, phosphating, alkaline degreasing, anodizing)**	
11 01 05	pickling acids	X
11 01 06	acids not otherwise specified	X
11 01 07	pickling bases	X
11 01 08	phosphatizing sludges	X
11 01 09	sludges and filter cakes containing dangerous substances	X
11 01 10	sludges and filter cakes other than those mentioned in 11 01 09	
11 01 11	aqueous rinsing liquids containing dangerous substances	X
11 01 12	aqueous rinsing liquids other than those mentioned in 11 01 11	
11 01 13	degreasing wastes containing dangerous substances	X
11 01 14	degreasing wastes other than those mentioned in 11 01 13	
11 01 15	eluate and sludges from membrane systems or ion exchange systems containing dangerous substances	X
11 01 16	saturated or spent ion exchange resins	X
11 01 98	other wastes containing dangerous substances	X
11 01 99	wastes not otherwise specified	
11 02	**wastes from non-ferrous hydrometallurgical processes**	
11 02 02	sludge from zinchydrometallurgy (including jarosite, goethite)	X
11 02 03	wastes from the production of anodes for aqueous electrolytical processes	
11 02 05	wastes from copper hydrometallurgical processes containing dangerous substances	X
11 02 06	wastes from copper hydrometallurgical processes other than those mentioned in 11 02 05	
11 02 07	other wastes containing dangerous substances	X
11 02 99	wastes not otherwise specified	
11 03	**sludge and solids from tempering processes**	
11 03 01	wastes containing cyanide	X
11 03 02	other wastes	X
11 05	**wastes from hot galvanizing processes**	
11 05 01	hard zinc	
11 05 02	zinc ash	
11 05 03	solid wastes from gas treatment	X
11 05 04	spent flux	X
11 05 99	wastes not otherwise specified	
12	**WASTES FROM SHAPING AND PHYSICAL AND MECHANICAL SURFACE TREATMENT OF METALS AND PLASTICS**	
12 01	**wastes from shaping and physical and mechanical surface treatment of metals and plastics**	
12 01 01	ferrous metal filings and turnings	
12 01 02	ferrous metal dust and particles	
12 01 03	non-ferrous metal filings and turnings	

12 01 04	non-ferrous metal dust and particles	
12 01 05	plastics shavings and turnings	
12 01 06	mineral-based machining oils containing halogens (except emulsions and solutions)	X
12 01 07	mineral-based machining oils free of halogens (except emulsions and solutions)	X
12 01 08	machining emulsions and solutions containing halogens	X
12 01 09	machining emulsions and solutions free of halogens	X
12 01 10	synthetic machining oils	X
12 01 12	spent waxes and fats	X
12 0113	welding wastes	
12 01 14	machining sludges containing dangerous substances	X
12 01 15	machining sludge other than those mentioned in 12 01 14	
12 01 16	waste blasting material containing dangerous substances	X
12 01 17	waste blasting material other than those mentioned in 12 01 16	
12 01 18	metal sludge (grinding, honing and lapping sludge) containing oil	X
12 01 19	readily biodegradable machining oil	X
12 01 20	spent grinding bodies and grinding materials containing dangerous substances	X
12 01 21	spent grinding bodies and grinding materials other than those mentioned in 12 01 20	
12 01 99	wastes not otherwise specified	
12 03	**wastes from water and steam degreasing processes (except 11)**	
12 03 01	aqueous washing liquids	X
12 03 02	steam degreasing wastes	X
13	**OIL WASTES AND WASTES OF LIQUID FUEL** (except edible oils, and those in chapters 05, 12 and 19)	
13 01	**waste hydraulic oils**	
13 01 01	hydraulic oils, containing PCBs[10]	X
13 01 04	chlorinated emulsions	X
13 01 05	non-chlorinated emulsions	X
13 01 09	mineral-based chlorinated hydraulic oils	X
13 01 10	mineral based non-chlorinated hydraulic oils	X
13 01 11	synthetic hydraulic oils	X
13 01 12	readily biodegradable hydraulic oils	X
13 01 13	other hydraulic oils	X
13 02	**waste engine, gear and lubricating oils**	
13 02 04	mineral-based chlorinated engine, gear and lubricating oils	X
13 02 05	mineral-based non-chlorinated engine, gear and lubricating oils	X
13 02 06	synthetic engine, gear and lubricating oils	X
13 02 07	readily biodegradable engine, gear and lubricating oils	
13 02 08	other engine, gear and lubricating oils	X
13 03	**waste insulating and heat transmission oils**	
13 03 01	insulating or heat transmission oils containing PCBs	
13 03 06	mineral-based chlorinated insulating and heat transmission oils other than those mentioned in 13 03 01	X X
13 03 07	mineral-based non-chlorinated insulating and heat transmission oils	X

[10] For the purpose of this list of wastes, PCBs will be defined as in Directive 96/59/EC.

13 03 08	synthetic insulating and heat transmission oils	X
13 03 09	readily biodegradable insulating and heat transmission oils	X
13 03 10	other insulating and heat transmission oils	X
13 04	**bilge oils**	
13 04 01	bilge oils from inland navigation	X
13 04 02	bilge oils from jetty sewers	X
13 04 03	bilge oils from other navigation	X
13 05	**oil/water separator contents**	
13 05 01	solids from grit chambers and oil/water separators	X
13 05 02	sludge from oil/water separators	X
13 05 03	interceptor sludge	X
13 05 06	oil from oil/water separators	X
13 05 07	oily water from oil/water separators	X
13 05 08	mixtures of wastes from grit chambers and oil/water separators	X
13 07	**wastes of liquid fuels**	
13 07 01	fuel oil and diesel	X
13 07 02	petrol	X
13 07 03	other fuels (including mixtures)	X
13 08	**oil wastes not otherwise specified**	
13 08 01	desalter sludge or emulsions	X
13 08 02	other emulsions	X
13 08 99	wastes not otherwise specified	X
14	**WASTE ORGANIC SOLVENTS, REFRIGERANTS AND PROPELLANTS** (except 07 and 08)	
14 06	**waste organic solvents, refrigerants and foam/aerosol propellants**	
14 06 01	chlorofluorocarbons, HCFC, HFC	X
14 06 02	other halogenated solvents and solvent mixtures	X
14 06 03	other solvents and solvent mixtures	X
14 06 04	sludge or solid wastes containing halogenated solvents	X
14 06 05	sludge or solid wastes containing other solvents	X
15	**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**	
15 01	**packaging (including separately collected municipal packaging waste)**	
15 01 01	paper and cardboard packaging	
15 01 02	plastic packaging	
15 01 03	wooden packaging	
15 01 04	metallic packaging	
15 01 05	composite packaging	
15 01 06	mixed packaging	
15 01 07	glass packaging	
15 01 09	textile packaging	
15 01 10	packaging containing residues of or contaminated by dangerous substances	X
15 01 11	metallic packaging containing a dangerous solid porous matrix	

	(for example asbestos), including empty pressure containers	X
15 02	**absorbents, filter materials, wiping cloths and protective clothing**	
15 02 02	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	X
15 02 03	absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02	
16	**WASTES NOT OTHERWISE SPECIFIED IN THE LIST**	
16 01	**end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)**	
16 01 03	end-of-life tyres	
16 01 06	end-of-life vehicles, containing neither liquids nor other hazardous components	
16 01 07	oil filters	X
16 01 08	components containing mercury	X
16 01 09	components containing PCBs	X
16 01 10	explosive components (for example air bags)	X
16 01 11	brake pads containing asbestos	X
16 01 12	brake pads other than those mentioned in 16 01 11	
16 01 13	brake fluids	X
16 01 14	antifreeze fluids containing dangerous substances	X
16 01 15	antifreeze fluids other than those mentioned in 16 01 14	
16 01 16	tanks for liquefied gas	
16 01 17	ferrous metal	
16 01 18	non-ferrous metal	
16 01 19	plastic	
16 01 20	glass	
16 01 21	hazardous components other than those mentioned in 16 01 07 to 16 01 11 and16 01 13 and 16 01 14	X
16 01 22	components not otherwise specified	
16 01 99	wastes not otherwise specified	
16 02	**wastes from electrical and electronic equipment**	
16 02 09	transformers and capacitors containing PCBs	X
16 02 10	discarded equipment containing or contaminated by PCBs other than those mentioned in 16 02 09	X
16 02 11	discarded equipment containing chlorofluorocarbons, HCFC, HFC	X
16 02 12	discarded equipment containing free asbestos	X
16 02 13	discarded equipment containing hazardous components[11] other than those mentioned in 16 02 09 to 16 02 12	X
16 02 14	discarded equipment other than those mentioned in 16 02 09 to 16 02 13	
16 02 15	hazardous components removed from discarded equipment	X
16 02 16	components removed from discarded equipment other than those mentioned in16 02 15	

[11] Hazardous components from electrical and electronic equipment may include accumulators and batteries mentioned in 16 06 and marked as hazardous; mercury switches, glass from cathode ray tubes and other activated glass, etc.

16 03	**off-specification batches and unused products**	
16 03 03	inorganic wastes containing dangerous substances	X
16 03 04	inorganic wastes other than those mentioned in 16 03 03	
16 03 05	organic wastes containing dangerous substances	X
16 03 06	organic wastes other than those mentioned in 16 03 05	
16 04	**waste explosives**	
16 04 01	waste ammunition	X
16 04 02	fireworks wastes	X
16 04 03	other waste explosives	X
16 05	**gases in pressure containers and discarded chemicals**	
16 05 04	gases in pressure containers (including halons) containing dangerous substances	X
16 05 05	gases in pressure containers other than those mentioned in 16 05 04	
16 05 06	laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals	X
16 05 07	discarded inorganic chemicals consisting of or containing dangerous substances	X
16 05 08	discarded organic chemicals consisting of or containing dangerous substances	X
16 05 09	discarded chemicals other than those mentioned in 16 05 06, 16 05 07 or 16 05 08	
16 06	**batteries and accumulators**	
16 06 01	lead batteries	X
16 06 02	Ni-Cd batteries	X
16 06 03	mercury-containing batteries	X
16 06 04	alkaline batteries (except 16 06 03)	
16 06 05	other batteries and accumulators	
16 06 06	separately collected electrolyte from batteries and accumulators	X
16 07	**wastes from transport tank, storage tank and barrel cleaning (except 05 and13)**	
16 07 08	wastes containing oil	X
16 07 09	wastes containing other dangerous substances	X
16 07 99	wastes not otherwise specified	
16 08	**spent catalysts**	
16 08 01	spent catalysts containing gold, silver, rhenium, rhodium, palladium, iridium or platinum (except 16 08 07)	
16 08 02	spent catalysts containing dangerous transition metals[12] or dangerous transition metal compounds	X
16 08 03	spent catalysts containing transition metals or transition metal compounds not otherwise specified	
16 08 04	spent fluid catalytic cracking catalysts (except 16 08 07)	
16 08 05	spent catalysts containing phosphoric acid	X

