



European Commission

Disposal and recycling routes for sewage sludge

Part 2 – Regulatory report

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Luxembourg: Office for Official Publications of the European Communities, 2001

ISBN 92-894-1799-4

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Environment

Disposal and recycling routes for sewage sludge

Part 2 - Regulatory report

October 2001



European Commission
DG Environment

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1. Executive summary and main conclusions

The analysis of the existing legislation related to sludge treatment, disposal and recycling carried out in this study shows that specific legal requirements focus principally on the use of sludge in agriculture, both at national and European level. For the moment, other uses or disposal routes for sludge generally fall under more general laws on waste and water management.

Similarly, although several Directives have an influence on sludge management (such as Directive 1999/31/EEC on the landfill of waste), the ones which have the strongest impact on sludge production, disposal and recycling, are Directives 91/271/EEC concerning urban waste water treatment and 86/278/EEC on the use of sludge in agriculture. In particular, requirements set by Directive 86/278/EEC are a crucial element in the management of sludge currently produced in the Member States. One of the aims of this study is therefore to compare these requirements with provisions adopted at national level and to identify the main differences.

The most significant result of this survey is the fact that national regulations, which have been established on the basis of Directive 86/278/EEC, have often introduced provisions which go beyond the requirements of the Directive.

In particular, the limit values for concentrations of heavy metals in sludge are lower than the limit values specified in the Directive in a majority of countries. In five countries (Belgium -Flanders-, Denmark, Finland, the Netherlands and Sweden), the limit values for heavy metals in sludge are even much lower. However, six Member States (Greece, Ireland, Italy, Luxembourg, Portugal and Spain) have implemented limit values, which are identical to those specified in Annex IB of Directive 86/278/EEC.

The perspective of the revision of Directive 86/278/EEC, which could lead to the implementation of more stringent limit values for heavy metals in sludge, could therefore have an impact in the latter countries, at least on the provisions to be set by national regulations (average heavy metals content in sludge is in most cases well below regulatory requirements).

In addition, the regulations on sludge use include limit values for pathogens in France, Italy and Luxembourg and in a larger number of cases for organic compounds (Austria, Belgium -Flanders-, Denmark, France, Germany and Sweden), both of which are not included in the Directive.

Concerning Accession countries, regulations in Estonia, Latvia, and Poland are comparable or even more stringent than the Directive's current requirements on limit values for heavy metals. In the other Accession countries, sludge use and disposal usually falls under more general laws on waste or on environmental protection.

For the moment, national legislations have not introduced major changes as regards the other requirements included in Directive 86/278/EEC on sludge use:

- concerning the type of sludge covered, the sludge regulations in Belgium, Denmark, Italy, and the Netherlands explicitly apply both to urban sewage sludge and to industrial sludge, while in France, a specific Order applies to industrial sludge spread on land;
- in terms of obligations for treatment, France, Ireland, Luxembourg, and Sweden permit the use of untreated sludge under certain conditions, while Denmark, Finland, Germany, Italy, the Netherlands and Spain have prohibited the use of untreated sludge. In other countries, there is no specific legal requirement on this aspect;
- concerning information requirements, no major changes have been implemented in national regulations, although Danish regulation requires analysis of organic compounds content at least once a year. For the moment, no certification of products or services is mentioned in existing national regulations.

It should however be noted that the two voluntary agreements which have been signed on the use of sludge in agriculture (Sweden in 1994 and the UK in 1998) include requirements for use of sludge in agriculture which are more stringent than those contained in national regulations, either in terms of limit values for pollutants in sludge or in terms of treatment requirements.

The analysis of the requirements contained in national regulations enables us to roughly classify groups of countries by the severity of existing legislation, taking Directive 86/278/EEC as a reference. These groups of countries are as follows:

National requirements compared to EU requirements

Much more stringent	Denmark, Finland, Sweden, Netherlands
More stringent	Austria, Belgium, France, Germany (Poland)
Similar	Greece, Ireland, Italy, Luxembourg, Portugal, Spain, United Kingdom. (Estonia, Latvia)

The review of relevant legislation reveals that very few elements in the regulations specifically address the use of sludge in routes other than the recycling in agriculture (use in silviculture, on natural forest, green areas, and in land reclamation). However, use of sludge on forest soil is mentioned by the regulation on sludge use in Belgium-Flanders, Denmark, France, and Luxembourg. In addition, some national regulations have prohibited the use of sludge on silviculture (Germany, the Netherlands) on natural forest (Walloon region, Germany), and in green areas (Germany, the Netherlands). Significantly, the regulation in Poland includes limit values for heavy metals concentrations in sludge for use in land reclamation and on "non-agricultural soil".

Similarly, incineration or disposal to landfill of sludge is usually covered by general waste regulations on incineration or on landfill and not by specific provisions in national "sludge" regulations.

2. Introduction

2.1 Objectives of the sub-component report

This report aims to:

- review the existing legislation related to sludge disposal and recycling routes, both at national and EU level;
- carry out a comparative analysis between EU legislation and national legislation, and thus to identify the main gaps between EU legislation and national legislation.

2.2 Scope of the sub-component report

The scope of this report concerns existing legislation relating to disposal and recycling routes for sludge, defined as both urban sewage sludge and industrial sludge, although main focus is on the use of sludge in agriculture, silviculture, and land reclamation, and on sludge that is produced from the treatment of urban waste water.

In the majority of Member States, the specific regulations which have been introduced covering the disposal and recycling of sludge mainly concern the use of sludge in agriculture, while the disposal of sludge is addressed by general legislation on landfill and incineration of waste. In the same way, these regulations mostly focus on urban sludge, as landspreading of industrial sludge is covered in the majority of countries by the regulations on the use of waste on land or on waste management. Therefore, this report does not aim to provide a comprehensive description of all national legislation covering waste management, but rather aims to identify the legal requirements which apply when urban or industrial sludge is recycled or disposed of.

The geographical scope of this report, as defined by the Terms of Reference of the study, includes both the 15 Member States and the Accession countries, with a major emphasis on the Member States.

3. Review of existing legislation at EU level

3.1 Review of legislation related to treatment, disposal and recycling of sewage sludge at EU level

The legal framework established by the European Commission and regulating the various sludge routes is mainly composed of Directives which have to be transposed into national legislation by Member States. These Directives are listed in Appendix 1. The ones most relevant to sludge management are the following:

- The Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture. This Directive sets minimum quality standards for the soil and sludge used in agriculture, and defines monitoring requirements when sludge is spread on agricultural land. The limit values defined in this Directive concern heavy metals concentration for sewage sludge as well as for soil when sewage sludge is used on land and maximum annual heavy metals loads through the application of sewage sludge. A more detailed analysis of the provisions of this Directive is provided in Section 4.
- The Waste Framework Directive (91/156/EEC amending 75/442/EEC on waste) confirms the waste management hierarchy already outlined in the Communication on Community strategy for waste management. According to this hierarchy preference has to be given to waste prevention followed by waste reduction, re-use, recycling, energy recovery. This Directive establishes principles for the use and disposal of waste, waste management plans, approval procedures and monitoring. In addition, this Directive provides the definition for the term "waste". A list of the different type of waste is provided by the recent Commission Decision 2001/118/EC which amends Decision 2000/532/EC. Directives specific to certain wastes (e.g. sludge) are applied additionally to the Waste Framework Directive.
- The Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC), known as the Urban Waste Water Treatment Directive, is aimed at protecting the environment from the adverse effects of waste water discharges. This Directive sets minimum sewage treatment standards to be achieved in stages by the end of 2005, and provides for advanced waste water treatment for the removal of nitrogen and phosphorus from sensitive areas. Sensitive areas are defined as: areas particularly susceptible to eutrophication, surface waters intended for the abstraction of drinking water with high nitrate levels, and other waters that require a higher standard of treatment to satisfy the requirements of other Directives. The Directive 91/271/EEC supports the use of sewage sludge in article 14: *"sludge arising from waste water treatment shall be re-used whenever appropriate. Disposal routes shall minimise the adverse effects on the environment"*. The same article also prohibits the disposal of sludge to surface waters since 31/12/1998, and specifies that from 31/12/1998 onwards, the disposal of sludge from urban waste water treatment plants is subject to general rules, registration or authorisation. In addition, this Directive introduces detailed monitoring requirements and requires Member States to submit reports every two years on their sludge disposal activities.
- The Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, known as the nitrates Directive, requires identification by Member States of Nitrates Vulnerable Zones (NVZ). These zones are defined as areas where water quality has or will exceed EC drinking water standard in terms of nitrates concentration (defined in Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in Member States).

In addition to these Directives the Commission Decision 98/488/EC, establishing the ecological criteria for the award of the Community eco-label to soil improvers, specifies that these products must not contain sewage sludge.

Some other Directives related to waste management have also implications on sludge management. The Directive on the landfill of waste 1999/31/EC will contribute to making disposal of sludge to landfill more difficult, as this Directive aims at reducing the quantity of biodegradable waste going to landfills, and prohibits the landfilling of both liquid and untreated wastes. In addition, Directive on the Incineration of Waste 2000/76/EC sets limit values for emissions of pollutants to air due to waste incineration.

3.2 Progress of work carried out by CEN/TC 308 on the characterisation of sewage sludge

In addition to the legal framework, the ISO and CEN committees establish international standards and set out recommendations on sludge management. In particular, CEN/TC 308 on characterisation of sludge has published or is in the process of producing reports and standards on:

- good practices for the use and disposal of sludge (use of sludge in agriculture, land reclamation, landfill of sludge, incineration of sludge),
- the standard vocabulary,
- the determination of the various elements in sludge (phosphorus, nitrogen, organic compounds, pathogens).

In particular, CEN has recently published a report on *"Characterisation of sludges - Guide to preserve and extend sludge utilisation and disposal routes"* (CR 13846).

The standards which have been published by CEN concerning characterisation of sludge are the following:

- *Water quality - Sampling - Part 13: Guidance on sampling of sewage, waterworks and related sludges* (EN/ISO 5667-13) ;
- *Characterisation of sludge - Determination of pH-value of sludges* (EN 12176) ;
- *Characteristics of sludges - Utilisation and disposal of sludges - Vocabulary* (EN 12832).
- *Characterization of sludges - Aqua regia extraction methods - Determination of trace elements and phosphorus* (EN 13346) ;
- *Characterization of sludges - Determination of the loss on ignition of dry mass* (EN 12879) ;
- *Characterization of sludges - Determination of dry residue and water content* (EN 12880) ;
- *Characterization of sludges - Determination of Kjeldhal nitrogen* (EN 13342) ;

Other reports on these aspects which should be published by CEN in the near future are listed in appendix 3.

4. Comparative survey of existing legislation

4.1 Competence and legal structure

4.1.1 Competence

The information collected shows that in most cases, central government is responsible for developing policy and establishing legal requirements concerning sludge management. Regional or local authorities often have controlling or supervisory functions. In several cases, other bodies have controlling powers (e.g. the Danish Plant Directorate).

In the other cases, which in general correspond to countries with a federal structure, the regions have competence for sludge management policy. This is the case in particular for Austria, in which there is no federal legislation for sludge, the Directive 86/278/EEC having been implemented directly by the *Länder*¹. In Germany, the federal government is responsible for framework regulations on environmental issues, which are then transposed and implemented at *Länder* level. This is also the case for Spain, where the regions have full regulatory powers (and are also responsible for controlling sludge quality), within the framework of the Royal Decree 1310/90 which was then implemented by the regions. In these countries, regional regulations are usually more stringent and more detailed than federal legislation on sludge.

4.1.2 Legal structure

A majority of countries included in the scope of this study have established regulations which are specific to the use of sewage sludge in agriculture. This is especially the case for the Member States, as only three Accession countries have incorporated a specific regulation on sludge into their legislation: Latvia, Estonia and Poland. In the other countries, sludge use and disposal usually falls under more general laws on waste or environmental protection.

Concerning the transposition of Directives 86/278/EEC and 91/271/EEC which are the most relevant to sludge management it has to be noted that:

- In most cases, Council Directive 86/278/EEC was adopted by Member States between 1988 and 1993. This transposition into national legislation was carried out without any major difficulty². It should be noted that in the case of France, the initial transposition of Directive 86/278/EEC was considered insufficient by the Commission in 1995 (the Enforcement Order of August 29, 1988, making the AFNOR NFU 44-041 standard compulsory). Therefore, France has adopted both the Decree of December 8, 1997 and the Enforcement Order of January 8, 1998 which completed the transposition of Directive 86/278/EEC. Appendix 2 provides an overview of the national regulations implementing Directive 86/278/EEC.
- Concerning Directive 91/271/EEC on urban waste water treatment, the Member States had to bring into force the regulations necessary to comply with the Directive by June 30, 1993. At the time of the publication of the *Report from the Commission on the Implementation of Council Directive 91/271/EEC*, in 1999, Italy still had not transposed this Directive, while transposition had not met the required EU standards in the case of Greece and Austria. However, in Italy, the Decree 152/99 of 11 May 1999 has given effect to Directive 91/271/EEC.

¹ Although regulations on sewage sludge have not yet been established by all *Länder*. Therefore the Commission has sent a Reasoned Opinion (second written warning) to Austria on 6 April 2000

² For more details, see the Report from the Commission to the Council and the European Parliament on the implementation of Community waste legislation for the period 1995 – 1997, COM(1999) 752 final

4.2 Types of sludge covered by legislation in the Member States (compared to EU requirements)

The aim of this section is to assess whether the scope of national regulations is wider than that defined for Directive 86/278/EEC, in terms of the sludge types covered.

Directive 86/278/EEC was adopted in order to "*regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil, vegetation, animals and man, [...]³*". The term "sludge" is defined⁴ as:

- (i) residual sludge from sewage plants treating domestic or urban waste waters and from other sewage plants treating waste waters of composition similar to domestic and urban waste waters;
- (ii) residual sludge from septic tanks and other similar installations for the treatment of sewage;
- (iii) residual sludge from sewage plants other than those referred in (i) and (ii) provided that its use is regulated by the Member State concerned⁵.

Most Member States have transposed these specifications into their national legislation on sludge. However, the sludge regulations in Belgium, Denmark, Italy, and the Netherlands apply to the use in agriculture of both urban sewage sludge and industrial sludge:

- In Belgium, the Walloon Government Order of 12 April 1995 covers residual sludge originating from domestic and industrial waste water treatment plants. In Flanders, the Decree of 16 April 1998 covers the landspreading of both industrial waste and urban sewage sludge.
- In the case of Denmark, the Order No. 49 of January 20, 2000 on the *Application of Waste Products for Agricultural Purposes* applies to the landspreading of industrial and municipal waste (and sludge).
- In Italy, the Decree 99/92 defines sludge as residues from the treatment of urban waste waters and of industrial waste waters. The Decree applies both to urban sewage sludge and to industrial sludge of similar characteristics.
- The Dutch regulation (Decree of 20 November 1991) defines sludge as "*sludge wholly or mainly from sewage plants treating domestic, urban, industrial or other waste waters of a composition similar to domestic, urban and industrial waters*". Thus, the Dutch legislation on sludge applies to industrial sludge as well as to urban sewage sludge.

The scope of national regulations on sludge is in most cases very similar to the definitions provided in the Directive. Thus, very few specific provisions for sludge from septic tanks are included in national regulations. Requirements for sludge from specific industrial sectors are not mentioned in general. Landspreading of industrial sludge is in fact covered in the majority of countries by regulations on the use of waste on land or on waste management. Nevertheless the Danish regulation (Statutory Order No. 2000/49) specifies treatments and possible uses for several types of industrial sludge. In France, specific provisions on landspreading of industrial waste or sludge are provided in the Order of August 17, 1998. This Order sets requirements similar to those set by the Order of January 8, 1998 on landspreading of urban sewage sludge, but also prohibits landspreading of certain types of abattoir sludge. In addition, the same Order states that only waste products likely to be of positive or nutritive effect for the crops can be used in agriculture.

It is also important to note that in the United Kingdom, several types of industrial sludge, applied to agricultural land, are exempt from licensing under waste regulations to permit the beneficial recovery of certain wastes. These industrial sludges are defined in the *Waste Management Licensing Regulations* (WMLR) 1994, as follows: waste food, drink or materials used in or resulting from the preparation of food or drink, blood and guts contents from abattoirs, lime sludge from cement manufacture or gas processing, paper waste sludge, and effluent treatment sludge from tanneries.

³ Article 1

⁴ Article 2

⁵ Article 3

4.3 Specific requirements for the use of sludge in agriculture

4.3.1 Limit values for heavy metals in sludge

In accordance with Directive 86/278/EEC, national legislation which has been established in the Member States prohibits the use of sludge in agriculture if the heavy metals concentrations exceed specific limit values. Moreover, the Directive specifies that sludge may not be used on land when the soil concentration exceeds the limit values set out in the same Directive and that Member States have to ensure that the limit values are not exceeded as a result of the use of sludge⁶. In order to comply with this requirement, Directive 86/278/EEC allows the Member States to choose between:

- limit values for heavy metals in sludge in accordance with Annex I B together with a limit for quantities if sludge is to be applied on land⁷;
- and limit values for the quantities of metals introduced in the soil as a 10-year mean value in accordance with Annex I C⁸.

Several Member States have chosen to establish limit values for heavy metals in sludge *and* for maximum annual average loads of heavy metals (Finland, France, Luxembourg, Netherlands, Sweden, as well as Belgium –Flanders- and three Austrian *Länder*). In fact, the United Kingdom is the only Member State in which regulations on the use of sludge do not specify limit values for heavy metals in sludge, but define limit values for quantities of metals introduced in the soil, in accordance with Article 5, paragraph 2(b) of Directive 86/278/EEC. The limit values for heavy metals in sludge which are defined in national regulations are presented below in table 1. In most cases, these limit values have been set significantly below the requirements of Directive 86/278/EEC (these limit values are highlighted in shaded cells in Table 1).

⁶ Article 5

⁷ Article 5, paragraph 2a

⁸ Article 5, paragraph 2b

Table 1: Limit values for heavy metals in sludge (mg/kg DM)
(shaded cells represent limit values below those required by Directive 86/278/EEC)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn	As	Mo	Co
Directive 86/278/EEC	20 - 40	-	1000 - 1750	16 - 25	300 - 400	750 - 1200	2500 - 4000	-	-	-
Austria	2 ^a 10 ^b 10 ^c 4 ^d 10 ^e 0,7 - 2,5 ^f	50 ^a 500 ^b 500 ^c 300 ^d 500 ^e 70 - 100 ^f	300 ^a 500 ^b 500 ^c 500 ^d 500 ^e 70 - 300 ^f	2 ^a 10 ^b 10 ^c 4 ^d 10 ^e 0,4 - 2,5 ^f	25 ^a 100 ^b 100 ^c 100 ^d 100 ^e 25 - 80 ^f	100 ^a 400 ^b 500 ^c 150 ^d 500 ^e 45 - 150 ^f	1500 ^a 2000 ^b 2000 ^c 1800 ^d 2000 ^e 200 - 1800 ^f			10 ^a 100 ^e
Belgium (Flanders)	6	250	375 ^f	5	100	300	900 ^f	150	-	-
Belgium (Walloon)	10	500	600	10	100	500	2000		-	-
Denmark - dry matter basis - total phosphorus basis	0,8 100	100	1000	0,8 200	30 2500	120 ^g 10 000 ^g	4000	25 ^h	-	-
Finland	3 1,5 ⁱ	300	600	2 1 ⁱ	100	150 100 ⁱ	1500	-	-	-
France	20 ^j	1000	1000	10	200	800	3000	-	-	-
Germany	10	900	800	8	200	900	2500	-	-	-
Greece	20 - 40	500	1000 - 1750	16 - 25	300 - 400	750 - 1200	2500 - 4000	-	-	-
Ireland	20	-	1000	16	300	750	2500	-	-	-
Italy	20	-	1000	10	300	750	2500	-	-	-
Luxembourg	20 - 40	1000 - 1750	1000 - 1750	16 - 25	300 - 400	750 - 1200	2500 - 4000	-	-	-
Netherlands	1,25	75	75	0,75	30	100	300	-	-	-
Portugal	20	1000	1000	16	300	750	2500	-	-	-
Spain - soil pH < 7 - soil pH > 7	20 40	1000 1750	1000 1750	16 25	300 400	750 1200	2500 4000	- -	- -	- -
Sweden	2	100	600	2,5	50	100	800	-	-	-
UK	-	-	-	-	-	-	-	-	-	-
<i>Accession countries</i>										
Estonia	15	1200	800	16	400	900	2900	-	-	-
Latvia	20	2000	1000	16	300	750	2500	-	-	-
Poland	10	500	800	5	100	500	2500	-	-	-

^a Lower Austria (grade II)

^b Upper Austria

^c Burgenland

^d Vorarlberg

^e Steiermark

^f Carinthia

^g These values are reduced to 125 (Cu) and 300 (Zn) from 31/12/2007

^h For private gardening, lead value is reduced to 60 mg/kg DM or 5000 mg/kg P

ⁱ For private gardening

^j Target limit values for 1998

^k 15 mg/kg DM from January 1, 2001 and 10 mg/kg DM from January 1, 2004

Table 1 shows that the most stringent national legislations have established limit values which can represent less than 10 % of the limit value established by the Directive 86/278/EEC. The countries in which the limitations on heavy metals concentration are the most stringent are Belgium (Flanders region), Denmark, Finland, the Netherlands and Sweden. For example, the limit value for cadmium in sludge according to Danish legislation is 0,8 mg/kg of dry matter, which is 25 times less⁹ than the lowest limit value set by the Directive (20 mg/kg of dry matter). However it has to be noticed that Nordic countries generally use extraction methods based on nitric acid (HNO₃) which are weaker than methods based on *aqua regia*, more common in the rest of Europe. Without

⁹ However it should be noticed that Danish legislation allows two possibilities for expressing heavy metals content: in relation to dry matter or to phosphorus.

questioning the severity of some legislations this should be kept in mind when considering differences¹⁰.

Greece, Luxembourg, Ireland, Italy, Portugal and Spain have set limit values for heavy metals in sludge which are mostly similar to the limit values set by the Directive 86/278/EEC.

Concerning the Accession countries, it is quite significant to notice that limit values set by the regulation in Poland are significantly lower than EU standards, as limit values in Poland for cadmium content in sludge is 10 mg/kg of dry matter, and 5 mg/kg of dry matter for mercury.

The limit values set by the national regulations can be compared to the heavy metals concentration in sludge which have been observed (see box below).

Heavy metals content in sludge

Figures 1 and 2 present average content of lead, cadmium and mercury observed in sludge. Information on the repartition of sludge quality per decile, although more relevant, is not available for most countries.

These figures show that the average contents of heavy metals observed in sludge are well below the limit values established by Directive 86/278/EEC. In addition, these average concentrations are in most cases also below national requirements for sludge use in agriculture. The countries for which the average contents observed are the lowest are also those which have set the most stringent limit values for heavy metals in sludge. However, this is not always verified, since certain countries such as Ireland or Spain have not established very low limit values for heavy metals in sludge and yet the average contents observed appear to be quite low. In addition, if national requirements for cadmium and mercury contents in sludge vary considerably, the average contents are quite similar in the European Union, as they are in most cases between 1 and 3 mg/kg of dry matter.