[12] For the purpose of this entry, transition metals are: scandium, vanadium, manganese, cobalt, copper, yttrium, niobium, hafnium, tungsten, titanium, chromium, iron, nickel, zinc, zirconium, molybdenum and tantalum. These metals or their compounds are dangerous if they are classified as dangerous substances. The classification of dangerous substances shall determine which among those transition metals and which transition metal compounds

16 08 06	spent liquids used as catalysts	X
16 08 07	spent catalysts contaminated with dangerous substances	X
16 09	**oxidizing substances**	
16 09 01	permanganates, for example potassium permanganate	X
16 09 02	chromates, for example potassium chromate, potassium or sodium dichromate	X
16 09 03	peroxides, for example hydrogen peroxide	X
16 09 04	oxidizing substances, not otherwise specified	X
16 10	**aqueous liquid wastes destined for off-site treatment**	
16 10 01	aqueous liquid wastes containing dangerous substances	X
16 10 02	aqueous liquid wastes other than those mentioned in 16 10 01	
16 10 03	aqueous concentrates containing dangerous substances	X
16 10 04	aqueous concentrates other than those mentioned in 16 10 03	
16 11	**waste linings and refractories**	
16 11 01	carbon-based linings and refractories from metallurgical processes containing dangerous substances	X
16 11 02	carbon-based linings and refractories from metallurgical processes others than those mentioned in 16 11 01	
16 11 03	other linings and refractories from metallurgical processes containing dangerous substances	X
16 11 04	other linings and refractories from metallurgical processes other than those mentioned in 16 11 03	
16 11 05	linings and refractories from non-metallurgical processes containing dangerous substances	X
16 11 06	linings and refractories from non-metallurgical processes others than those mentioned in 16 11 05	
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**	
17 01	**concrete, bricks, tiles and ceramics**	
17 01 01	concrete	
17 01 02	bricks	
17 01 03	tiles and ceramics	
17 01 06	mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	X
17 01 07	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	
17 02	**wood, glass and plastic**	
17 02 01	wood	
17 02 02	glass	
17 02 03	plastic	
17 02 04	glass, plastic and wood containing or contaminated with dangerous substances	X
17 03	**bituminous mixtures, coal tar and tarred products**	
17 03 01	bituminous mixtures containing coal tar	X
17 03 02	bituminous mixtures other than those mentioned in 17 03 01	
17 03 03	coal tar and tarred products	X

17 04	**metals (including their alloys)**	
17 04 01	copper, bronze, brass	
17 04 02	aluminum	
17 04 03	lead	
17 04 04	zinc	
17 04 05	iron and steel	
17 04 06	tin	
17 04 07	mixed metals	
17 04 09	metal waste contaminated with dangerous substances	X
17 04 10	cables containing oil, coal tar and other dangerous substances	X
17 04 11	cables other than those mentioned in 17 04 10	
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**	
17 05 03	soil and stones containing dangerous substances	X
17 05 04	soil and stones other than those mentioned in 17 05 03	
17 05 05	dredging spoil containing dangerous substances	X
17 05 06	dredging spoil other than those mentioned in 17 05 05	
17 05 07	track ballast containing dangerous substances	X
17 05 08	track ballast other than those mentioned in 17 05 07	
17 06	**insulation materials and asbestos-containing construction materials**	
17 06 01	insulation materials containing asbestos	X
17 06 03	other insulation materials consisting of or containing dangerous substances	X
17 06 04	insulation materials other than those mentioned in 17 06 01 and 17 06 03	
17 06 05	construction materials containing asbestos	X
17 08	**gypsum-based construction material**	
17 08 01	gypsum-based construction materials contaminated with dangerous substances	X
17 08 02	gypsum-based construction materials other than those mentioned in 17 08 01	
17 09	**other construction and demolition wastes**	
17 09 01	construction and demolition wastes containing mercury	X
17 09 02	construction and demolition wastes containing PCB (for example PCB containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors)	X
17 09 03	other construction and demolition wastes (including mixed wastes) containing dangerous substances	X
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	
18	**WASTES FROM HUMAN OR ANIMAL HEALTH CARE AND/OR RELATED RESEARCH** (except kitchen and restaurant wastes not arising from immediate health care)	
18 01	**wastes from natal care, diagnosis, treatment or prevention of disease in humans**	
18 01 01	sharps (except 18 01 03)	
18 01 02	body parts and organs including blood bags and blood preserves	

	(except 18 01 03)	
18 01 03	wastes whose collection and disposal is subject to special requirements in order to prevent infection	X
18 01 04	wastes whose collection and disposal is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)	
18 01 06	chemicals consisting of or containing dangerous substances	X
18 01 07	chemicals other than those mentioned in 18 01 06	
18 01 08	cytotoxic and cytostatic medicines	X
18 01 09	medicines other than those mentioned in 18 01 08	
18 01 10	amalgam waste from dental care	X
18 02	**wastes from research, diagnosis, treatment or prevention of disease involving animals**	
18 02 01	sharps (except 18 02 02)	
18 02 02	wastes whose collection and disposal is subject to special requirements in order to prevent infection	X
18 02 03	wastes whose collection and disposal is not subject to special requirements in order to prevent infection	
18 02 05	chemicals consisting of or containing dangerous substances	X
18 02 06	chemicals other than those mentioned in 18 02 05	
18 02 07	cytotoxic and cytostatic medicines	X
18 02 08	medicines other than those mentioned in 18 02 07	
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTEWATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**	
19 01	**wastes from incineration or pyrolysis of waste**	
19 01 02	ferrous materials removed from bottom ash	
19 01 05	filter cake from gas treatment	X
19 01 06	aqueous liquid wastes from gas treatment and other aqueous liquid wastes	X
19 01 07	solid wastes from gas treatment	X
19 01 10	spent activated carbon from flue-gas treatment	X
19 01 11	bottom ash and slag containing dangerous substances	X
19 01 12	bottom ash and slag other than those mentioned in 19 01 11	
19 01 13	fly ash containing dangerous substances	X
19 01 14	fly ash other than those mentioned in 19 01 13	
19 01 15	boiler dust containing dangerous substances	X
19 01 16	boiler dust other than those mentioned in 19 01 15	
19 01 17	pyrolysis wastes containing dangerous substances	X
19 01 18	pyrolysis wastes other than those mentioned in 19 01 17	
19 01 19	sands from fluidized beds	
19 01 99	wastes not otherwise specified	
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**	
19 02 03	premixed wastes composed only of non-hazardous wastes	
19 02 04	premixed wastes composed of at least one hazardous waste	X
19 02 05	sludge from physico/chemical treatment containing dangerous substances	X

19 02 06	sludge from physico/chemical treatment other than those mentioned in 19 02 05	
19 02 07	oil and concentrates from separation	X
19 02 08	liquid combustible wastes containing dangerous substances	X
19 02 09	solid combustible wastes containing dangerous substances	X
19 02 10	combustible wastes other than those mentioned in 19 02 08 and 19 02 09	
19 02 11	other wastes containing dangerous substances	X
19 02 99	wastes not otherwise specified	
19 03	**stabilized/solidified wastes[13]**	
19 03 04	wastes marked as hazardous, partly[14] stabilized	X
19 03 05	stabilized wastes other than those mentioned in 19 03 04	
19 03 06	wastes marked as hazardous, solidified	X
19 03 07	solidified wastes other than those mentioned in 19 03 06	
19 04	**vitrified waste and wastes from vitrification**	
19 04 01	vitrified waste	
19 04 02	fly ash and other flue-gas treatment wastes	X
19 04 03	non-vitrified solid phase	X
19 04 04	aqueous liquid wastes from vitrified waste tempering	
19 05	**wastes from aerobic treatment of solid wastes**	
19 05 01	non-composted fraction of municipal and similar wastes	
19 05 02	non-composted fraction of animal and vegetable waste	
19 05 03	off-specification compost	
19 05 99	wastes not otherwise specified	
19 06	**wastes from anaerobic treatment of waste**	
19 06 03	liquor from anaerobic treatment of municipal waste	
19 06 04	digestate from anaerobic treatment of municipal waste	
19 06 05	liquor from anaerobic treatment of animal and vegetable waste	
19 06 06	digestate from anaerobic treatment of animal and vegetable waste	
19 06 99	wastes not otherwise specified	
19 07	**landfill leachate**	
19 07 02	landfill leachate containing dangerous substances	X
19 07 03	landfill leachate other than those mentioned in 19 07 02	
19 08	**wastes from wastewater treatment plants not otherwise specified**	
19 08 01	screenings	
19 08 02	waste from desanding	
19 08 05	sludge from treatment of urban wastewater	
19 08 06	saturated or spent ion exchange resins	X
19 08 07	solutions and sludge from regeneration of ion exchangers	X
19 08 08	membrane system waste containing heavy metals	X
19 08 09	grease and oil mixture from oil/water separation containing only edible oil and fats	
19 08 10	grease and oil mixture from oil/water separation other than those	

[13] Stabilization processes change the dangerousness of the constituents in the waste and thus transform hazardous waste into non-hazardous waste. Solidification processes only change the physical state of the waste (e.g. liquid into solid) by using additives without changing the chemical properties of the waste.