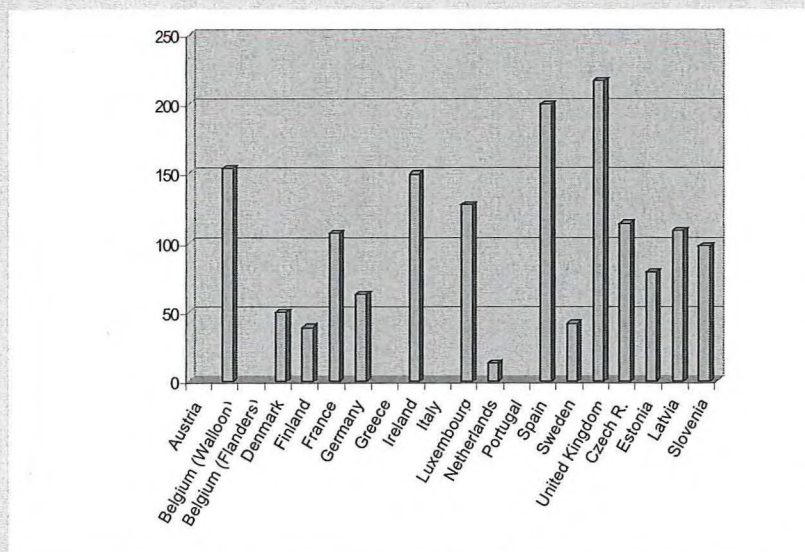


Figure 1: Average content of lead in sludge (mg/kg DM)

¹⁰ These aspects were discussed during the workshop on sampling and analysis methods for heavy metals, organic compounds and pathogens in soil and sludge (Stresa, Lake Maggiore, Italy, February 8 and 9, 2001; European Commission and Joint Research Center)

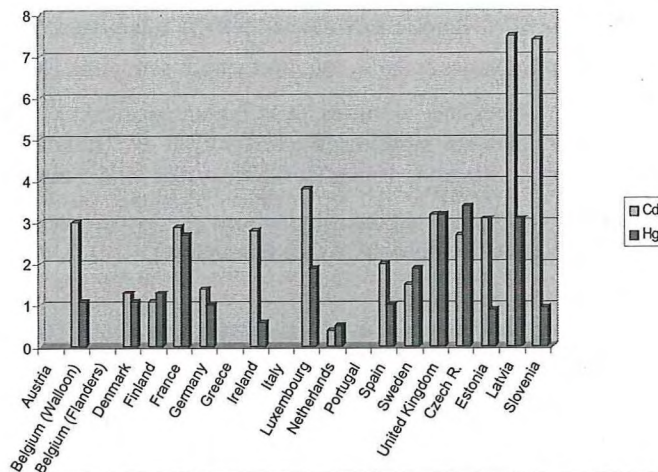


Figure 2: Average content of cadmium and mercury in sludge (mg/kg DM)

It should also be noted that the available data on the average contents of metals in sludge show that heavy metals concentration in sludge has decreased over the last years¹¹. This is true both of countries in which legislation is very stringent and of countries with less stringent limitations on heavy metals concentrations.

¹¹ See the scientific sub-component report for additional elements on heavy metal concentration in sludge (section 3.4 and in Appendix 2).

4.3.2 Limit values for pathogens in sludge

The Directive 86/278/EEC does not include specific requirements for pathogens content in sludge used in agriculture. However, in order to reduce possible health risks related to pathogens, several national regulations have added limitations on pathogens content to standard requirements on sludge quality.

This is the case in France, Italy, Luxembourg, and in two Länder in Austria (Burgenland and Lower Austria, only for sludge to be used on "*grassland and arable land on which forage is grown*"). The most common pathogens which are addressed by legislation are salmonella and enteroviruses. The limit values for pathogens are quite different, and are presented in table 2 below. Also, according to legislation in Poland, sludge may not be used if it contains salmonella and other pathogenic elements.

Table 2: Limit values for pathogens concentrations in sludge

	Salmonella	Other pathogens
France	8 MPN/10 g DM	Enterovirus: 3 MPCN/10 g of DM Helminths eggs: 3/10 g of DM
Italy	1000 MPN/g DM	
Luxembourg		Enterobacteria: 100/g No egg of worm likely to be contagious
Poland	Sludge can not be used in agriculture if it contains salmonella	"Parasites": 10/ kg of DM

MPN: Most Probable Number

MPCN: Most Probable Cytophatic Number

In Denmark, requirements on pathogens only concern advanced treated sludge, which must have no occurrence of salmonella, and faecal streptococci must be below 100 per g (SO/2000/49).

Therefore regulatory requirements on pathogens content in sewage sludge still remains quite limited in national legislations. This can be partly explained by the fact that national codes of practice are considered to sufficiently cover this issue, by providing recommendations on sludge treatment and sludge landspreading. For example, in the United Kingdom the Code of Practice for Agricultural Use of Sewage Sludge provides examples of the most effective sludge treatment processes so as to reduce the potential health hazard posed by pathogens.

4.3.3 Limit values for organic compounds in sludge

Directive 86/278/EEC does not provide any limit values or requirements for organic compounds in sewage sludge. In this case also, several national regulations on the use of sludge have added specifications on organic compounds. This is the case in particular of Austria (for three Länder), Denmark, France, Germany which have all included limit values for some organic compounds in the relevant regulation for use of sludge (see table 3 below). In Sweden, the regulation contains no requirement on organic compounds in sludge, however restrictions on the concentration of organic compounds in sewage sludge for use in agriculture have been introduced in the agreement between SEPA, the *Federation of Swedish Farmers* and the *Swedish Water and Waste Water Association* signed in 1994.

Table 3: Limit values for organic compounds in sludge (mg/kg DM)

	Dioxins and Furans (PCDD, PCDF) ng TE/kg DM	PCBs	AOX	LAS ¹	DEHP ^p	NPE ^q	PAH ^r	Toluen
Austria	100 ^{a,b,d} 50 ^f	0,2 ^{a,b,d} 1 ^f	500 ^{a,b,f}	—	—	—	6 ^f	—
Belgium (Flanders)^k								
Denmark	—	—	—	2600	100	50	6	—
- from 1/07/2000				1300	50	30	3	
- from 1/07/2002				1300	50	10	3	
France	—	0,8 ^m	—	—	—	—	2 - 5 ⁿ 1.5 - 4 ^o	—
Germany	100	0,2 ^s	500	—	—	—	—	—
Sweden	—	0,4	—	—	—	100	3	5

^a Lower Austria

^b Upper Austria

^c Burgenland

^d Vorarlberg

^e Steiermark

^f Carinthia

^k Limit values for approximately 30 organic compounds (see p. 35)

¹ Linear alkyl-benzene sulphonates,

^m Sum of 7 principal PCBs (PCB 28, 52, 101, 118, 138, 153, 180)

ⁿ Fluoranthene, Benzo(b)fluoranthene, Benzo(a)pyrene

^o When used on pasture land

^p Di (2-ethylhexyl)phthalate

^q Includes nonylphenol

^r Poly aromatic hydrocarbons

^s For each one of the six congeners

4.3.4 Limit values for soil to which sludge is applied

In all Member States, regulations on the use of sludge specify limit values for heavy metals in soil, which are in most cases similar or lower than the requirements set in Directive 86/278/EEC (see table 4 below). Some countries (Spain, Portugal, and the United Kingdom) have defined limit values for several categories of soil pH, while regulations in Latvia and Poland have distinguished several categories of soil based on their granulometric content. In addition, the legislation in several Member States includes limitations in terms of the maximum annual load of heavy metals to agricultural land, on a ten years basis (Finland, France, Luxembourg, Netherlands, Sweden, as well as Belgium-Flanders- and three Länder in Austria). Limit values which are below the ones specified in Directive 86/278/EEC are highlighted in shaded cells in Table 4.

Table 4: Limit values for heavy metals in soil (mg/kg DM)
(shaded cells represent limit values below those required by Directive 86/278/EEC)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn	As	Mo	Co
Directive 86/278/EEC (6<pH<7)	1 - 3	-	50 - 140	1 - 1.5	30 - 75	50 - 300	150 - 300	-	-	-
Austria	1.5 ^a 1 ^b 2 ^c 2 ^d 2 ^e 0.5 - 1.5 ^f	100 ^a 100 ^b 100 ^c 100 ^d 100 ^e 50 - 100 ^f	60 ^a 100 ^b 100 ^c 100 ^d 100 ^e 40 - 100 ^f	1 ^a 1 ^b 1.5 ^c 1 ^d 1 ^e 0.2 - 1 ^f	50 ^a 60 ^b 60 ^c 60 ^d 60 ^e 30 - 70 ^f	100 ^a 100 ^b 100 ^c 100 ^d 100 ^e 50 - 100 ^f	200 ^a 300 ^b 300 ^c 300 ^d 300 ^e 100 - 200 ^f	-	10 ^e	50 ^e
Belgium (Flanders)	0.9	46	49	1.3	18	56	170	22	-	-
Belgium (Walloon)	2	100	50	1	50	100	200	-	-	-
Denmark	0.5	30	40	0.5	15	40	100	-	-	-
Finland	0.5	200	100	0.2	60	60	150	-	-	-
France	2	150	100	1	50	100	300	-	-	-
Germany	1.5	100	60	1	50	100	200	-	-	-
Greece	1 - 3	-	50 - 140	1 - 1.5	30 - 75	50 - 300	150 - 300	-	-	-
Ireland	1	-	50	1	30	50	150	-	-	-
Italy	1.5	-	100	1	75	100	300	-	-	-
Luxembourg	1 - 3	100 - 200	50 - 140	1 - 1.5	30 - 75	50 - 300	150 - 300	-	-	-
Netherlands	0.8	100	36	0.3	35	85	140	-	-	-
Portugal								-	-	-
- soil pH < 5.5	1	50	50	1	30	50	150			
- 5.5 < soil pH < 7	3	200	100	1.5	75	300	300			
- soil pH > 7	4	300	200	2	110	450	450			
Spain										
- soil pH < 7	1	100	50	1	30	50	150	-	-	-
- soil pH > 7	3	150	210	1.5	112	300	450	-	-	-
Sweden	0.4	60	40	0.3	30	40	100 - 150	-	-	-
UK								-	-	-
- 5 < soil pH < 5.5	3	-	80	1	50	300	200			
- 5.5 < soil pH < 6	3	-	100	1	60	300	250			
- 6 ≤ soil pH ≤ 7	3	-	135	1	75	300	300			
- soil pH > 7	3	-	200	1	110	300	450			
Estonia	3	100	50	1.5	50	100	300	-	-	-
Latvia	0.3 - 1	15 - 30	10 - 25	0.1 - 0.15	8 - 30	15 - 30	35 - 100	-	-	-
Poland	1 - 3	50 - 100	25 - 75	0.8 - 1.5	20 - 50	40 - 80	80 - 180	-	-	-

^a Lower Austria

^b Upper Austria

^c Burgenland

^d Vorarlberg

^e Steiermark

^f Carinthia

In most countries, sludge cannot be used when these limit values are exceeded, however the regulation in the United Kingdom specifies that when limits are exceeded, sludge can be used on "dedicated sites" which are defined as areas of agricultural land *"which on 17th June 1986 was dedicated to the disposal of sludge but on which commercial food crops were being grown exclusively for animal consumption"*¹². Similarly, in Luxembourg, the regulation specifies that where the concentration of any heavy metals exceeds limit values, sludge may nevertheless be used on lands which are aimed at eliminating sludge and on which only commercial crops exclusively intended for animal food may be cultivated.

Maximum quantities of sludge which can be spread on land have been set between 1 ton (Netherlands, on grassland) and 10 tons (Denmark) per hectare and per year, as summarised in the table below. However, in practice, quantities used on land usually do not exceed 2 tons per hectare and per year.

Table 5: Maximum quantities of sludge to be spread on land

This table has to be read as follows: "4/2 years" stands for 4 tons of dry matter per ha every two years

	Application rate t DM per ha
Directive 86/278/EEC	
Austria	2.5 – 10 / 2 years ^a
Belgium (Flanders)	4 / 2 years (arable land) 2 / 2 years (pasture land)
Belgium (Walloon)	12 / 3 years (arable land) 6 / 3 years (pasture land)
Denmark	10 / year
Finland	-
France	-
Germany	5 / 3 years
Greece	-
Ireland	2 / year
Italy	-
Luxembourg	3 / year
Netherlands	2 – 4/year on arable land ^b 1 – 2 /year on grassland ^b
Portugal	6 / year
Spain	-
Sweden	-
UK	-
<i>Accession countries</i>	
Estonia	-
Latvia	-
Poland	-

^a depending on the Land, the DM content and the sludge type

^b depending on the sludge structure (liquid or solid sludge)

¹² See provision 3 (4) (a) of the Sludge Regulation 1989 n°1263

4.3.5 Obligations for treatment

Directive 86/278/EEC specifies in that *"sludge shall be treated before being used in agriculture"*¹³. The definition of treated sludge is provided in Article 2 as *"sludge which has undergone biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use"*. However, the use of untreated sludge is possible according to the same Directive *"if it is injected or worked into the soil"*.

In fact, most countries have exactly transposed these provisions into national legislation. However, Belgium-Flanders Denmark, Finland, Germany, Greece, Italy, the Netherlands, Portugal and Spain prohibit the use of untreated sludge, while other countries have no specific requirements concerning the treatment of sludge.

In Finland, sludge must be treated by digestion or lime stabilisation before being used in agriculture. In the case of Denmark even stabilised sludge has to be worked into the soil within 12 hours after application. In fact, Denmark is the only country where the regulation on use of sludge identifies different treatment requirements for application on land depending on waste types. It is also interesting to note that in Poland, sludge must be stabilised before use on land.

In France, Ireland, Luxembourg, Sweden, the legislation permits the use of untreated sludge, in accordance with the Directive. In the United Kingdom, the regulation allows untreated sludge to be used under the following conditions: *"where any untreated sludge has been used on agricultural land without being injected into soil, the occupier of the land affected shall, as soon as reasonably practicable thereafter, cause such sludge to be worked into the soil of the land affected"*. However, one of the consequences of the recent agreement between the sludge producers (Water UK) and the food retailers (BRC) is to ban the use of untreated sludge in agriculture.

4.3.6 Surfaces on which use of sludge is prohibited

Article 7 of the Directive 86/278/EEC provides restrictions concerning the spreading of sludge on grazing and pastureland, and on land on which vegetables and fruits are grown. Those dispositions have been transposed by Member States, but in different ways according to the country. Ireland, Portugal and the United Kingdom have for instance transposed the exact requirements of the directive. Other countries have introduced higher delays before spreading, like in Belgium (Walloon), Italy, or Austria. Lastly, some countries have introduced restrictions on specific crops, such as Austria, or on agricultural practices, in order to privilege the ploughing down of sludge (e.g. in Germany) or the use of hygienised sludge (e.g. in France, where delay before spreading is higher when not using not hygienised sludge). Differences with the Directive's requirements are summarised in the table below.

¹³ Article 6

Table 6: Surfaces on which the use of sludge is prohibited
Comparison between requirements of Directive 86/278/EEC (article 7) and national legislation
(= stands for no difference with the Directive)

Directive 86/278/EEC Requirements of Article 7	Grassland or forage crops if the grassland is to be grazed or the forage crops to be harvested before a certain period has elapsed. This period, shall under no circumstances be less than three weeks	Soil in which fruit and vegetable crops are growing , with the exception of fruit trees	Ground intended for the cultivation of fruit and vegetable crops which are normally in direct contact with the soil and normally eaten raw , for a period of 10 months preceding the harvest of the crops and during the harvest itself
Austria	Prohibition on meadows, pasture, alpine pastures	=	Prohibition on vegetable crops, berries or medicinal herbs ; no growing of these crops before 1 year
Belgium (Flanders)	6 weeks delay	=	=
Belgium (Walloon)	6 weeks delay	=	=
Denmark	=	=	=
Finland	Ploughing down compulsory Sludge may be used only on soil on which grain, sugar beet, oil-bearing crops or crops not used for human food or animal feed are cultivated	=	Potatoes, root crops and vegetables may not be cultivated on arable land before a 5 year delay
France	=	=	=
Germany	Prohibition		
Greece	=	=	=
Ireland	=	=	=
Italy	5 weeks delay	=	=
Luxembourg	4 weeks delay	=	=
Netherlands	Prohibition on forage crops land prohibition during the grazing season on grazing land	=	=
Portugal	=	=	=
Spain	=	=	=
Sweden	Prohibition on grazing land, In arable land which is to be used for grazing or if fodder crops are to be harvested within ten months of the time the sludge is spread	=	=
UK	=	=	=
<i>Accession countries</i>			
Estonia	2 months for fodder crops	=	1 year delay
Latvia	Prohibition	No restriction	Restriction concerning spreading period according to crop type
Poland	Prohibition	No restriction	18 delay

Apart from the requirements of article 7 of the Directive, most countries have introduced additional requirements for landspreading, most often restricting the use of sludge in agriculture near surface water, on wet land, on forest soils, on frozen or snow-covered ground, and on sloping land in order to reduce the impact of erosion and run-off. Requirements may also be added in order to protect

ground water. It may be observed that those additional restrictions vary according to the country more than the region. For instance, not all Nordic countries have forbidden the use of sludge on frozen soil. Those restrictions are summarised in the table below. This table takes into account only mandatory prescriptions and does not address possible existing recommendations, codes of practice or voluntary agreements

Table 7: Surfaces on which the use of sludge is prohibited

Additional requirements introduced by national legislation, in comparison to Directive 86/278/EEC (article 7)

	Frozen or snow covered ground	Sloping land	Wet land, or after heavy rain	Groundwater protection areas	Near surface water	Forest soil	Additional restrictions
Austria	X	X ^a			X ^b	X	
Belgium (Flanders)				X		X	
Belgium (Walloon)	X		X		X ^c	X	Natural reserves areas
Denmark				X	X	X ^d	On surfaces where sludge is likely to cause significant nuisances or unsanitary conditions
Finland							
France	X	X	X	X	X	X ^e	Not regularly worked out land In areas close to human settlements and public buildings
Germany				X	X	X	
Greece							
Ireland							
Italy		X ^f	X				Soils of pH < 5, and CEC < 8 meq/100 g
Luxembourg			X			X ^g	On biotopes and protected areas as defined in the Act on nature and natural resources protection
Netherlands	X					X ^h	On « miscellaneous » land and undisturbed ground
Portugal			X	X	X		In areas close to individual houses and human settlements
Spain							
Sweden							
UK							Soils of pH < 5
<i>Accession countries</i>							
Estonia	X		X				Soils of pH < 6
Latvia	X	X ^j		X	X		
Poland	X	X ^j	X	X	X		National parks and protected areas Near individual housing and human settlements Soils of high permeability Crops grown under greenhouses

^a for sludge containing less than 10% of DM

^b caution must be taken to avoid impacts on those waters

^c below 10 m from surface waters^d restricted use allowed

^e use allowed in case of risk minimisation

^f slope higher than 15% when the DM content is less than 30%

^g after licensing from the Ministry of environment. Same restriction within 30 m near forests borders

^h allowed for certain kinds of plantations

^j slopes higher than 10 %

4.3.7 Further quality related restrictions

Certification and information requirements

Member States have generally transposed in national legislation the information requirements (record-keeping, reporting to the competent authorities) defined in Directive 86/278/EEC:

- in Article 6 (b): “*sewage sludge producers shall regularly provide users with all the information referred to in Annex II A.*”.
- and in Article 10, as follows:
 - “1. *Member States shall ensure that up-to-date records are kept, which register:*
 - a) the quantities of sludge produced and the quantities supplied for use in agriculture;*
 - b) the composition and the properties of the sludge in relation to the parameters referred to in Annex A;*
 - c) the type of treatment carried out, as defined in Article 2 (b);*
 - d) the names and addresses of the recipients of the sludge and the place where the sludge is to be used;*
 - 2. *The records shall be available to the competent authorities [...].*”

In some cases, additional analyses are required by national legislation (this is the case for several Länder in Germany, for example). In Denmark, the regulation requires an analysis of concentrations of organic compounds in sludge at least every twelve months.

Concerning frequency of analysis, the legislation in several countries follow the same requirements as specified in the Directive (at least once every 6 months, according to Annex II A), however in Denmark, Finland, France, Luxembourg, Italy and Sweden, the frequency of analysis depends on the size of the sludge treatment plant. In France for example, the number of analyses per year is related to the tons of dry matter spread on land, and can reach 48 the first year landspreading is carried out. In Germany also, local authorities can in certain cases reduce the frequency of analysis to two months. Requirements in the Member States concerning the frequency of analysis are summarised in the table below.

Table 8: Frequency of analysis

	<i>Range of sampling frequencies</i>		
	Sludge		Soil
	Heavy metals and agronomic parameters	Organic compounds	
Directive 86/278/EEC	6 months		Before first application
Austria	2 months – 10 years ^a	Every 2 years ^b	Before first application and at least every 5-10 years ^a
Belgium (Flanders)	6 months	6 months	Before first application and after having spread 20 tDM per hectare
Belgium (Walloon)	1 – 12 per year	-	Before first application and at least every 10 years
Denmark	3 months	12 months	Before first application
Finland	1 – 12 per year first year 1 – 4 per year later	-	Before first application
France	2 - 48 the first year ^c 2 – 24 per year later ^c	1 - 12 the first year ^c 1 – 12 per year later ^c	Before first application and at least every 10 years
Germany	6 months	6 months	Before first application and every 10 years.
Greece	6 months	-	Before first application
Ireland	6 months	-	Before first application and every ten years
Italy	> 100 000 p.e.: every 3 months < 5000 p.e. :once a year every 6 months for others	-	Every 3 years at most.
Luxembourg	1 – 6 per years	-	Before use then depending on results, size of the WWTP, quantity of sludge
Netherlands	N/A	-	Before first application
Portugal	6 months	-	Before first application
Spain	6 months	-	Before first application
Sweden	1 – 12 per year	-	Before first application
UK	6 months	-	5 – 20 years
<i>Accession countries</i>			
Estonia	depends on capacity	-	-
Latvia	N/A	-	Before first application
Poland	1- 6 years	-	metals and P2O5 : 1 – 5 years

^a according to the Länder

^b for PCB and PCDD/PCDFs

^c depending of the dry matter content of the sludge

Producer responsibility has for the moment remained limited to complying with information requirements, in other words to provide users with information on sludge quality, to keep updated records as defined by Article 10 of Directive 86/278/EEC, as well as to transmit these records to the competent authorities. In some cases, sludge producers are also responsible of the conformity of sludge with the quality requirements set out in the regulation (Walloon region), or responsible for ensuring that information on quality accompanies the sludge (Denmark). In France, the legislation also requires the producer to carry out a preliminary study before supplying sludge for use on land, to establish a landspreading plan each year and to produce a yearly report (*bilan*) on the sludge spread on land and on the resulting impacts on soil quality.

For the moment, certification procedures, such as product or service quality certification, are not specified in national legislation on the use of sludge. However, the voluntary agreement on sludge in Sweden has led the main players to issue guidelines for quality assurance. In addition to these guidelines, consultative groups have been established at local level in order to conduct sewage sludge quality audits. It has recently been agreed to set up a voluntary quality certification scheme for landspreading in Sweden, which should be established in the next three years.

Codes of practice and guides

In most countries, and on the basis of the information available, no codes of practice or guides on the use of sewage sludge have been developed. The existing codes of practice are either national (Ireland, Sweden, United Kingdom) or regional (Austria, Spain) and provide technical guidance and details on the steps to follow when using sludge in agriculture. In the case of the United Kingdom, the Code of Practice for Agricultural Use of Sewage Sludge contains requirements which are more stringent than the regulation. In addition, compliance with this code is not compulsory, but if a problem occurs, non-compliance may be held against the person responsible.

Voluntary agreements on disposal and recycling of sewage sludge

Only two voluntary agreements on the use of sludge have been signed, in Sweden and in the United Kingdom. However, both in the Walloon region of Belgium and in France, ongoing discussions could lead to the signature of a "sludge agreement" in the next months¹⁴.

In 1994 in Sweden, the *Swedish Environment Protection Agency* (SEPA), the *Federation of Swedish Farmers* (LRF) and the *Swedish Water and Waste Water Association* (VAV) signed a voluntary agreement (the "*Sewage Sludge Agreement*") regarding quality assurance. This agreement has mainly led to the adding of constraints on organic compounds content to the existing regulatory requirements, as well as to the creation of a *national consultative group* in order to develop the work on the measures agreed upon in the framework of this agreement.

In the United Kingdom, the agreement between the main sludge producers (regrouped in Water UK) and the main food retailers (British Retailers Consortium) was reached in 1998. This agreement has led to the common adoption of a "*Safe Sludge Matrix*" which provides additional restrictions for the use of sewage sludge on agricultural land, as well as categories of crops on which sludge may not be used. Another result of this agreement is the ban on the use of untreated sludge except on non-food industrial crops on which untreated sludge may be used until the end of 2001.

¹⁴ See sub-component report on sludge acceptance for further details on this aspect (section 4).