[14] A waste is considered as partly stabilized if, after the stabilization process, dangerous constituents which have not been changed completely into non-dangerous constituents could be released into the environment in the short, middle or long term.

	mentioned in 19 08 09	X
19 08 11	sludge containing dangerous substances from biological treatment of industrial wastewater	X
19 08 12	sludge from biological treatment of industrial wastewater other than those mentioned in 19 08 11	
19 08 13	sludge containing dangerous substances from other treatment of industrial waste water	X
19 08 14	sludge from other treatment of industrial wastewater other than those mentioned in 19 08 13	
19 08 99	wastes not otherwise specified	
19 09	**wastes from the preparation of water intended for human consumption or water for industrial use**	
19 09 01	solid waste from primary filtration and screenings	
19 09 02	sludge from water clarification	
19 09 03	sludge from decarbonation	
19 09 04	spent activated carbon	
19 09 05	saturated or spent ion exchange resins	
19 09 06	solutions and sludge from regeneration of ion exchangers	
19 09 99	wastes not otherwise specified	
19 10	**wastes from shredding of metal-containing wastes**	
19 10 01	iron and steel waste	
19 10 02	non-ferrous waste	
19 10 03	fluff-light fraction and dust containing dangerous substances	X
19 10 04	fluff-light fraction and dust other than those mentioned in 19 10 03	
19 10 05	other fractions containing dangerous substances	X
19 10 06	other fractions other than those mentioned in 19 10 05	
19 11	**wastes from oil regeneration**	
19 11 01	spent filter clays	X
19 11 02	acid tars	X
19 11 03	aqueous liquid wastes	
19 11 04	wastes from cleaning of fuel with bases	X
19 11 05	sludge from on-site effluent treatment containing dangerous substances	X
19 11 06	sludge from on-site effluent treatment other than those mentioned in 19 11 05	
19 11 07	wastes from flue-gas cleaning	
19 11 99	wastes not otherwise specified	X
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**	
19 12 01	paper and cardboard	
19 12 02	ferrous metal	
19 12 03	non-ferrous metal	
19 12 04	plastic and rubber	
19 12 05	glass	
19 12 06	wood containing dangerous substances	X
19 12 07	wood other than that mentioned in 19 12 06	
19 12 08	textiles	

19 12 09	minerals (for example sand, stones)	
19 12 10	combustible waste (refuse derived fuel)	
19 12 11	other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances	X
19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11	
19 13	**wastes from soil and groundwater remediation**	
19 13 01	solid wastes from soil remediation containing dangerous substances	X
19 13 02	solid wastes from soil remediation other than those mentioned in 19 13 01	
19 13 03	sludge from soil remediation containing dangerous substances	X
19 13 04	sludge from soil remediation other than those mentioned in 19 13 03	
19 13 05	sludge from groundwater remediation containing dangerous substances	X
19 13 06	sludge from groundwater remediation other than those mentioned in 19 13 05	
19 13 07	aqueous liquid wastes and aqueous concentrates from groundwater remediation containing dangerous substances	X
19 13 08	aqueous liquid wastes and aqueous concentrates from groundwater remediation other than those mentioned in 19 13 07	
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**	
20 01	**separately collected fractions (except 15 01)**	
20 01 01	paper and cardboard	
20 01 02	glass	
20 01 08	biodegradable kitchen and canteen waste	
20 01 10	clothes	
20 01 11	textiles	
20 01 13	solvents	X
20 01 14	acids	X
20 01 15	alkalines	X
20 01 17	photochemicals	X
20 01 19	pesticides	X
20 01 21	fluorescent tubes and other mercury-containing waste	X
20 01 23	discarded equipment containing chlorofluorocarbons	X
20 01 25	edible oil and fat	
20 01 26	oil and fat other than those mentioned in 20 01 25	X
20 01 27	paint, inks, adhesives and resins containing dangerous substances	X
20 01 28	paint, inks, adhesives and resins other than those mentioned in 20 01 27	
20 01 29	detergents containing dangerous substances	X
20 01 30	detergents other than those mentioned in 20 01 29	
20 01 31	cytotoxic and cytostatic medicines	X
20 01 32	medicines other than those mentioned in 20 01 31	
20 01 33	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	X
20 01 34	batteries and accumulators other than those mentioned in 20 01 33	
20 01 35	discarded electrical and electronic equipment other than those	

	mentioned in 20 01 21 and 20 01 23 containing hazardous components[15]	X
20 01 36	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	
20 01 37	wood containing dangerous substances	X
20 01 38	wood other than that mentioned in 20 01 37	
20 01 39	plastics	
20 01 40	metals	
20 01 41	wastes from chimney sweeping	
20 01 99	other fractions not otherwise specified	
20 02	**garden and park wastes (including cemetery waste)**	
20 02 01	biodegradable waste	
20 02 02	soil and stones	
20 02 03	other non-biodegradable wastes	
20 03	**other municipal wastes**	
20 03 01	mixed municipal waste	
20 03 02	waste from markets	
20 03 03	street-cleaning residues	
20 03 04	septic tank sludge	
20 03 06	waste from sewage cleaning	
20 03 07	bulky waste	
20 03 99	municipal wastes not otherwise specified	

[15] Hazardous components from electrical and electronic equipment may include accumulators and batteries mentioned in 16 06 and marked as hazardous; mercury switches, glass from cathode ray tubes and other activated glass etc.

ANNEX 3: SLUDGE FROM INDUSTRY COMPARABLE TO SLUDGE FROM MUNICIPAL WASTEWATER

The sludge from on-site effluent treatment listed below may be considered as comparable to sludge from municipal wastewater. The sludge listed originates in the production of foodstuffs and semi-luxury goods. They may only be used if there has been no mixing with effluents or sludges outside the specific production process. Sludge from on-site effluent treatment originating from the preparation and processing of meat, fish and other foods of animal origin may only be used in installations for anaerobic treatment and must be pasteurized (70°C; at least one hour) if it is to be used in agriculture.

Excerpt from Annex 2:

02	**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**	
02 02	**wastes from the preparation and processing of meat, fish and other foods of animal origin**	
02 02 04	sludge from on-site effluent treatment	
02 03	**wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation**	
02 03 05	sludge from on-site effluent treatment	
02 04	**wastes from sugar processing**	
02 04 03	sludge from on-site effluent treatment	
02 05	**wastes from the dairy products industry**	
02 05 02	sludge from on-site effluent treatment	
02 06	**wastes from the baking and confectionery industry**	
02 06 03	sludge from on-site effluent treatment	
02 07	**wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)**	
02 07 05	sludge from on-site effluent treatment	

ANNEX 4: LIST OF DISPOSAL AND RECOVERY OPERATIONS[16]

DISPOSAL OPERATIONS (Section A) Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses. Section A encompasses all such disposal operations which occur in practice

D1	Deposit into or onto land, (e.g., landfill, etc.)
D2	Land treatment, (e.g., biodegradation of liquid or sludgy discards in soils, etc.)
D3	Deep injection, (e.g., injection of pumpable discards into wells, salt domes of naturally occurring repositories, etc.)
D4	Surface impoundment, (e.g., placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill, (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6	Release into a water body except seas/oceans
D7	Release into seas/oceans including sea-bed insertion
D8	Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are disposed by means of any of the operations in Section A
D9	Physico chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations in Section A, (e.g., evaporation, drying, calcination, neutralization, precipitation, etc.)
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g. emplacement of containers in a mine, etc.)
D13	Blending or mixing prior to submission to any of the operations in Section A
D14	Repackaging prior to submission to any of the operations in Section A
D15	Storage pending any of the operations in Section A

[16] Annex IV Section A & B Basel Convention 2011

DISPOSAL OPERATIONS (Section B) Operations which may lead to resource recovery, recycling, reclamation, direct re-use or alternative uses Section B encompasses all such operations with respect to materials legally defined as or considered to be hazardous wastes and which otherwise would have been destined for operations included in Section A

R1	Use as a fuel (other than in direct incineration) or other means to generate energy
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases
R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Used oil re-refining or other reuses of previously used oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Uses of residual materials obtained from any of the operations numbered R1-R10
R12	Exchange of wastes for submission to any of the operations numbered R1-R11
R13	Accumulation of material intended for any operation in Section B

ANNEX 5: SAMPLING, SAMPLE PREPARATION AND ANALYSIS OF SEWAGE SLUDGE AND SOIL

In addition to the analysis methods named comparable methods may be applied with written permission from the Department of Environment.

1 Sewage sludge

1.1 Taking samples

In respect of the sewage sludge analyses prescribed in chapter 3.4.3, the samples shall be taken in accordance with DIN 38414, Part 1 (issued in November 1986) or comparable method, the sewage sludge being in the state in which it is applied on agricultural areas of land.

In order to ensure representative analysis results, composite samples must be produced in the following manner:

Prior to the date set for the analysis, five litres of sludge must be taken from each of at least five different sewage sludge batches and mixed in a suitable vessel (e.g. of aluminium) to form the composite sample. Samples should, as far as possible, be taken at intervals of several days.

From the carefully mixed composite sample, a partial quantity shall be taken which is sufficient to ensure four parallel analyses for all of the prescribed analysis parameters.

The partial quantity shall be filled into a suitable, well- closing vessel (e.g. aluminium) and delivered immediately to the analyzing laboratory.

1.2 Preparing the sample

The sludge sample submitted for analysis shall undergo constant mixing immediately before a sub- sample is taken. In the event of there being any risk of demixing, the partial sample shall be taken during the mixing process.

For all analysis, parameters determined from the dry matter, a partial sample shall be taken that is at least sufficient to ensure four parallel analyses.

A partial sample shall also be taken for freeze-drying that is at least sufficient to conduct four parallel analyses in accordance with Sections 1.3.3.1 and 1.3.3.2.

Freeze-drying must be performed in such a way that evaporation losses of the substances to be analyzed are avoided. In particular, it shall be ensured that the sample is unable to thaw during the freeze-drying process. Sewage sludge with a high water content should be partially de-watered by centrifuge prior to freeze-drying. The separated centrifugate should contain no particles.

1.3 Performing the analyses

When working with fresh and freeze-dried sewage sludge, it shall be necessary to observe

safety rules usually applicable to work carried out in microbiological laboratories. Provided the analysis results will not be influenced, it shall be possible to sterilize a partial quantity of the fresh or freeze-dried sludge for the relevant analyses (e.g. by heating the sample for a period of 30 minutes at 70°C).

For each analysis parameter, it shall be necessary to perform at least two parallel analyses and specify the result as the arithmetic mean of the two values. Equivalent methods shall be permitted.

1.3.1 Determination of the heavy metals, nutrients, pH value, dry residue, ignition loss and adsorbed organically bound halogens (AOX).

The prescribed analyses of these parameters shall be performed in accordance with the methods of analysis described in Table 1.

1.3.2 Determination of the basifying substances

I. Purpose and scope

The method shall be applicable to sewage sludge containing calcium and magnesium in basifying form (e.g. as oxide, hydroxide and carbonate).

II. Principle

The substance shall be rendered soluble with acid and the excess of acid back-titrated. The basifying substances shall be specified as % CaO.

III. Chemicals

III.I Hydrochloric acid solution

HCl = 0.5 mol/l

III.II Sodium hydroxide solution

NaOH = 0.25 mol/l

III.III Phenolphthalein solution

w (phenolphthalein) = 1 % in ethanol (w = 96 %)

IV. Equipment

Standard laboratory equipment

V. Performance

V.I Preparing samples

From the sample dried at 1050°C and comminuted and homogenised following standard procedure, 2 g shall be weighed off to accuracy 1 mg on an analysis balance, transferred to a 200 ml measuring flask and mixed with 100 ml of hydrochloric acid in accordance with Section III.I. The measuring flask shall be allowed to stand in the cold until the reaction is concluded. This shall be followed by a process of careful heating and boiling for 5 minutes

in such a way that no hydrochloric acid losses occur. Once the dissolution process is concluded, the solution shall be cooled, topped up with water as far as the 200 ml mark, shaken and filtered by a fluted filter (5- 8µm).

V.II FOERSTER method

50 ml (A) of the hydrochloric filtrate (described in Section V.I) shall be pipetted into a 200 ml measuring flask and, after adding phenolphthalein solution specified in Section III.III, titrated with sodium hydroxide solution specified in Section III.II. The still weakly acidic solution shall be boiled in order to remove the carbon dioxide. The titration is continued during the boiling process until the onset of turbidity (consumed volume of alkali = x ml). This shall be followed by cooling, topping up with water as far as the mark, shaking and filtration. The titration shall be completed in 100 ml of filtrate containing 0.25 g of substance (consumed volume of alkali = y ml).

VI. Calculation

The content of basifying substances w_{bas} in % CaO shall be calculated using the following formula:

$$w_{bas} = (A - 0.5\ B) * C$$

$$= (50 - \frac{x + 2y}{2}) * 1.402$$

Where B = (x + 2y)(ml)

- A: amount of hydrochloric acid solution in ml (factor to be multiplied with is 1.00)
- B: amount of sodium hydroxide solution in ml (factor to be multiplied with is 1.00)
- x: amount of sodium hydroxide solution until the occurrence of turbidity
- y: consumption of standard sodium hydroxide solution after completion of filtration
- C: conversion factors

C1 = 1.402 for CaO
C2 = 2.502 for $CaCO_3$

1.3.3 Determination of the polychlorinated biphenyls (PCB), polychlorinated dibenzo-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)

1.3.3.1 Determination of the polychlorinated biphenyls

I. Principles

The following method of analysis is suitable for the determination, prescribed for precautionary reasons under chapter 3.4.3 section 10, of the six selected PCB congeners in sewage sludge.

The method describes tested procedures which may only be applied by analysts or under the supervision of analysts with experience in trace analysis using gas chromatography and who ensure that the necessary measures are taken for quality assurance and control (refer to Section IX).

It shall only be permissible to diverge from the prescribed work processes if the gas-chromatographic separation of the PCB congeners is adversely affected to such an extent by disturbing co-eluent substances that any reliable identification/quantification is not possible. In these cases of exception, it may be worthwhile repeating prescribed purification processes or performing other additional purification methods. It may furthermore be necessary in this context to use a mass-spectrographic detector.

In order to separate PCB from some chlorinated hydrocarbons, such as p,p-DDT, dieldrin, heptachlor epoxide, HCH isomers and others, it shall, if necessary, be possible to use a silica gel separation column as an additional purification stage (refer, for example Bibliography 10, 13, 14, 17).

As the procedure described here is geared towards the limit values (0.2mg/kg DM) for the components (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 and PCB 180) it will be necessary to alter the subsampling- and dilution volumes as well as the added amounts of internal standard when very low PCB concentration need to be determined.

II. Brief description

The freeze-dried sewage sludge sample shall be extracted with n-hexane in the Soxhlet extractor after adding internal standard. Any PCB congeners contained in the extract will be extensively freed from any disturbing companion substances by means of purification steps, separated by capillary gas chromatography and determined using the electron capture detector (ECD) - (refer to diagram in Figure 1).

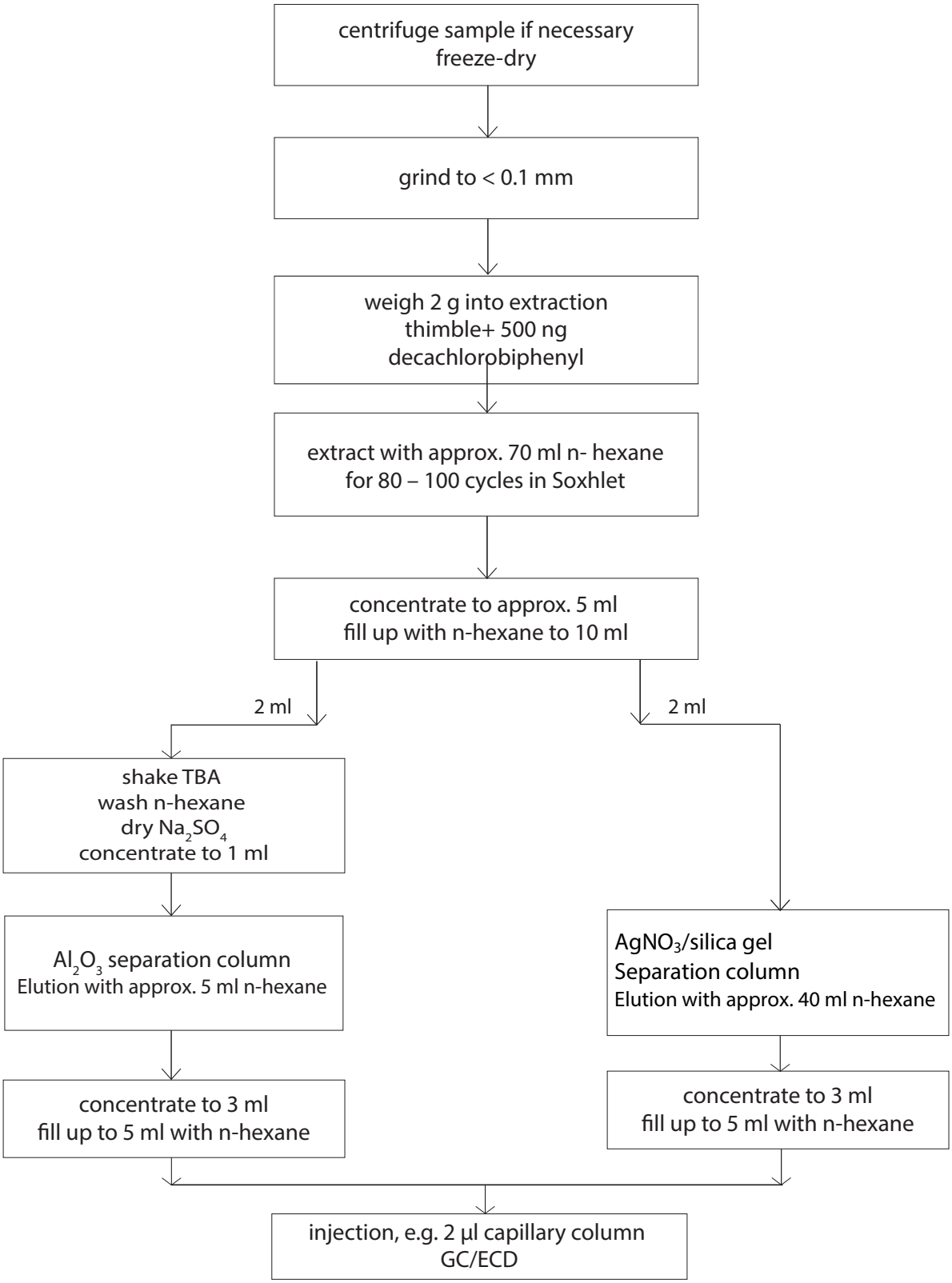


Figure 1: Diagram of PCB determination in sewage sludge

III. Chemicals

All chemicals must have a reagent grade which allows the determination of PCB components within the detection limit of the method. This must be verified by conducting regular blank tests and, if necessary, be guaranteed by implementing additional purification measures.

III.I Solvents for residue analyses

n-dodecane, n-hexane and isopropanol, if necessary extensively purified, e.g. re-distilled through a high-performance distillation column.

III.II Water, demineralized

III.III Desiccant

III.III.I Sodium sulphate, anhydrous

If necessary, the sodium sulphate must be purified and dried by heating to 550°C for at least two hours in a muffle furnace.

III.III.II Magnesium perchlorate

III.IV Tetrabutyl ammonium hydrogensulphate (TBA)

III.V Sodium sulphate

III.VI TBA sulphate reagent

3.39 g of tetrabutyl ammonium hydrogensulphate shall be weighed into a 100ml measuring flask to an accuracy of 0.01 g, dissolved in demineralized water and topped up with water. The solution shall be extracted three times in a 250 ml separatory funnel with 20 ml of n-hexane and saturated with 25 g of sodium sulphate. The solution should not be preserved for a period exceeding one month.

III.VII Silver nitrate

III.VIII Packing materials for column chromatography

III.VIII.I Aluminium oxide

Aluminium oxide W 200, basic or neutral, Super 1 Woelm activity or equivalent, shall be dried for a period of 16 hours at 150°C or for a period of two hours at 400° C. 89g of the dried aluminium oxide shall be mixed with 11g of water and shaken in a closed flask until all lumps have disappeared. The mixture shall be preserved for a period of at least 16 hours in a closed flask before it is used for the first time.

III.VIII.II Silica gel

Silica gel 60, 0.063-0.200 mm (70-230 mesh), e.g. Merck Quality No. 7754 or equivalent, shall be dried for a period of 16 hours at 200°C, cooled in the desiccator over magnesium perchlorate where it shall be kept for a maximum period of 14 days.

III.VIII.III Silver nitrate/silica gel mixture

10 g of silver nitrate shall be dissolved in 40 ml of water and added in portions to 90 g of activated silica gel described in Section III.VIII.II. The mixture shall be shaken until all lumps have disappeared and then heated in the drying oven from 70°C to 120°C within a period of five hours.
The mixture shall be heated for 15 hours to 125°C for activation, cooled in the desiccator over magnesium perchlorate, filled into a brown flask where it shall be kept for a maximum period of 14 days.

III.IX Gases

III.IX.I Carrier gas

Helium or hydrogen, each with a volume percentage of ≥ 99.99 %.

III.IX.II Auxiliary gases

Gas mixture comprising 95 parts by volume of argon and five parts by volume of methane; alternatively nitrogen, each with a volume percentage of > 99.99 %. Nitrogen, purified and oil-free for the concentration of small extract volumes.