4.4 Specific requirements for use of sludge in silviculture, forest, land reclamation and green areas¹⁵

It is not always possible, without carrying out an in-depth analysis for each country, to establish that certain uses of sludge are not covered by any regulation. In addition, it is even more difficult to estimate whether uses for which there are no specific regulation are prohibited, authorised or simply tolerated. Use of sludge in silviculture is defined here as use of sludge in commercial forests, and energy coppices, while use of sludge on natural forest is defined as use of sludge on existing forests and in amenity forests.

4.4.1 Silviculture (plantation)

We identified a limited number of national legislations on sewage sludge with specific requirements on the use of sludge in silviculture. In addition, in some cases the term "forest" or "forest soil" is mentioned without specifying whether it covers silviculture, natural forest and reforested areas. For instance, in Flanders, the Forest Decree prohibits the use of waste in forests, without making a distinction between natural and cultivated forests.

Regulations which specifically address use of sludge in silviculture are the following:

- According to the Danish Statutory Order No. 49, the local council in Denmark can allow use of sludge in cultivated forests, based on a need for fertilisation. The council can also establish specific restrictions for use.
- In Germany, the use of sludge on land for silviculture is prohibited by paragraph 4 of the Sludge Ordinance.
- In the Netherlands, land for silviculture is either considered as agricultural land (and therefore the regulations for agricultural land apply) or as miscellaneous land (use of sludge being prohibited on these areas).
- In Sweden, no specific elements address these aspects in the regulation, but the General Guidelines 1990/13 from the SEPA, *Sludge from municipal sewage treatment plants*, contain recommended maximum values when sludge is used in silviculture.

4.4.2 Natural forest

Regulations on sewage sludge in Greece, Finland, Ireland, Italy, Netherlands¹⁶, Portugal, Spain and Sweden do not address use of sludge on natural forests.

The Countries or regions which explicitly prohibit the use of sludge on forest are Austria, Belgium (Flanders and Walloon regions) and Germany. In Austria, although the regulation on use of sludge does not mention use on forests, section 16 of the Forest Law prohibits the use of sludge on forests. However, this prohibition does not apply to "forest gardens", forest seed plantations and Christmas tree plantations.

¹⁵ Information on additional legislation on other routes should be completed, this is why this section deals only with the requirements on silviculture, land reclamation, green areas in the existing legislation on use of sludge.

¹⁶ The regulation in the Netherlands does not explicitly mention natural forests, which are considered as "miscellaneous land", on which sludge may not be applied.

In the cases listed below, the use of sludge on forest areas is authorised, under certain conditions.

- In France, the Government Decree of December 8, 1997 specifies in Article 16 that the requirements defined for the use of sewage sludge on agriculture also apply to natural forest areas, whether public or private, provided that risks for humans as well as for the fauna are minimised.
- In Luxembourg, according to the Grand Ducal Regulation of 14 April 1990, use of sludge on forest soil is subject to licensing. Moreover, licensing is also necessary before spreading on agricultural land at a distance of less than 30 meters of a forest boundary.
- In the United Kingdom, the use of sludge in natural forest and reforested areas is not addressed by the regulation, but a "Manual of Good Practice for the Use of Sewage Sludge in Forestry" has been published by the Forest Authority.

4.4.3 Land reclamation

There are almost no specific requirements for the use of sludge in land reclamation in most national regulations. The only exceptions to this are Austria (Vorarlberg), Belgium (Flanders), France and Poland.

In Austria, the regulation in Vorarlberg specifies that "*recultivation using sludge as a fertiliser*" (Klärschlamm Dünger) (defined in this regulation as composted or heat-dried sewage sludge), for areas where the soil has been "*considerably damaged by human intervention*" is permissible, provided that heavy metals limits are respected.

In Belgium (Flanders), the use of sludge, in conformity with the limit values defined by the regulation, as covering layer for landfills falls under "black soil" applications. This latter entails the sludge being mixed with other materials such as sand. In practice, the use of sludge in black soil is limited.

In France, it is stated in Article 17 of the Decree of December 8, 1997 that the use of sewage sludge for land reclamation must be adapted to the particularities of the soil (considering other substances which may have been introduced in the soil). In addition, the use of sludge is prohibited in mines or quarries.

In Poland the Decree of August 11 1999 established specific limit values for heavy metals in sludge when sludge is used for land reclamation

Other elements relating to land reclamation in the Member States are the following:

- Sweden: the regulation does not address these aspects, but the General Guidelines 1990/ 13 provide recommendations on sludge use in land reclamation.
- United Kingdom: a manual of good practice for the use of sewage sludge in land reclamation is also available¹⁷.

4.4.4 Green areas

The national regulations on sewage sludge do not address the use of sewage sludge on green areas, except in few cases which either explicitly prohibit the use of sludge on green areas (Germany and Netherlands¹⁸) or provide additional requirements (in Denmark, where sludge used on green areas

¹⁷ WRc, Manual of good practice for the use of sewage sludge in land reclamation, 1999, ISBN 1 898 920 389

¹⁸ As "green areas" are considered as "miscellaneous land" on which use of sludge is prohibited under Dutch legislation.

must be pasteurised). In Sweden, the regulation does not address these aspects, but the "General Guidelines 1990/13 provide recommendations on use of sludge on green areas. The Decision of the Ministry of Agriculture and Forestry (46/1994) in Finland provides that "soil improving agents" used for landscaping purposes are exempt from requirements on heavy metals concentrations.

Regulations on sludge in Poland and in Estonia cover the use of sludge on green areas, and for the case of Poland include limit values for heavy metals in sludge to be used on green areas:

- In Estonia, use of sludge in green areas is covered by the same regulation as for use in agriculture, the 1999 regulation on "*Instructions for use of wastewater sludge in agriculture, green area creation and recultivation*".
- In Poland, the Decree of August 11, 1999 defines specific limit values for heavy metals in sludge for use on non-agricultural soil.

4.5 Specific requirements or legislation for other routes

4.5.1 Incineration

National regulations on the use of sewage sludge generally do not include any specific requirements on the incineration of sewage sludge. This route is usually covered by general regulations on the incineration of waste, such as the *Air Emissions Waste Incineration Decree* of 1993 in the Netherlands, the *SEPA Regulations on emissions into the air from waste incineration* (SNFS 1993/13 or SNFS 1993/14) in Sweden on the reduction of air pollution from existing municipal waste-incineration plants, or the *Environmental Pollution Act* of 1995 in the United Kingdom.

4.5.2 Disposal to landfill

The national regulations on sludge do not contain requirements on the disposal to landfill of sewage sludge. Disposal to landfill of sludge is therefore covered by other legislation on landfill. Some of these regulations include specifications for sewage sludge, as follows:

- In Austria, the Landfill Ordinance requires that from 2004 onwards, sewage sludge must be treated beforehand so as to reduce its biological reactivity.
- In Italy, landfilling is regulated by a deliberation of 27 July 1984, stating that urban non toxic sludge can be disposed of in category 1 landfills.
- In the Netherlands, sewage sludge can be disposed to landfills (Decree on landfilling in the 1993 *Environmental Protection Act*). Nevertheless this route is increasingly restricted. Landfilling should thus remain an option for sewage sludge incineration ashes and residues from sludge dryers, if the organic matter content is less than 10% of the dry matter content.
- In France, the Order of September 9, 1997 on landfills specifies that sludge from waste water treatment plants can be landfilled only if its dry matter content is above 30%. Disposal to landfill of sewage sludge should be further reduced from 2002 onwards, as the 1992 *Waste Act* prohibits the landfilling of all wastes except "ultimate" waste.
- In Sweden, from 2005 onwards, no organic waste (including sludge) will be accepted in landfills, by application of waste regulations.

It should be noticed that in most countries, disposal to landfill of sludge should progressively be reduced, in application of the Directive on the landfill of waste (1999/31/EEC) which recommends to reduce the quantities of biodegradable waste going to landfills, and prohibits the landfilling of both liquid wastes and untreated wastes.

5. Conclusion: major differences between legislation at EU and national level

The analysis of the legislations which have been implemented at national level in order to transpose the requirements of Directive 86/278/EEC shows that more stringent provisions have been introduced for a certain number of aspects. These differences have been summarised in table 7.

5.1 Limit values for pollutants in sludge and in soil

Differences between national regulations and EU requirements are particularly significant for limit values on the concentrations of heavy metals in sludge. Comparing the limit values set in the Directive with national provisions (see Table 1 for details) shows that only six Member States (Greece, Ireland, Italy, Luxembourg, Portugal and Spain) have implemented in their legislation limit values which are identical to those specified in Annex IB of Directive 86/278/EEC. In addition, UK regulations do not specify any limit value for concentrations of heavy metals in sludge.

This means that the majority of Member States have chosen to establish stricter requirements in this area. In particular, in countries such as Denmark, Finland, the Netherlands and Sweden, the limit values which are set in national regulations are extremely stringent, although use in agriculture remains an important outlet for sludge in these countries, with the exception of the Netherlands. Danish legislation is unique in offering the possibility to express the heavy metal concentration in sludge either on a dry matter basis or on the phosphorus content basis. In the latter case, Danish law presents two sets of limit values: prior to June 30, 2000 and after June 30, 2000.

This means that a revised Directive which would include limit values set lower than the current requirements, would only require a limited number of countries to adjust their provisions on maximum concentrations of heavy metals in sludge. It should also be mentioned that the requirements set by regulations in Estonia, Latvia, and Poland are comparable, or even more stringent than the Directive's current requirements in this area.

Concerning limit values for heavy metals in soil to which sludge is applied, requirements established in most national regulations are similar to requirements specified in Annex I A of Directive 86/278/EEC. However, Denmark, Finland and the Netherlands have established lower limit values on this aspect.

In addition, the regulations on sludge use include limit values for pathogens in sludge in France, Italy, Luxembourg and Poland and in a larger number of cases for organic compounds in sludge (Austria, Belgium-Flanders, Denmark, France, Germany and Sweden).

5.2 Other requirements for use of sludge in agriculture

Concerning other requirements, there are no major differences between the requirements of Directive 86/278/EEC and the regulations on sludge use at national level.

Regarding the sludge type covered by national regulations, the Directive's scope has been applied at national level in most cases. However, the sludge regulations in Belgium, Denmark, Italy, and the Netherlands explicitly apply both to urban sewage sludge and to industrial sludge. In France, a specific Order applies to industrial waste and sludge spread on land, although its provisions are very similar to the requirements specific to landspreading of urban sludge.

In terms of obligations for treatment (for sludge to be used on land), most countries have in general either adopted the provisions specified in the Directive or have prohibited the use of untreated sludge. However, the Danish regulation has introduced a matrix specifying possible uses for sludge depending on treatment.

Concerning information requirements, no major changes have been implemented in national regulations, although Danish regulation requires analysis of organic compounds content at least once a year. In other cases, differences between national legislation and the Directive's requirements mainly concern the frequency of sludge and soil analysis. For the moment, no certification of products or services is mentioned in existing national regulations.

Voluntary agreements have been signed only in two countries (Sweden and the UK). In both cases, these agreements include requirements for the use of sludge in agriculture which are more stringent than national regulations, either in terms of limit values for pollutants contained in sludge or in terms of treatment requirements.

5.3 Specific requirements for the use of sludge in other routes

On the basis of the information collected, most regulations concerning the use of sludge are limited to the use of sludge in agriculture and do not include specific requirements on sludge use in silviculture and natural forests (although the use of sludge on forest is prohibited in Belgium - Flanders and Walloon-, Germany, the Netherlands, and Austria), land reclamation and green areas.

It is therefore interesting to notice here that the regulation in Poland includes limit values for heavy metals concentrations in sludge for use in land reclamation and on "non agricultural soil".

Similarly, incineration or disposal to landfill of sludge is usually covered by general waste regulations on incineration and landfill, and not by specific provisions in national "sludge" regulations.