III.X Calibrating and reference substances

III.X.I Individual PCB components

2,4,4'-Trichlorobiphenyl	PCB 28
2,2',5,5'-Tetrachlorobiphenyl	PCB 52
2,2',4,5,5'-Pentachlorobiphenyl	PCB 101
2,2',3,4,5,5'-Hexachlor obiphenyl	PCB 138
2,2',4,4',5,5'-Hexachlorobiphenyl	PCB 153
2,2',3,4,4',5,5'-Heptachlorobiphenyl	PCB 180
Decachlorobiphenyl	PCB 209 (internal standard)

Stock solutions shall be produced by dissolving the individual components in hexane to form a mixture with a content per component of, for example, 10 µg/ml . The working standards shall be produced by diluting the stock solution(s) with n- hexane in such a way that under the given gas-chromatographic conditions the electron capture detector shows a linear reading throughout the selected working range. In general, contents of 2 µg/l to 20 µg/l shall be adequate for this purpose.

An equally large amount of decachlorobiphenyl shall be added as the internal standard to all working standards. This amount should be rated in such a way that the signal measured for the internal standard in the linear working range is greater than the signal measured for the individual PCB components of the working standard with the highest PCB content. With a working range of 2 µg/l to 20 µg/l and an injection volume of 1-2 µl, a concentration of internal standard of 20 µg/l may be sufficient.

Prior to extraction, the sewage sludge sample shall also be mixed with as much internastandard as is necessary for the signal measured for the internal standard in the

measurement solution under Section V.II.I.II or V.II.II to be larger than the signal measured for the individual PCB components in this solution, however no more than ten times its magnitude. In the procedure described here, the addition of 500 ng of decachlorobiphenyl will produce a content in the measurement solution of 20 µg/l.

III.X.II Technical PCB mixtures

Technical PCB mixtures shall be used for detecting the peak pattern and for assessing the separation capacity of the gas-chromatographic system. In addition to the individual products of Chlophen[R] A30, A40, A50 and A60 or the corresponding Arochlor mixtures[R], a mixture of Chlophen[R] A40 and A60, e.g. each in a concentration of 2 µg/ml, shall in particular be used for the above-mentioned purpose.

IV. Equipment

All equipment coming into contact with the sample and its solutions/extracts must exhibit a degree of cleanliness that permits determination of the PCB components within the scope of the detection limit of the procedure. This must be verified by regular blank tests and, if necessary, ensured by performing additional cleaning measures.

IV.I Standard laboratory equipment

IV.II Freeze-drying system

IV.III Capillary gas chromatography with electron capture detector (ECD)

IV.IV Gas-chromatographic separation column

IV.V Columns for preliminary liquid-chromatographic purification

Glass columns of different lengths (e.g. 150 to 250 mm) with an inside diameter of 6 mm at the bottom tapering to a point with a length of approx. 40 mm and provided at the top end with a reservoir, e.g. 50 mm in length with 20 mm inside diameter.

With the separation columns described below, the elution behaviour of PCB's on the column must be checked regularly, however at least for each new batch of packing material, with a mixture of the six PCB components and decachlorobiphenyl.

IV.V.I Aluminium oxide separation column

A chromatographic column of the type described in Section IV.V shall be fitted with a glass-wool bung and filled with 2 g of aluminium oxide suspended in n-hexane (refer to Section III.VIII.I).

IV.V.II Silver nitrate/silica gel separation column

A glass column of the type described in Section IV.V shall be fitted with a glass-wool bung, filled with a 5 mm deep layer of anhydrous sodium sulphate, covered with 2 g of silver nitrate/silica gel mixture according to Section III.VIII.III and above that a further 5 mm deep layer of anhydrous sodium sulphate. The column must be freshly prepared before each purification.

V. Preparing samples

V.I Extraction

2 g of the sewage sludge freeze-dried and comminuted in an analysis grinder and homogenized shall be weighed to an accuracy of 1mg into an extraction thimble (pre-cleaned if necessary), mixed with 500 ng of decachlorobiphenyl as the internal standard (refer to section III.X.I) and extracted in the Soxhlet extractor with n-hexane (e.g. 70 ml). The duration of extraction shall be rated in such a way that about 80-100 extraction cycles take place. The extract shall, if necessary, be filtered, concentrated to about 5ml by gentle distillation, if applicable by adding a little n- dodecane (e.g. 100 µl of a solution of 20 µg/µl n-dodecane in n-hexane), quantitatively transferred into a 10 ml measuring flask and topped up with n-hexane.

V.II Purifying the extract

The following describes two equivalent modes of procedures for separating the PCB's from disturbing companion substances (refer to diagram in Figure 1).

a) A two-phase procedure involving the removal of sulphur and sulphurous compounds by means of TBA and column chromatography with aluminium oxide.

b) A single-phase purification process using a silver nitrate/silica gel separation column.

Both procedures will generally be sufficient for samples exhibiting only a low level of contamination.

V.II.I Purification with TBA and aluminium oxide

V.II.I.I Removal of sulphur and sulphurous compounds (Ref 17)

2 ml of the extract described in Section V.I or, if applicable, another suitable aliquot shall be mixed with 1 ml of isopropanol and 1ml of TBA sulphate reagent and shaken vigorously for a period of at least two minutes. If no crystalline precipitation is formed thereafter, a sufficient number of 100 mg lots of sodium sulphate shall be added and shaken until such time as a crystalline precipitation is formed. After adding 5ml of water, shaking must be continued for a further two minutes. The hexane phase shall be removed and the aqueous phase subsequently extracted twice with a little n-hexane. The combined organic phases shall be dried with sodium sulphate and filtered off. The sodium sulphate shall be washed twice with a little n-hexane and the entire n-hexane phase concentrated gently with nitrogen to 1ml.

V.II.I.II Aluminium oxide separation column

The n-hexane phase, concentrated to 1 ml in accordance with Section V.II.I.I, shall be quantitatively pipetted onto the aluminium oxide separation column prewashed with n-hexane and described in Section IV.V.I. The residue vessel shall be re-washed with 0.5 ml of n-hexane. The hexane shall be pipetted onto the surface of the packing when the meniscus of the solution has just commenced infiltration. This rinsing process shall be repeated a further twice. The column shall then, as described above, be eluted with 5ml

portions of n-hexane or a volume determined in accordance with Section IV.V. The eluate shall be gently concentrated at room temperature in the stream of nitrogen to approx. 3ml and topped up with n-hexane to 5 ml in the measuring flask for GC analysis.

V.II.II Purification with silver nitrate/silica gel

2 ml of the extract specified in Section V.I or, if applicable, another suitable aliquot, shall be filled onto the silver nitrate/silica gel column prewashed with n-hexane and described in Section IV.V.II.

When the meniscus of the extract just starts to infiltrate the surface of the packing, 40 ml of n-hexane or another volume adequate for the complete elution of the PCB shall be added in portions onto the column. The entire eluate shall be gently concentrated to about 3 ml and topped up with n-hexane to 5 ml in the measuring flask for GC analyses.

VI. Gas chromatographic determination

The six PCB congeners in the purified extract shall be identified and quantified by means of capillary gas chromatography and electron capture detector. The separation capacity of the GC system must be optimized in such a manner as to achieve an adequate dissolution of the components PCB 28 and PCB 31. In order to optimize the GC working conditions, refer to DIN 51527, Part 1, Sections 9.3 and 10 (4) or follow comparable standard methods.

It is recommended to secure identification of the PCB components with two capillary separation columns of differing polarity. Furthermore, it must be ensured that no interferences occur between the PCB components 101 and o,p'-DDE or α-endosulphane as well as between PCB 138 and p,p'- DDT.

If, in addition to PCB, the sewage sludge sample also contains tetraclorodiphenyl methanes (e.g. Ugilec 141), a large part of the corresponding isomers will also be found in the eluate of the separation column(s) and may disturb the identification or quantification of PCB component 153. In order to ensure the perfect quantification of this component, a mass-spectrometric detector should be used in this case (refer, for example, to bibliography for analyses of sewage sludge and soil 7, 10, 11, 12, 14).

VII. Calibration

The gas-chromatographic separation system shall be calibrated in the linear measurement range of the ECD. For this purpose, it shall be appropriate to use multi-component solutions as the working standards (refer to Section III.X.I).

The linear calibration functions of the individual PCB components shall be determined by recognized standard procedure or as follows in accordance with DIN 38402, Part 51(1) on the basis of at least 5 calibration concentrations distributed equidistantly throughout the working range.

The working standards doped with internal standard shall be injected in rising concentrations into the gas chromatograph under the same conditions prevailing at the time of the sample measurement. The j measurement values y_{iej} shall be put in proportion

to the values measured for internal standard y_{lej}. The same shall also apply to the mass concentrations β_{iej} and β_{lej} on which the measurement values are based. These proportions shall be used to calculate the calibration functions (1) on the basis of linear regression:

$$\frac{y_{ie}}{y_{le}} = m_{il} * \frac{\beta_{ie}}{\beta_{le}} + b_{il} \qquad (1)$$

Where:

Y_{ie} => value measured for PCB i during calibration; dependent on β_{ie}; unit dependent on evaluation; e.g. peak area

y_{le} => value measured for internal standard l during calibration; dependent on β_{ie}; unit dependent on evaluation; e.g. peak area

β_{ie} => mass concentration of substance i in the working standard in µg/l

β_{le} => mass concentration of the internal standard in µg/l

m_{il} => gradient of the calibration curve, unit without dimension

b_{il} => section of the calibration curve on the ordinate axis, unit without dimension

The calibration functions shall only apply to the concentration range covered by them. They are also dependent on the operating status of the gas chromatograph and must be checked at regular intervals. For routine operation, the calibration function must be adjusted once daily in the form of a two-point calibration.

VIII. Evaluation

VIII.I Identification

The PCB congeners in the sample shall be identified by comparing the retention times of the relevant peaks in the sample gas chromatograms with the reference solutions measured under the same conditions or with those of a gas chromatogram for the sample extract stocked up with the substances being sought. In this context, concurring peaks should, as far as possible, be observed on two capillary columns of differing polarity for the anticipated substance-specific retention times.

If any reliable identification of individual PCBs is not possible with two capillary columns, e.g. in the case of heavily contaminated samples or disturbance through tetrachlorodiphenyl methane, it may be necessary to employ another detection method, e.g. mass spectrometry in the form of GC/MS coupling.

VIII.II Quantification

The identified PCB congeners shall be quantified using the method of the internal standard. The mass concentration β_i of the PCB i in mg/kg in the sewage sludge sample shall be calculated on the basis of the following equation (2):

$$\beta_i = \frac{\frac{y_i}{y_l} - b_{il}}{m_{il}} \cdot \frac{M_l}{E} \qquad (2)$$

Where:
β_i => mass concentration of the PCB congener i being sought in the sewage sludge sample in mg/kg
y_i => value measured for the congener i in the measurement solution; unit dependent on evaluation; e.g. peak
y_I => value measured for internal standard I (decachlorobiphenyl) in the measurement solution; unit dependent on evaluation; e.g. peak
M_I => mass of internal standard added to the sewage sludge sample in µg
E => weighed portion of sewage sludge sample in g
m_{il}, b_{il} refer to equation (1)

IX. Quality assurance and quality control

The reliability of the results of this method must be ensured by employing suitable measures of quality assurance and quality control. Individual measures necessary are, for example, described in:

- American Chemical Society's Committee on Environmental Improvement (1983) (8)
- Erickson (1986) (10)
- Laenderarbeitsgemeinschaft Wasser (Laender Working Group on Water) (1989) (15)

In performing measures of quality control conforming to the above-mentioned references, particular importance must, for example, be attached to:
a) measuring at least one method blank reading for each analysis series,
b) achieving high (> 80%) reproducible recovery rates for the PCB congeners, including the internal standard,
c) monitoring and calibrating the efficiency of the measuring system (GC/ECD) by regularly measuring control standards (e.g. by keeping control cards),
d) documenting all quality control measures in verifiable form and keeping them on record for a prolonged period.

X. Blank readings

At least one method blank reading must be measured per analysis series in order to check the examination method. For this purpose, the entire method is carried out without sample.

In the event of a significant blank reading being obtained, the values for calibration and sample measurement must be corrected if the blank reading cannot be further reduced by optimizing GC separation or by purifying the chemicals and cleaning the equipment.

XI. Specification of results

The results shall be formed as the arithmetic mean from two separate determinations (extractions). In this context, the mass concentrations β_{ij} of the six PCB congeners shall be specified individually in mg/kg sewage sludge sample, rounded to 0.01 mg/kg.

XII. Analysis report

The report is to refer to this method and contain the following details:
a) identity of the sewage sludge sample,
b) information on preliminary sample treatment, storage and preparation,
c) indication of complete mode of procedure (aliquoting, dilution, GC conditions),
d) mode of procedure for identifying and quantifying the individual PCB's,
e) specification of the results in accordance with Section XI,
f) any divergence from the above-mentioned analysis method and indication of all the circumstances that may have influenced the analysis result.

1.3.3.2 Determination of polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDD/ PCDF)

I. Principles

The following method of identification must be applied to the determination, prescribed for precautionary reasons under Section 3, sub-section 6, of selected PCDD and PCDF congeners in sewage sludge.

It represents an analysis concept and is made up in such a way to encompass the necessary and possible elements of an analytical method which, when followed and applied in laboratories experienced in trace analyses, will, in conjunction with the regular implementation of measures of quality assurance and control, provide results of sufficient reliability.

II. Brief description

The freeze-dried sewage sludge sample shall be mixed with ^{13}C-marked PCDD and PCDF standards and extracted with toluene. The added standards and any PCDD/PCDF congeners contained in the sample shall be extensively freed from disturbing companion substances, separated by capillary gas chromatography and then determined using mass spectrometry in accordance with the MID (multiple ion detection) technique, with the quantification process following the isotope dilution method.

III. Equipment and chemicals

All equipment coming into contact with the sample and its solutions/extracts must be free from PCDD and PCDF within the detection limit of the method. All chemicals must exhibit a degree of purity that permit the mass-spectrometric determination of PCDD and PCDF within the detection limit of the method. This must be verified and ensured by means of regular blank tests.

III.I Standard laboratory equipment

III.II Gas chromatograph for capillary chromatography

III.III Mass spectrometer with evaluation unit

III.IV Gas-chromatographic separation columns

- polar columns, e.g. SP 2331 or SP 2330, 60 m
- non-polar column, e.g. DB-5, 25 m

III.V Separation columns/packing materials for multi-phase column chromatography

III.VI Calibration substances

For the quantification to be carried out using the isotope dilution method, use shall be made of a solution of ^{13}C- marked PCDD and PCDF standards each of which contains a PCDD or PCDF isomer respectively per homolog group.

IV. Preparing samples (extraction and enrichment)

The various stages of the multi-stage sample preparation process may altogether differ at the qualified and experienced analyzing bodies. This shall be permissible since the quality assurance and quality control measures accompanying the analysis guarantee the comparability of the results attained at the various analyzing bodies. The following contains an example of a tried and tested mode of procedure that is applied in many research laboratories:

50 g (also less in specific cases) of the freeze-dried and ground sample shall be mixed with the following ^{13}C-marked PCDD's and PCDF's: 5 ng each of 2,3,7,8-tetraCDD, 2,3,7,8-tetraCDF, 1,2,3,7,8-pentaCDD, 1,2,3,7,8-pentaCDF, 1,2,3,6,7,8-hexaCDD and 1,2,3,4,7,8-hexaCDF as well as 10 ng each of 1,2,3,4,6,7,8-heptaCDD, 1,2,3,4,6,7,8-heptaCDF, octaCDD and octaCDF.

The sample shall then be extracted with toluene in the Soxhlet apparatus for 20 h. The toluene extract shall be concentrated to approx. 25 ml. In some cases, it will only be possible to concentrate the extract to about 40 ml since a gelatinous mass will have already been produced.

The extract shall then be diluted in benzene to 100 ml. In those cases in which the extract can only be concentrated to about 40 ml, benzene shall be added until a volume of 200 ml has been attained. The following values specified in parentheses refer to those samples that have been absorbed in 200 ml of benzene. 50 g (or 75 g) of aluminium oxide shall be filled into a chromatographic column (60x4 cm) and covered with a layer of 50 g of sodium sulphate. The extract shall be added onto the column and eluted with 300 ml (or 400 ml) of benzene and 300 ml (or 500 ml) of n-hexane/dichloromethane (98:2). The eluates shall be discarded. The PCDD/PCDF fraction shall then be eluted with 300 ml of n-hexane/dichloromethane (1:1). After changing the solvent to n-hexane, the samples shall be chromatographed on a "mixed" column of silica gel (2 g), silica gel/NaOH (5 g), silica gel (2 g), silica gel /H_2SO_4(10 g), silica gel (2 g) and silica gel/$AgNO_3$ (5 g). 300 ml of n-hexane shall be used for the elution process. The eluate shall be concentrated to approx. 5 ml and then chromatographed on a column (30 x 2.5 cm) filled with S-X3 bio-beads, with cyclohexane/ethyl acetate (1:1) as the eluting agent.

The fraction of 100-160 ml contains the PCDD/PCDF. It shall be concentrated to a few millilitres, transferred to a 3 ml test tube, the solvent shall be blown off in the nitrogen stream and the "residue" absorbed with approx. 50 µl of toluene. After carefully rinsing the wall of the test tube with the solvent, 5 ng of 13C6-1,2,3,4-tetraCDD shall be added and the volume of the sample solution reduced to approx. 20 µl.

V. Gas-chromatographic/mass-spectrometric analysis (GC/MS)

Identification and quantification of the 17 PCDD/PCDF congeners to be used for calculating the TCDD toxicity equivalent shall be performed by means of capillary gas chromatography and mass spectrometric detection. VDI Guideline 3499 (Ref 18) must be applied in performing this step.

VI. Quality assurance and quality control

The following statements shall apply in supplementation or amendment of the statements made in 1.3.3.1/IX.:

a) Level and reproducibility of the recovery rates (RR) of the ^{13}C- marked PCDD/PCDF standards for the selected separation processes must be subject to regular checks, the RR must be > 40 % for OCDD/OCDF, > 70 % for all other congeners.

b) The efficiency of the measuring system (GC/MS) must be checked by means of regular measurements and calibrated (e.g. keeping of control cards).

VII. Specification of results

The results shall be formed as the arithmetic mean from two separate determinations (extractions). In doing so, the mass concentrations of the 17 PCDD/PCDF congeners to be used for calculating the TCDD toxicity equivalent shall be indicated individually in ng/kg of sewage sludge dry matter, rounded to 1 ng/kg. In order to calculate the sum of 2,3,7,8-TCDD toxicity equivalents (TE), the respective mass concentrations shall be multiplied by the following factors and the products obtained in such way will be added to get the summation of TE (as presented in the following example).

2,3,7,8-tetraCDD	1.00
1,2,3,7,8-pentaCDD	0.50
1,2,3,4,7,8-hexaCDD	0.10
1,2,3,6,7,8-hexaCDD	0.10
1,2,3,7,8,9-hexaCDD	0.10
1,2,3,4,6,7,8-heptaCDD	0.01
octaCDD	0.001
2,3,7,8-tetraCDF	0.10
1,2,3,7,8-pentaCDF	0.05
2,3,4,7,8-pentaCDF	0.50
1,2,3,4,7,8-hexaCDF	0.10
1,2,3,6,7,8-hexaCDF	0.10
1,2,3,7,8,9-hexaCDF	0.10
2,3,4,6,7,8-hexaCDF	0.10
1,2,3,4,6,7,8-heptaCDF	0.01
1,2,3,4,7,8,9-heptaCDF	0.01
octaCDF	0.001

Example for calculation of the toxicity equivalents:

Congeners	Factor F	Measured mass concentrations (ng/kg DM) C	Toxicity equivalent (TE) F×C
2,3,7,8-tetraCDD	1.0	0.001	0.001
1,2,3,7,8-pentaCDD	0.5	0.005	0.0025
1,2,3,4,7,8-hexaCDD	0.1	0.003	0.0003
		Sum	**0.0038**

The value gained in this way shall be used for checking the value to be verified under chapter 3.4.3 section 10.

Analysis of Salmonella[17]

For each analysis, 50 g quantity of material, taken from a well-mixed sample (approx. 3 kg) produced from five sub-samples of the finished sludge, compost or fermentation residue, is tested for Salmonellae according to the method described below. The product analysis is considered to have been successful if no Salmonellae can be found in any of the above mentioned samples of 50 g.

The presence of Salmonellae is determined using the suspension solutions produced according to the following method: 50 g of material, taken from a well-mixed sample (approx. 3 kg) are slowly shaken in 450 ml of buffered peptone water at 4°C for over 30 minutes, followed by incubation at 37°C for a period of more than 20 hours. In the next step, two samples, each 0.1 ml of the well mixed pre-enrichment, are incubated in 10 ml of enrichment bouillon according to Rappaport[18] for a period of over 24 hours, one sample at a temperature of 37°C, the other at 43°C. Subsequently, parallel smears are applied on brilliant green-phenol red-saccharose-agar (BPLSA) and xylose-lysin-desoxycholate (XLD) and incubated at a temperature of 37°C for over 24 hours. Any colonies suspected of being infected with Salmonellae are identified using biochemical and serological methods[19]. If these tests are conducted in the laboratory, control samples must be kept available.