Table 9: Summary table of the comparative analysis between national legislation compared to EU provisions

	Limit values for heavy metals in sludge ^a	Limit values for pathogens ^b	Limit values for organic compounds ^b	Limit values for soil ^a	Obligations for treatment ^a	Codes of practice and guidelines ^b	Voluntary agreements ^b	Specific requirements for other routes (forest/silviculture/land reclamation/green areas)	Restrictive requirements for landfill/incineration
Austria ^c	+		√	=	Biological stabilisation	√ (local codes)		Prohibition of use on forest	only waste with less than 5% of organic matter is accepted in landfill from 2004 onwards
Belgium (Flanders)	+		√	=	Prohibition of use of untreated sludge			Prohibition of use on forest	
Belgium (Walloon)	+			=	=		In discussion	Prohibition of use on forest	
Denmark	++		√	++	Stabilisation, composting or pasteurisation			Only pasteurised sludge for green areas	
Finland	++			+	Digestion or lime stabilisation				
France	+	√	√	=	=	√ (local codes)	In discussion	Allowed in forest provided risks have been minimised Prohibition of use in mines or quarries	Minimum 30% of DM content for landfilling
Germany	+		√	=	Prohibition of use of untreated sludge	√ (local codes)		Prohibition of use on forest, silviculture and green areas	only waste with less than 5% of organic matter is accepted in landfill from 2005 onwards
Greece	=			=	Prohibition of use of untreated sludge				
Ireland	=			=	=	√			
Italy	=	√		=	Prohibition of use of untreated sludge				prohibition of waste not submitted to recycling or recovery from 2001 onwards
Luxembourg	=	√		=	=			Additional authorisation requirements for forests	
Netherlands	++			+	Prohibition of use of untreated sludge			Prohibition of use on forest (partly) and green areas	only waste with less than 10% of organic matter is accepted in landfill from 2005 onwards
Portugal	=			=	Prohibition of use of untreated sludge				

Spain	=			=	Prohibition of use of untreated sludge	√ (local codes)			
Sweden	++		√	++	=	√	√		No organic waste is accepted in landfill from 2005 onwards
UK	no limit values			=	=	√	√		
Estonia	=			=				Land reclamation and green areas follow the same legislation as for agriculture	
Latvia	=			++?					
Poland	+	√		+	Chemical treatment, heat treatment or other treatments			Limit values for sludge use in land reclamation and green areas	

^a This column should be read as follows:

=: national requirements on this aspect are similar to EU provisions

+: national requirements on this aspect are more stringent than EU provisions (at least for some elements)

+ +: national requirements on this aspect are much more stringent than EU provisions

6. Sludge regulations in the Member States and in Accession countries (country sheets)

The next pages provide an overview of regulations related to sludge management in the following countries:

Member States

Austria
Belgium
Denmark
Finland
France
Germany
Greece
Ireland
Italy
Luxembourg
Netherlands
Portugal
Spain
Sweden
United Kingdom

Accession countries

Bulgaria
Czech Republic
Estonia
Hungary
Latvia
Lithuania
Poland
Romania
Slovenia
Slovakia

Austria

Reviewed by Regine Pabst, March 2001

Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft

Competence and legal structure

Competence

Austria is a federal state composed of 9 "Länder". Most "Länder" have their own regulation on the use of sludge, usually in the form of Orders on Sewage Sludge. At local level, municipalities are responsible for the collection and treatment of waste water.

Legal structure

There is no federal regulation on the use of sludge, even though several laws provide requirements on waste management¹⁹, use of fertilisers²⁰, and protection of surface and groundwater²¹ at the federal level. However, in 1984, recommendations were given at federal level on the use of sludge in agriculture²²

8 of 9 Länder have adopted regulations on the use of sludge in agriculture between 1990 and 2001²³, following the adoption of a regional law on soil protection (*Bodenschutzgesetz*). Some of

¹⁹ Waste Management Act of 6/6/1990, BGBl. No. 325/1990 ST0140 (*Bundesgesetz über die Vermeidung und Behandlung von Abfällen – Abfallwirtschaftsgesetz*)

²⁰ Fertiliser Act of 12/7/1990, BGBl. No. 513/1994 ST0160 *Bundesgesetz über den Verkehr mit Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln – Düngemittelgesetz*) and Fertiliser Ordinance of 21/12/1994, BGBl. No. 1007/1994 ST0309 (*Verordnung des Bundesministers für Land- und Forstwirtschaft, mit der Bestimmungen zur Durchführung des Düngemittelgesetzes erlassen werden – Düngemittelverordnung*)

²¹ Water Act of 1959, BGBl. No. 215/1959 (*Wasserrechtsgesetz*), in der Fassung BGBl. I No. 155/1999.

²² Use of sludge in agriculture, 1984 (*Landwirtschaftliche Verwertung von Klärschlämmen*).

²³ Länder regulations are as follows:

Carinthia – Carinthian order on the waste management of 30/03/99, LGBL No. 14/1999 (*Gesetz vom 17. Dezember 1998, mit dem die Kärntner Abfallwirtschaftsordnung geändert wird*),

Carinthia – Carinthian order on compost and sludge management of 15/12/2000, LGBL No. 74/2000 (*Verordnung der Landesregierung über die Aufbringung von behandeltem Klärschlamm, Bioabfall und Grünabfall auf landwirtschaftlich genutzte Böden – Kärntner Klärschlamm- und Kompostverordnung*).

Steiermark – Order on sludge management of 14/12/1987, LGBL No. 89/1987 (*Verordnung der Steiermärkischen Landesregierung vom 14. Dezember 1987 über die Aufbringung von Klärschlamm auf landwirtschaftlichen Böden (Klärschlammverordnung)*, *Landgesetzblatt für die Steiermark, ausgegeben am 22. Dezember 1987*), LGBL 89/1987.

Vorarlberg -Order on sewage sludge management of 09/10/1997, LGBL No. 75/1997 (*Verordnung der Landesregierung über die Ausbringung von Klärschlamm (- Klärschlammverordnung)*), *Vorarlberger Landesgesetzblatt, Herausgegeben und versendet am 9. Oktober 1997*, LGBL 75/1997.

Lower Austria – Lower Austrian order on sewage sludge management of 30/05/2000, LGBL No. 6160/2-0 (*Nieder Österreich Klärschlammverordnung, Stammgesetz 80/1994*),

Upper Austria – Upper Austrian Order on sewage sludge, compost, and composted waste and sewage sludge management, LGBL No. 21/1993 (*Ober Österreich Klärschlamm-, Müll- und Klärschlammkompostverordnung*), LGBL 21/1993.

Vienna – Law on the prohibition of sewage sludge application on soil of 02/03/2000, LGBL No. 8/2000 (*Gesetz über das Verbot der Ausbringung von Klärschlamm*), LGBL für Wien Nr. 08/200

them implement the Directive 86/278/CEE, but all dispositions of this directive have not been transposed by now in all Länder. Moreover, Salzburg has not adopted any specific legislation concerning sludge use in agriculture. Therefore, the European Commission has sent a Reasoned Opinion (Second Written Warning) to Austria on April 6 2001 for failing to adopt the national legislation required to give effect to the Community's sewage sludge directive.

Types of sludge covered by legislation

Regional regulations²⁴ apply to sludge from urban waste water treatment plants, although in most cases, the regulations only refers to the term "sewage sludge" without any further precision. There are no separate regulations for the use in agriculture of sludge from industrial waste water treatment plant.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

Each Land has fixed its own limit values, although two Länder, Salzburg and Tyrol, only fix guide values²⁵. All of these limit values are more stringent than those set in Directive 86/278/EEC. In addition, the regulations in Lower Austria and Steiermark set limit values for metals which are not covered by Directive 86/278/EEC such as cobalt, molybden and arsenic (Steiermark only).

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Burgenland	Upper Austria	Lower Austria		Voralberg	Steiermark	Carinthia			
	Annex 1 B			Grade III	Grade II			Klasse B	Klasse AB	Klasse A	Klasse I
Cd	20 – 40	10	10	8	2	4	10	2.5	2	1	0.7
Cr	-	500	500	500	50	300	500	100	70	70	70
Cu	1000 – 1750	500	500	500	300	500	500	300	300	150	70
Hg	16 – 25	10	10	8	2	4	10	2.5	2	0.7	0.4
Ni	300 – 400	100	100	100	25	100	100	80	60	60	25
Pb	750 – 1200	500	400	400	100	150	500	150	150	150	45
Zn	2500 – 4000	2000	2000	2000	1500	1 800	2000	1800	1200	500	200
Co	-			100	10		100				
Mo	-						20				
As							20				

Burgenland – Sewage sludge and compost management order of 8/02/2001, *LGBl No. 4/2001 Stück 4 (Verordnung der Burgenländischen Landesregierung vom 31. Jänner 2001, mit der die Bgld. Klärschlamm- und Müllkompostverordnung geändert wird Ausgegeben und versendet am 8. Feber 2001)*

Tirol – Law on the protection of agricultural fields of 05/07/2000, *LGBl. No. 58/2000 Stück 26 (Gesetz vom 5. Juli 2000 über den Schutz des Feldgutes und die Ausbringung von Klärschlamm (Tiroler Feldschutzgesetz 2000) ausgegeben am 12. September 2000).*

²⁴ Regulations from 8 out of 9 Länder have been collected. The Land of Salzburg has not transposed the Directive 86/278/EEC yet.

²⁵ Guide values set by Tirol (*Richtlinie für die Ausbringung von Klärschlamm auf Böden*, 1987) and Salzburg (*Richtlinie für die Klärschlammverwertung in der Landwirtschaft*, 1987) are almost identical to the limit values set in Steiermark (with one exception : no limit value is set in Salzburg for molybden). Tirol adopted an ordinance on 5.7.2000 concerning sludge use in agriculture, in which it is stated that the regional government have to set limit values for heavy metals in sludge, soil, and determine maximum allowable application rates for sludge.

Only in the case of Carinthia, Steiermark and Burgenland does the regulation specify maximum annual average loads of heavy metals to agricultural land (although guide values are set for Salzburg), as follows:

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Burgenland		Steiermark		Carinthia
	Annex 1 C	Crops	Pasture	Crops	Pasture	
Cd	150	25	12,5	25	12,5	6
Cr	-	1250	625	1250	625	350
Cu	12000	1250	625	1250	625	1800
Hg	100	25	12,5	25	12,5	6
Ni	3 000	250	125	250	125	300
Pb	15 000	1250	625	1250	625	600
Zn	30 000	5000	2500	5000	2500	4500
Co	-			250	125	
As	-			50	25	
Mo	-			50	25	

Carinthia, Lower Austria and Upper Austria have set maximum quantities of sewage sludge for use in agriculture. These limits are 2,5 tonnes of dry matter per hectare and per year in Lower Austria, while in Upper Austria, quantities of sludge used on land for a three year period cannot exceed 10 tonnes of dry matter per hectare for sludge containing more than 35% of dry solids, or 5 tonnes if sludge contains less than 35% of dry solids. In Carinthia, maximum quantities of sewage sludge to be spread are 4.8, 6, 8 or 10 t DM/ha/2 years according to the sludge type (see previous table).

Limit values for pathogens in sludge

On the basis of collected information, there are no specific requirements on these aspects in most regional regulations. However, the regulations in Burgenland and Lower Austria specify that sewage sludge spread on "grassland and arable land on which forage is grown" should comply with the following conditions:

- *"no more than 1000 Enterobacteriaceae are found per 1 g of sewage sludge;*
- *1 g of sewage sludge is free from Salmonella;*
- *there are no worm larvae present which pose a risk to animal or human health."*

The regulation of Carinthia specifically addresses treated sludge, that is biologically treated or composted sludge. Possible treatment processes are listed in the law.

Limit values for organic compounds in sludge

In Carinthia, Upper Austria, Lower Austria and Vorarlberg, regulations on sewage sludge impose limit values for organic compounds in sludge, which are given in the following table.