For the test method for detecting, enumerating, and determining the viability of Helminth ova in sludge please refer to the publication EPA/625/R-92/013 Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge Revised July 2003.

[17]Adapted from the German Ordinance on the Utilisation of Bio-wastes on Land used for Agricultural, Silvicultural and Horticultural Purposes (Ordinance on Bio-wastes - BioAbfV) 1998.

[18]It is a grow medium for Salmonella. For details please find http://www.merckmillipore.com/DE/en/product/Salmonella-enrichment-broth- acc.-to-RAPPAPORT,MDA_CHEM-110236#overview

[19]Relevant biochemical tests are fermentation of glucose, negative urease reaction, lysine decarboxylase, negative indole test, H2S production, and fermentation of dulcitol. Polyvalent antisera for flagellar (H) and somatic (O) antigens are typically used in serological confirmation tests. Isolates with a typical biochemical profile, which agglutinate with both H and O antisera are identified as Salmonella spp. When results are not conclusive, it can be necessary to perform biochemical tests in addition.

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2 Soil

2.1 Taking and preparing samples

The period after harvesting and before the next time of sewage sludge application must be selected for sampling. One sample that represents the average must be taken from each uniformly farmed piece of land (e.g. plot) covering an area of up to one hectare. On larger pieces of land, samples must be taken from parts of approximately one hectare in size, on land with uniform soil properties and identical form of management from parts of up to three hectares in size. At least 20 penetrations extending down as far as tilling depth shall be necessary for an average sample. The penetrations must be distributed evenly throughout the area.

The average sample shall be dried in the air, if necessary crushed, screened (< 2 mm), mixed and reduced to grain size of 0.1mm. In order to accelerate drying, it shall be permissible to dry the samples in the drying oven at 40°C.

2.2 Performance of analyses

At least two parallel analyses must be conducted for each analysis parameter, with the arithmetic mean of the two values being specified as the result. Equivalent methods shall be permissible.

2.2.1 Determination of heavy metals

The air-dry average sample shall be used for digestion and determination of the heavy metals. The samples shall be digested in accordance with DIN Standard 38414, Part 7 (issued in January 1983) (aqua regia digestion) or comparable standards.

In the case of lead, cadmium, chromium, copper, nickel and zinc the measurements shall be performed in accordance with DIN Standard 38406, Part 22 (issued in March 1988) or comparable standards, for mercury in accordance with DIN Standard 38406, Part 12 (issued in July 1988) or comparable standards.

The results of the heavy metal determinations must be specified in mg per kg of dry matter (105°C).

2.2.2 Determination of plant nutrients

The contents of phosphate, potassium and magnesium available for plants shall be determined in the air-dry sample using the methods customary in agricultural fertilizer counseling.
The results must be specified in milligrams per kilogram of dry matter (105° C).

2.2.3 Determination of the pH value

The pH value must be determined in accordance with DIN Standard 19684/Part 1 (1977) or comparable standards. Before each further sludge application, the pH value may be measured by means of a mobile method. Compared with the DIN method the difference in accuracy may account for a maximum of 0.2 pH units.

2.2.4 Determination of the clay content

The clay content shall be determined in accordance with DIN Standard 18123 (1983) or comparable standards.

3 Exceeding the limit values

Any of the contents permissible under Chapter 3.4.3. sub-sections 8,10, 11 and 12 shall be deemed to have been exceeded if the contents determined for
– the relevant heavy metals are more than 5%
– the relevant PCB congener are more than 25%
– halogen organic compounds (AOX) are more than 10%
– TCDD toxicity equivalents are more than 25% higher than the relevant limit values

4 Quality assurance and control

The analyzing bodies shall undertake to ensure the reliability of the analysis results by

taking suitable measures of quality assurance and quality control. Refer, for example, to AQS - Analytical quality assurance. General recommendations of the Laender Working Group on Water for water, wastewater and sludge analysis. Published by: LAWA, E. Schmidt Verlag, Berlin 1989. This shall, for example, involve the successful participation in inter-laboratory tests.

Table 1 Methods of analyzing sewage sludge

No.	Parameter	Analysis method(s)	Matrix/sample preparation
1	pH value	DIN 38414, Part 5 (issued September 1981) or other recognized comparable standards	Original sample
2	Dry residue	DIN 38414, Part 2 (issued November 1985) or other recognized comparable standards	Original sample
3	Ignition loss (organic substance)	DIN 38414, Part 3 (issued November 1985) or other recognized comparable standards	Dry residue
4	Total nitrogen	DIN 19684, Part 4 (issued February 1977) (distillation method) or other recognized comparable standards	Original sample
5	Ammonia	DIN 38406, Part 5 (issued October 1983) or other recognized comparable standards	Original sample nitrogen
6	Lead	DIN 38406, Part 6 (issued May 1981) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
7	Cadmium	DIN 38406, Part 19 (issued July 1980) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
8	Calcium	DIN 38406, Part 3 (issued September 1982) DIN 38406,Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
9	Chromium	DIN 38406, Part 10 (issued June 1985) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
10	Potassium	DEV method E 13 (5th delivery 1968) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
11	Copper	DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[20]

[20]Of the dry residue according to DIN 38414, Part 7 (issued January 1983)

12	Magnesium	DIN 38406, Part 3 (issued September 1982) or other recognized comparable standards	Aqua regia digestion[19]
13	Nickel	DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
14	Phosphorus	DIN 38414, Part 12 (issued November 1986) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
15	Mercury	DIN 38406, Part 12 (issued July 1988) or other recognized comparable standards	Aqua regia digestion[19]
16	Zinc	DIN 38406, Part 8 (issued October 1980) DIN 38406, Part 22 (issued March 1988) or other recognized comparable standards	Aqua regia digestion[19]
17	Abdsorbed, organically bound halogens (AOX)	DIN 38414, Part 18 (issued November 1989) or other recognized comparable standards	Dry residue

ANNEX 6: STANDARD FORMS FOR DOCUMENTATION OF AGRICULTURAL USE OF SLUDGE

Wastewater Treatment Plant

Name and address of the operator

_____

_____

_____

Place:

Date:

Tel.:

Fax:

Delivery Note

According to the Sludge standards and guidelines

This delivery note must be preserved by the operator of the wastewater treatment plant for a period of 30 years.

Name and address of the user:

_____

_____

In the month(s) of …… 20…… we shall be

- o surrendering
- o applying
- o instructing _____ to deliver/apply

(Name & address of the authorized third party)

_____ m^3 of sewage sludge with a dry substance content of _____% (this corresponds to a volume of _____t of dry matter) at Daag no._____, district of_____, size _____ (katha/bigha/acre).

Present soil use: _____

The soil analysis dated _____ (Analysis no.: _____)

- o showed that the permissible contents of heavy metals were not exceeded.
- o showed that the permissible contents of heavy metals were partially exceeded.

The sewage sludge has been treated as follows:

- o Biologically
- o Chemically
- o Thermally
- o Been in long term storage
- o Decontaminated
- o Other treatment

The sewage sludge analysis dated _____ (Analysis no.: _____)

- o showed that the permissible pollutant contents were not exceeded.
- o showed that the permissible pollutant contents were partially exceeded.

The soil-/sewage sludge analyses produced the following results:

1) Soil:

pH value _____

Soil type _____

The soil on average contains:

	mg/100 g dry matter
Phosphate (P_2O_5)	
Potassium oxide (K_2O)	
Magnesium (Mg)	

	Limit value	mg/kg dry matter
Lead	100	
Cadmium	1.5	
Chromium	100	
Copper	60	
Nickel	50	
Mercury	1	
Zinc	200	

2) Sewage sludge:

The sewage sludge has the following pH value:_____

The sewage sludge on average contains:

	a) Nutrient contents in the fresh substance in %	b) Nutrient contents in the dry substance in %
Organic matter (OM)		
Total nitrogen (N)		
Ammonia nitrogen (NH_4-N)		
Phosphate (P_2O_5)		
Potassium oxide (K_2O)		
Calcium oxide (CaO)		
Magnesium oxide (MgO)		

Limit values in accordance with chapter 3.4.3 of the Guideline

	Limit value	mg/kg sludge dry matter
Lead	900	
Cadmium	10	
Chromium	900	
Copper	800	
Nickel	200	
Mercury	8	
Zinc	2500	
Arsenic	40	

Polychlorinated biphenyls (PCB[21]) for No.	Limit value	mg/kg sludge dry matter
28	0.2 mg PCB/kg sludge dry matter for per component	
52		
101		
138		
153		
180		

PCDD, PCDF[22]	Limit value	ng TE/kg sludge dry matter
	100	

Confirmation is hereby given that the above-specified sludge from our wastewater treatment plant may be utilized in accordance with the document issued by the Department of Environment dated ……. and in accordance with the guideline introduced by the responsible land authority relating to the utilization of sewage sludge in agriculture dated ……. …….

_____

(Signature of the operator of the wastewater treatment plant)

[21]Systematic numbering of the PCB components in accordance with the rules of the International Union for Pure and Applied Chemistry (IUPAC).

[22]According to the calculation prescribed in Annex 5 of the Guidelines for sludge management.

Confirmation of Surrender according to the Sludge standards and guidelines

Today, we have surrendered _____m^3 of sewage sludge with a dry substance content of _____%, this corresponding to_____t dry matter, in accordance with the above specifications.

(Signature of the operator of the wastewater treatment plant)

Confirmation of sewage sludge application according to the Sludge standards and guidelines

Today, I have applied the above-specified sewage sludge which was surrendered to me by _____ (holder of the sludge) on _____ (Date). The application volume permissible under chapter 3.4.4 of the Sludge standards and guidelines is not exceeded.

(Signature of the recipient)

ANNEX 7: LIST OF BIOWASTE/ORGANIC AND MINERAL AGGREGATES GENERALLY SUITABLE FOR UTILIZATION ON LAND

List of the types of bio-waste / organic waste generally suitable for utilization on land and of generally suitable mineral aggregates

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	**Types of waste suitable for utilization from the waste designations listed in column 1**	**Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)**
plant-tissue waste (02 01 03)	–Husk, husk and cereal dust –Waste feeding stuffs	These materials may be applied on permanent grassland, including as a component of a mixture.
animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site (02 01 06)	–Poultry droppings –Pig and cattle slurry –Manure –Old straw	Infectious manure is generally excluded from utilization. These materials may be applied on permanent grassland, including as a component of a mixture.
Waste from forestry exploitation (02 01 07)	–Barks –Wood, wood residues	Natural barks and unmixed products for further processing made from barks are exempted from treatment and testing requirements pursuant to Articles 3 and 4. If shredded properly, natural bark, wood or wood residues may be added to materials for composting and also to those types of bio-waste which are applied on permanent grassland.
Wastes not otherwise specified (02 01 99)	– Fungus substrate residue	Spent substrates from commercial mushroom cultivation. Cultures killed off by steam pasteurization.