	Unit	Upper Austria	Lower Austria	Vorarlberg	Carinthia
PCB	mg/kg DM	0.2	0.2	0.2	1
PCDD/Fs	ng TE/kg DM	100	100	100	50
AOX	mg/kg DM	500	500	-	500
PAH	mg/kg DM	-	-	-	6

Limit values for soil for application

Most Länder have fixed their own limit values, while Salzburg and Tirol have only fixed guide values²⁶. Most of these limit values are similar to those set in Directive 86/278/EEC. The regulation in Steiermark has also included limits on heavy metals concerning cobalt and molybden, which are not covered by Directive 86/278/EEC.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Burgen- land	Upper Austria	Lower Austria	Vorarlberg	Steiermark	Carinthia		
	6<pH<7						5<pH<5.5	5.5<pH<6.5	pH>6.5
Cd	1 – 3	2	1	1,5 (1 if pH<6)	2	2	0.5	1	1.5
Cr	-	100	100	100	100	100	50	75	100
Cu	50 – 140	100	100	60	100	100	40	50	100
Hg	1 – 1.5	1.5	1	1	1	1	0.2	0.5	1
Ni	30 – 75	60	60	50	60	60	30	50	70
Pb	50 – 300	100	100	100	100	100	50	70	100
Zn	150 – 300	300	300 (150 if pH<6)	200	300	300	100	150	200
Co						50			
Mo						10			

Obligation for treatment

The regulation in Vorarlberg defines the only type of sludge which can be used on land as "*biologically stabilised sewage sludge from sewage purification sludge*", which shall also be "*composted or heat-dried*". Carinthian legislation only addresses treated sludge, that is sludge after biological treatment. Possible sludge treatments are also indicated in the legislation. However, obligations for treatment are not systematically described in Austrian legislation.

Surfaces on which use of sludge is prohibited

In most Länder, sludge may not be spread on:

- meadows, pastures, alpine pastures
- waterlogged or frozen soil or soil fully covered by snow,
- vegetable crops, berries or medicinal herbs. These crops will not be grown for one year on soils on which sewage sludge has been spread.
- on inclined land (for sludge containing less than 10% of DM)

In addition, when spreading sewage sludge near flowing water or standing water, caution must be taken to avoid impacts on those waters.

Further quality restrictions

Certification and information requirements

Information requirements vary according to regional specifications, however in most cases analyses of sludge quality are to be carried out according to periods which vary depending on the size of the treatment plant. These periods vary from 3 months to 10 years in Lower Austria, from 6 months to 3 years in Upper Austria, from 2 to 6 months in Steiermark. In Lower Austria, regardless of the

²⁶ Identical to the limit values set in Steiermark, except for nickel in the guide values set in Tirol (50 mg/kg dry matter).

capacity of the sewage treatment plant, the organic pollutants PCB, PCDD and PCDF shall be analysed every 24 months for grades II and III, corresponding to different quality levels (see previous table).

The regulation in Lower Austria specifies²⁷ that a safety certificate shall be issued on the basis of analytical findings concerning the quality of sludge. Similarly, a certificate of suitability shall be issued by the Provincial Government in Upper Austria before sludge is used on land.

In the case of the Vorarlberg region, the regulation specifies that an expert report must be presented for all areas on which sewage sludge is used, in order to verify compliance with the regulatory limits for heavy metals in soil.

Codes of practice and guides

No codes of practice specific to landspreading have been published. The regulation in the Steiermark region states that sludge landspreading should be carried out in accordance with good practices for fertiliser use.

Voluntary agreements on disposal and recycling of sludge

There have been no voluntary agreements on sewage sludge in Austria.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

In Austria the use of sewage sludge in forests is forbidden under section 16 of the Forest Law²⁸. However "forest gardens", forest seed plantations and Christmas tree plantations are no forests in the definition of section 1 of the Austrian Forest Law.

Natural forest and reforested area

See above (section 1.41).

Land reclamation

The regulation in Vorarlberg²⁹ specifies that "*recultivation using sludge as a fertiliser (Klärschlammdünger)*" (defined in this regulation as composted or heat-dried sewage sludge), for areas where the soil has been "*considerably damaged by human intervention*" is permissible, provided that heavy metals limits are respected.

Green areas

No specific requirements are mentioned in the regulation for this use of sludge.

²⁷ Article 4

²⁸ Forest Law of 1975, BGBl. No. 440/1975 (*Forstgesetz*) in der Fassung der Bundesgesetze BGBl. Nr. 231/1977 und 142/1978 ; revised 12/04/1987, BGBl. No. 576/1987)

²⁹ Paragraph 10

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration of waste. In addition, no specific elements address incineration in the legislation on sludge use.

Disposal to landfill

According to the Austrian Landfill Ordinance of 1996³⁰, all waste will have to be treated³¹ from 2004 onwards before being landfilled in a way that the biological reactivity is reduced. Landfilling will be allowed only for waste containing a maximum of 5 % of organic matter or for waste which have undergone a mechanical biological treatment before being landfilled. This evolution should therefore contribute to reducing the quantities of sludge disposed to landfills.

³⁰ Landfill Ordinance of 10.4.96, BGBl. No. 164/1996 ST0049 (*Verordnung des Bundesministers für Umwelt über die Ablagerung von Abfällen - Deponieverordnung*).

³¹ The two possible treatments being incineration and mechanical biological treatment.

Belgium

Belgium has a federal structure, and is divided into three regions:

- the Flemish region;
- the Walloon region;
- the region of Brussels.

National authorities are in charge of taking global policy initiatives in the field of the environment, while the regions are responsible for transposing these initiatives into regional regulations as well as for the implementation of these measures. The recycling of waste to land is now regulated at regional level.

As in the Brussels region there is almost no agricultural activity, the current report will focus only on the Flemish and Walloon regions and regulations³².

Flemish region

Reviewed by Kathleen Schelfhout, March 2001

Openbare Afvalstoffenmaatschappij voor het Vlaamse Gewest - OVAM

Competence and legal structure

Competence

The Public Waste Agency for the Flemish Region (*Openbare Afvalstoffenmaatschappij voor het Vlaamse Gewest - OVAM*) has the responsibility for waste management and issues authorisations for recycling waste to land. Aquafin, a company which is controlled by OVAM, is in charge of urban waste water treatment as well as of urban sludge management.

Legal structure

The Flemish Decree on waste prevention and waste management (VLAREA) of 17 December 1997, and its amendment of 9 February 2001 give effect to Directive 86/278/EEC³³.

Types of sludge covered by legislation

The VLAREA Decree covers both the landspreading of industrial waste and the landspreading of urban sewage sludge. Sludge defined in this Decree is identical to the definition provided in Directive 86/278/EEC.

³² Environment matters are since 1989 monitored in the Brussels region by the *Institut Bruxellois de l'Environnement* (IBGE).

³³ Decree on waste prevention and waste management of 17.12.97, BS 18.4.98 (*Het Vlaams Reglement inzake afvalvoorkoming en -beheer VLAREA*).

Specific requirements for use of sludge in agriculture

As of December 1st, 1999, the use of urban sewage sludge for land spreading is prohibited in Flanders³⁴. This prohibition is not applicable for "sewage sludge treated to reduce its content of hydrosoluble forms of nutrients, nitrogen and phosphorus by at least 85 %, when compared to untreated sludge, so that it can be used in soil with a pH of 7". However, as this provision only concerns a negligible quantity of sewage sludge (less than 5 %), this Decree is in practical terms close to a total prohibition of sludge land spreading.

Limit values for heavy metals in sludge

Within the limitations above mentioned, the use of sludge as secondary material in fertiliser or as improving agent in soil is permitted provided that the limit values in sludge are respected.³⁵ All limit values³⁶ for heavy metals in sludge are more stringent than as is specified in Directive 86/278/EEC. For instance, the limit value for nickel is three times stricter than those set by the Directive 86/278/EEC. In addition, limit values have been introduced for arsenic.

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Flanders
	Annex 1 B	
Cd	20 – 40	6
Cr	-	250
Cu	1000 – 1750	375 (125 from 01/01/2008)
Hg	16 – 25	5
Ni	300 – 400	100
Pb	750 – 1200	300
Zn	2500 – 4000	900 (300 from 01/01/2008)
As		150

The Decree³⁷ specifies limit values for metals maximum annual input in land, as follows:

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Flanders
	Annex 1 C	
Cd	150	12
Cr	-	500
Cu	12000	750 (250 from 01/01/2008)
Hg	100	10
Ni	3 000	100
Pb	15 000	600
Zn	30 000	1800 (600 from 01/01/2008)
As		300

³⁴ Article 4.2.1.2

³⁵ Article 4.2.1.1 paragraph 1.1, which refers to the values presented in Annex 4.2.1.A

³⁶ Annex 4.2.1.A

³⁷ Annex 4.2.1.B

In addition, maximum quantities of sludge for use in agriculture are also specified in the Decree. These limits are 4 tonnes of dry matter per hectare every two years for arable land, and 2 tonnes of dry matter per hectare every two years for pasture land.

Limit values for pathogens in sludge

There are no specific requirements concerning pathogens.

Limit values for organic compounds in sludge

The VLAREA Decree specifies limit values for approximately 30 different organic compounds.

Organic compounds	Maximum concentration <i>mg/kg of Dry Matter</i>
Benzene	1,1
Ethylbenzene	1,1
Styrene	1,1
Toluen	1,1
Xylen	1,1
Benzo(a)anthracene	0,68
Benzo(a)pyrene	1,1
Benzo(ghi)perylene	1,1
Benzo(b)fluoranthene	2,3
Benzo(k)fluoranthene	2,3
Chrysene	1,7
Phenanthrene	0,9
Fluoranthene	2,3
Indeno(1,2,3cd)pyrene	1,1
Naphtalene	2,3
Monochlorobenzene	0,23
Dichlorobenzene	0,23
Trichlorobenzene	0,23
Tetrachlorobenzene	0,0045
Pentachlorobenzene	0,0045
Hexachlorobenzene	0,023
1,2-dichlorethane	0,23
Dichloromethane	0,23
Trichloromethane	0,23
Trichlorethene	0,23
Tetrachloromethane	0,23
Tetrachlorethene	0,23
Vynil chlorure	0,23
Octane	11

Sludge has to be sampled and analysed at least every 6 months. According to the origin, the OVAM may allow a reduction in the number of parameters to be analysed³⁸.

³⁸ Article 4.1.4

Limit values for soil for application

The Decree³⁹ and especially its amendment of 9 February 2001 provide limit values for heavy metals in soil generally more stringent than as is specified in Directive 86/278/EEC. For instance, the limit value for nickel is stricter than the value specified in the same Directive. The limits refer to a standard soil of 10% clay and 2% organic matter.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Flanders
	6<pH<7	
Cd	1 – 3	0.9
Cr	-	46
Cu	50 – 140	49
Hg	1 – 1.5	1.3
Ni	30 – 75	18
Pb	50 – 300	56
Zn	150 – 300	170
As		22

Obligation for treatment

The VLAREA Decree prohibits the use of untreated sludge⁴⁰.

Surfaces on which use of sludge is prohibited

The use of sludge is forbidden on the following surfaces:

- grassland or forage crops if the grassland is to be grazed or the forage crops to be harvested before a period of six weeks has elapsed,
- soil in which fruit or vegetable crops are growing, with the exception of fruit trees during the growth period,
- ground intended for the cultivation of fruit or vegetable crops which are normally in direct contact with the soil and normally eaten raw, for a period of 10 months preceding the harvest of crops and during the harvest itself,
- in areas close to forage and sources, and in zones I and II as defined in the Decree of 24 January 1984 on underground water protection⁴¹

³⁹ Sub-Annex 4.2.1.B

⁴⁰ Article 4.2.1.2

⁴¹ Decree on groundwater water protection of 24/1/1984, *Moniteur Belge* 5/6/1984 (*Décret du 24 janvier 1984 portant des mesures en matière de gestion des eaux souterraines*). Zones I and II are areas defined in order to protect water tables.

Apart from the last paragraph, the requirements are therefore similar to the requirements set in Article 7 of Directive 86/278/EEC.

Further quality related restrictions

Certification and information requirements

Anyone wishing to use sludge must receive a certificate of utilisation from the OVAM, as specified in the Decree. The certificate of utilisation is specified in the list of potential secondary raw materials⁴². The procedure to get a certificate is described in the section 4.3.

In addition, sludge producers must undertake sludge sampling after treatment and before delivery to the user⁴³. They also must undertake sludge analysis at least every six months. As regards soil, the sludge producers must undertake soil sampling and soil analysis which conditions are specified in sub annex 4.2.1.C of the same Decree.

Codes of practice and guides

On the basis of the information collected, no codes of practice specific to sludge use have been implemented.