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	**Types of waste suitable for utilization from the waste designations listed in column 1**	**Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)**
animal-tissue waste (02 02 02)	– Bristle and horn wastes	Including cattle hair from hair-preserving liming process.
Materials unsuitable for consumption or processing (02 02 03)	– Waste fat	(Processing of meat and fish) Waste fats may only be used in installations for anaerobic treatment. These materials, even as a component of a mixture, may be applied on permanent grassland only after being pasteurized (70°C; at least one hour).
Sludge from on-site effluent treatment (02 02 04)	– Content of fat separators and ` flotation agents	(Processing of meat and fish) Possible sources: slaughter-houses and meat processing plants; unmixed with other effluents. The content of fat separators and flotation agents may only be used in installations for anaerobic treatment. These materials, even as a component of a mixture, may be applied on permanent grassland only after being pasteurized (70°C; at least one hour).
Wastes not otherwise specified (02 02 99)	–Sludge from gelatin production –Gelatin stampings –Feathers –Contents of stomach and intestines	Sludge may be utilized only if unmixed with effluents or sludge from other sources.
sludge from washing, cleaning peeling, centrifuging and separation (02 03 01)	–Other sludge-like food waste –Starch sludge	(Food processing) To be utilized only if unmixed with effluents or sludge from other sources. These materials may be applied on permanent grassland, including as a component of a mixture.

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	**Types of waste suitable for utilization from the waste designations listed in column 1**	**Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)**
materials unsuitable for consumption or processing (02 03 04)	–Foodstuffs stored for too long –Residues from tinning processes –Semi-luxury foodstuffs stored for too long –Tobacco dust, veins and sludge –Defective cigarette batches –Residues from processing of coffee, tea and cocoa –Oilseed residues	(Food processing)
Wastes not otherwise specified (02 03 99)	–Sludge from production of edible fats –Sludge from production of edible oils –Bleaching earth, de-oiled –Seasonings residues –Molasses residues –Residues from production of potato, corn or rice starch	(Food processing) Sludge from production of edible fats and oils, molasses residues, as well as residues from production of potato, corn or rice starch, may be applied on permanent grassland, including as a component of a mixture.
Materials unsuitable for consumption or processing (02 05 01)	– Foodstuffs stored for too long	(Milk processing) These materials may be applied on permanent grassland, including as a component of a mixture.
Wastes not otherwise specified (02 05 99)	– Whey	(Wastes from milk processing) These materials may be applied on permanent grassland, including as a component of a mixture.
Materials unsuitable for consumption or processing (02 06 01)	–Foodstuffs stored for too long –Waste dough	(Bakery and confectionery products)

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	**Types of waste suitable for utilization from the waste designations listed in column 1**	**Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)**
Wastes from washing, cleaning and mechanical reduction of raw materials (02 07 01)	– Spent filter and absorbing mass (diatomaceous earth), active earths, active carbon	(Production of alcoholic and non-alcoholic beverages) Diatomaceous earths must not be applied when dried. They must be incorporated in the soil immediately after application.
wastes from spirits distillation (02 07 02)	–Spent grains, fruit and potato pulp –Sludge from distilleries (spirits distilleries)	These materials may be applied on permanent grassland, including as a component of a mixture.
Materials unsuitable for consumption or processing (02 07 04)		(Drinks manufacturing) e.g. fruit juice stored for too long. These materials may be applied on permanent grassland, including as a component of a mixture.
Sludge from on-site effluent treatment (02 03 05, 02 04 03, 02 05 02,02 06 03, 02 07 05)		(Production of foodstuffs and semi-luxury goods) To be utilized only if there has been no mixing with effluents or sludge outside the specific production process are not violated. These materials may be applied on permanent grassland, including as a component of a mixture.
Wastes not otherwise specified (02 07 99)	–Malt husks, malt sprouts, malt dust –Spent hops –Lees and sludge from breweries –Sludge from wine making –Pomace and wine marc –Yeast and yeast-like residues	(Production of alcoholic and non-alcoholic beverages) These materials, with the exception of pomace, may be applied on permanent grassland, including as a component of a mixture.

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	Types of waste suitable for utilization from the waste designations listed in column 1	Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)
waste bark and cork (03 01 01) waste bark and wood (03 03 01)	– Bark	(Wood-working and wood processing) Barks from roadside trees and shrubs may be utilized only if tests have shown that the heavy metal concentrations referred to in this document are not exceeded. Natural, untreated materials may be applied on permanent grassland, including as a component of a mixture.
sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04 (03 01 05)	–Sawdust –Wood wool	(Wood-working and wood processing, pulp production and manufacture of furniture) Only sawdust and wood wool from untreated wood. Saw-dust from natural, untreated wood from the wood processing industry may, in a composting process, be added to those bio-wastes which are applied on permanent grassland.
wastes from unprocessed textile fibres (04 02 21)	–Cellulose fibre wastes –Vegetable fibre wastes –Wool waste	(Textile industry) Shoddy, short wool fibres.
solid wastes other than those mentioned in 07 05 13 (07 05 14)	–Pomace from medicinal plants –Mycelium –Fungus substrate residue –Waste proteins	Mycelium from the pharmaceutical industry may be utilized only after an individual examination and if it does not contain any residues of medicinal products
solid waste from primary filtration and screenings (19 09 01)	– Waste catch, mowings and rakings	(Drinking water preparation, water management) Only mowing are suitable for utilization.

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	Types of waste suitable for utilization from the waste designations listed in column 1	Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)
Paper and cardboard (20 01 01)	– Waste paper	Only small quantities (approx. 10 %) may be added to separately collected bio-wastes or for the composting thereof. High-gloss paper and waste wallpaper must not be added to separately collected bio-wastes or for the treatment thereof.
biodegradable kitchen and canteen waste (20 01 08)	– Kitchen waste from canteens and restaurants	In the case of wastes from canteens and large-scale catering facilities. These materials, even as a component of a mixture, may be applied on permanent grassland only after being pasteurized (70°C; at least one hour).
edible oil and fat (20 01 25)		These materials may only be used in installations for anaerobic treatment. These materials, even as a component of a mixture, may be applied on permanent grassland only after being pasteurized (70°C; at least one hour).

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	Types of waste suitable for utilization from the waste designations listed in column 1	Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)
biodegradable waste (20 02 01)	– Garden and park wastes, landscape gardening wastes, residues from copse clearing, vegetable components of driftings	Pursuant to Article 10, materials collected separately, with the exception of tree and shrub prunings from the roadside (roadside greenery) or from industrial sites, are exempted from the treatment and testing requirements set out in Articles 3 and 4. Tree and shrub prunings from the roadside or from industrial sites as well as vegetable components of driftings may be utilized only if tests have proved that the heavy metal concentrations referred to in this document are not exceeded. These materials may be applied on permanent grassland, including as a component of a mixture.
Mixed municipal waste (20 03 01)	– Waste from households (only separately collected bio-wastes)	(Municipal waste) In particular, separately collected bio-wastes from private households and small businesses.
Waste from markets (20 03 02)	– Waste from markets	Only the separately collected, biodegradable fraction is suitable for utilization. Materials of vegetable origin collected separately may be applied on permanent grassland, including as a component of a mixture.
"waste not defined by a specific waste code"	– Mud and healing earths	These materials may be applied on permanent grassland, including as a component of a mixture.
"waste not defined by a specific waste code"	–Biodegradable product from regenerative raw materials as well as wastes from their processing	Degradability must be demonstrated in accordance with the provisions of a relevant technical standard.
"waste not defined by a specific waste code"	– Egg shells	

Waste designated according to Annex 2B List of Waste Processes (in brackets: code of waste)	**Types of waste suitable for utilization from the waste designations listed in column 1**	**Additional information (if necessary, the origin of the waste is specified in brackets at the beginning)**
Mineral aggregates (in case of wastes, specify EWC code of waste)		
Off-specification calcium carbonate (02 04 02)	– Carbonation sludge	(Sugar beet processing) These materials may also be added to bio-wastes which are to be applied on permanent grassland.
Sludge from decarbonation (19 09 03)	– Sludge from water softening	(Water treatment) These materials may also be added to bio-wastes which are to be applied on permanent grassland.
"waste/substances not defined by a specific waste code"	–Lime –Bentonite –Stone dust, sand –Clay	These materials may also be added to bio-wastes which are to be applied on permanent grassland.

ANNEX 8: STANDARD FORM FOR DOCUMENTATION OF TREATMENT OR DISPOSAL OF SLUDGE NOT APPLIED IN AGRICULTURE

WasteWater Treatment Plant

Name and address of the operator Place:

_____ Date

_____ Tel.

_____ Fax:

Delivery Note

According to the Sludge standards and guidelines

This delivery note must be preserved by the operator of the wastewater treatment plant for a period of 30 years.

Name and address of the user:

_____

_____

In the month(s) of …… 20…… we shall be

- o treating
- o disposing
- o instructing _____ to deliver _____ m^3
  (Name and address of the authorized third party)

of sewage sludge with a dry substance content of _____ % (this corresponds to a volume of _____ t of dry matter) at:

Name and address of the operator of the treatment plant or disposal facility

_____

Date _____

Tel. _____

Fax: _____

The sludge management plan was approved of by the DoE on the _____(date)

Confirmation is hereby given that the above-specified sludge from our wastewater treatment plant may be utilized in accordance with the document issued by the Department of Environment dated _____

(Signature of the operator of the wastewater treatment plant)

Confirmation of Surrender according to the Sludge standards and guidelines

Today, we have surrendered _____ m^3 of sewage sludge with a dry substance content of _____ %, this corresponding to_____ t dry matter, in accordance with the above specifications.

(Signature of the operator of the wastewater treatment plant)

Confirmation of sewage sludge application according the Sludge standards and guidelines

Today, I have applied the above-specified sewage sludge which was surrendered to me by _____ (holder of the sludge) on _____(Date). The application volume permissible under chapter 3.4.4 of the Sludge standards and guidelines is not exceeded.

(Signature of the recipient)

LITERATURE

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Department of Environment

Poribesh Bhaban
E/16 Agargaon, Sher-e-Bangla Nagar
Dhaka 1207, Bangladesh
www.doe.gov.bd

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