Voluntary agreements on disposal and recycling of sludge

There have been no voluntary agreements over recycling of sludge.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The Forest Decree⁴⁴ prohibits the use of waste (including sludge) in forests (without making a distinction between natural and cultivated forests).

Natural forest and reforested area

As for silviculture, the Forest Decree prohibits the use of sludge in forests.

Land reclamation

The use of sludge, in conformity with the limit values defined by the regulation, as covering layer for landfills falls under "black soil" applications. This latter entails the sludge being mixed with other materials such as sand. After due maturation this results in a product that can be used in shrubberies and other **green areas**, as well as the final covering layer for landfills. In practice the use of sludge in black soil is limited.

Green areas

See above paragraph on land reclamation.

⁴² Annex 4.1

⁴³ Sub annex 4.2.1.C

⁴⁴ Article 96 and 97, Forest Decree of 13.6.90, BS 28/09/1990 (*Bosdecreet*).

Specific requirements or legislation for other routes

Incineration

The regulations governing the incineration of sludge are included in VLAREM I and II⁴⁵. This mostly concerns limits on emissions. In particular, the VLAREM II legislation sets standards⁴⁶ for the incineration of domestic waste or waste considered as equivalent to domestic waste, such as sewage sludge. However, sludge co-incinerated in plants originally not built for waste (cement kilns, power stations, etc.) are submitted to the VLAREM legislation, the legislator's purpose being to restrict co-incineration of sludge meeting minimal quality requirements.

Disposal to landfill

Sludge Landfills are also regulated by VLAREM I and II. These specify the conditions under which sludge may be disposed of.

Walloon region

Reviewed by Jacques Defoux, March 2001

Direction Générale des Ressources Naturelles et de l'Environnement - DGRNE

Competence and legal structure

Competence

In the Walloon Region, the Administration of the Environment (*Direction Générale des Ressources Naturelles et de l'Environnement - DGRNE*) is in charge of environment related matters. Planning, technical aspects as well as the control of waste law implementation is carried out by a specific division of the DGRNE, the waste division (also referred to as the *Office régional wallon des déchets - OWD*). At regional level, eight *intercommunales* are in charge of waste water treatment.

Legal structure

The Council Directive 86/278/EEC is given effect by the Walloon Government Order of 12 January 1995 concerning the use of sewage sludge and of sludge in and on the soils⁴⁷.

Types of sludge covered by legislation

In the Walloon region, the landspreading of industrial sludge is covered under the same law as the landspreading of urban sewage sludge.

⁴⁵ Flemish provision on environmental pollution of 01/06/1995 and 24/03/1998, BS 01/08/1995 and 30/04/1998 (*Vlaams Reglement voor Milieuvergunningen*; *Vlarem I*: BVR 1 June 1995, BS 1 August 1995; *Vlarem II*: BVR 24 March 1998, BS 30 April 1998)

⁴⁶ Flemish provision on environmental pollution II, BS 30/04/1998 (*Vlaams Reglement voor Milieuvergunningen - VLAREM II*), article 5.2.3.3.

⁴⁷ Walloon Government Order on the use of sewage sludge of 12.1.95, *Moniteur Belge* 12.4.95 (*Arrêté du Gouvernement wallon portant réglementation de l'utilisation sur ou dans les sols des boues d'épuration ou de boues issues de centres de traitement de gadoues de fosses sceptiques*).

The Government Order of 12 January 1995 covers in its article 1, residual sludge stemming from domestic waste water treatment plants, industrial waste water sewage treatment plant and septic tanks.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The use of sludge in soil is permitted provided that the sludge is not dangerous and not toxic according to the OWD and provided that the limit values⁴⁸ for heavy metals are respected. All these limit values are more stringent than as is specified in the Council directive 86/278/EEC but not as stringent as the Flemish regulation (except for copper for which the limit value is stricter than both the maximum concentration specified in the same Directive and in the Flemish Decree).

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Walloon
	Annex 1 B	
Cd	20 – 40	10
Cr	-	500
Cu	1000 – 1750	600
Hg	16 – 25	10
Ni	300 – 400	100
Pb	750 – 1200	500
Zn	2500 – 4000	2 000

The Order also defines maximum quantities of sludge for use on land. These limits are 12 tonnes of dry matter per hectare every three years for arable land, and 6 tonnes of dry matter per hectare every three years for pasture land.

Limit values for pathogens in sludge

The regulation contains no specific requirements for pathogens in sludge.

Limit values for organic compounds in sludge

The regulation contains no specific requirements for organic compounds in sludge.

⁴⁸ Annex I A

Limit values for soil for application

The limit values for soil⁴⁹ are very similar to those set by the Directive 86/278/EEC with the exception of chromium which is not addressed by the Directive. Sludge can only be used on soil with a pH above 6.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Walloon
	6<pH<7	
Cd	1 – 3	2
Cr	-	100
Cu	50 – 140	50
Hg	1 – 1.5	1
Ni	30 – 75	50
Pb	50 – 300	100
Zn	150 – 300	200

Obligation for treatment

Article 9 (paragraph 2) specifies that where treated sludge is to be used, the user must incorporate it in soil within 24 hours, treated sludge being defined as in Directive 86/278/EEC. Where untreated sludge is to be used, the user must inject it or incorporate it directly into the soil.

Surfaces on which use of sludge is prohibited

The use of sludge is prohibited⁵⁰ on:

- grassland or forage crops if the grassland is to be grazed or the forage crops to be harvested before a period of six weeks has elapsed,
- soil in which fruit or vegetable crops are growing, with the exception of fruit trees after harvesting and before the next flowering,
- ground intended for the cultivation of fruit or vegetable crops which are normally in direct contact with the soil and normally eaten raw, for a period of 10 months preceding the harvest of crops and during the harvest itself,
- on forest soil,
- in natural *reserves* created or licensed pursuant to law of 12 July 1973 concerning nature conservation, on wetlands defined in the Walloon Regional Order of 8 June 1989 concerning the protection of wet areas with a biological interest, in natural areas and natural areas of scientific interest as defined in article 178 of the Walloon Code for the land use,
- at a distance below 10 metres from wells, sources, underground water storage installations, river shores, water logged areas,
- on soils permanently frozen since more than 24 hours.

⁴⁹ Annex I B

⁵⁰ Article 9, paragraph 1

Further quality related restrictions

Certification and information requirements

In order to be used in agriculture, sludge must obtain both a licence for use delivered by the regional authorities⁵¹, as well as a derogation from the Federal Agriculture Ministry, in accordance with the Royal Order of 7 January 1998. The licence for use can be obtained only if the sludge is not considered dangerous or toxic by the OWD. The Order holds⁵² that sludge must be analysed and that sludge users have to provide the producers with the necessary information concerning the sludge destination⁵³. Other information requirements specified in the order are similar to those specified in Directive 86/278/EEC. The Order also mentions⁵⁴ the fact that the producer is responsible of the conformity of sludge with the quality requirements set out in the regulation.

Codes of practice and guides

No codes of practice specific to sludge recycling in agriculture have been implemented.

Voluntary agreements on disposal and recycling of sludge

For the moment no voluntary agreements exist in the Walloon region, although ongoing discussions should lead to the signature of a voluntary agreement⁵⁵ in the near future.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The regulation does not specify any requirements on this aspect.

Natural forest and reforested area

Article 9 (paragraph 1) of the Order specifies that the use of sludge is prohibited on forest soil.

Land reclamation

The regulation does not specify any requirements on this aspect.

Green areas

The regulation does not specify any requirements on this aspect.

Specific requirements or legislation for other routes

Incineration

In the Walloon region, sludge incineration is regulated by the regulation on waste incineration⁵⁶.

⁵¹ Article 3

⁵² Article 4

⁵³ Article 5

⁵⁴ Article 6

⁵⁵ See sub-component report on sludge acceptance for more details.

Disposal to landfill

Sludge disposal to landfill is covered by the Government Order of 23 July 1987 on the landfill of waste⁵⁷.

⁵⁶ Government Order on air emissions from municipal waste incineration of 26.2.93, *Moniteur Belge* 26.2.93 (*Arrêté du Gouvernement wallon relatif à la lutte contre la pollution atmosphérique en provenance des installations d'incinération de déchets ménagers*).

⁵⁷ Government Order on controlled landfills of 23.7.87, *Moniteur Belge* 29.9.1987 (*Arrêté de l'Exécutif régional wallon relatif aux décharges contrôlées*)

Denmark

Reviewed by Inge Vibeke Hansen, August 2000

Danish Environmental Protection Agency.

Competence and legal structure

Competence

The main institutions in charge of environmental issues at national level are the Danish Ministry of Environment, which is the legislative authority, the Danish Environmental Protection Agency, and the Danish Plant Directorate. The regional authorities (14 *Regional Councils*) and local authorities (275 *Local Councils*) are the main bodies responsible for implementing environmental legislation. The Danish Plant Directorate is now the central authority for controlling the quality of sewage sludge used in agriculture, and the Danish EPA has the overall responsibility for enforcing the "Sludge Order".

Legal structure

In Denmark, three Statutory Orders lay down the rules governing sludge: the Statutory Order No. 590 of 27.6.94 on the Protection of the Environment⁵⁸, the "Sludge" Order (*Slambekendtgørelsen*) No. 49 of January 20, 2000 on Application of Waste Products for Agricultural Purposes (SO 2000/49)⁵⁹, and the Statutory Order No. 56 of January 24 2000⁶⁰ describing the control of sewage sludge for agricultural use (SO/2000/56).

The Sludge Order /2000/49 came into force on 2 February 2000 and implements Directive 86/278/EEC. The purpose of this Order is to describe the extent to which waste products (among them sludge) can be used for agricultural purposes without damaging the environment.

Types of sludge covered by legislation

The SO 2000/49 applies to the landspreading of industrial and municipal waste (and sludge).

In particular, it applies to waste from private households, institutions and enterprises, including composted waste, process waste water and sewage sludge, whenever the wastes are suitable for agricultural purposes and do not exceed limit values of substances presenting hazards to the environment.

⁵⁸ Statutory Order No. 590 of 27.6.94 on the Protection of the Environment, *LBK No. 590 of 27.6.94 (Bekendtgørelse af Lov om miljøbeskyttelse - Miljøloven)*.

⁵⁹ Statutory Order (Sludge Order - *Slambekendtgørelsen*) No. 49 of 20.1.2000 on the Application of Waste Products for Agricultural Purposes, *BEK No. 49 of 20.1.2000 (Bekendtgørelse om anvendelse af affaldsprodukter til jordbrugsformål)*. This Order replaces the Statutory Order . No. 823 of 16.9.96, on application of sludge, wastewater and compost for agricultural use, *BEK No. 823 of 16.9.96 (Bekendtgørelse om anvendelse af affaldsprodukter til jordbrugsformål)*

⁶⁰ Statutory Order No. 56 of 24.1.2000 describing the control of sewage sludge for agricultural use, *BEK No. 56 of 24.1.2000 (Bekendtgørelse om tilsyn med spildevandsslam m.m. til jordbrugsformål)*

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The Statutory Order 2000/56 determines the limit values for the content of heavy metals in sludge. Danish legislation is one of the strictest in the European Union regarding limit values for heavy metals in sludge. For instance, the limit value for nickel is ten times stricter than the Directive's requirements. It is to be noticed that the Statutory Order 2000/56 leaves the possibility for the waste producer to choose between dry matter related limit values or phosphorus related limit values (in this case, two kinds of limit values are established: prior to June 30, 2000 and after June 30, 2000). This choice is justified by the compulsory dephosphatation imposed to every treatment plant with a capacity above 5000 IE.

Limit values for heavy metals in sludge recycled to land (SO 2000/56)

	86/278/EEC mg/kg DM	Dry matter basis mg/kg DM	Total phosphorus basis mg/kg P	
			< 30 June 2000	> 1 July 2000
	Annex 1 B			
Cadmium^a	20 – 40	0.8	200	100
Mercury	16 – 25	0.8	200	200
Lead^b	750 – 1200	120	10,000	10,000
Nickel	300 – 400	30	2,500	2,500
Chromium	-	100		
Zinc	2500 – 4000	4,000		
Copper	1000 – 1750	1,000		
Arsenic^c		25		

^a Cadmium limit values were initially to be reduced to 0,4 mg/kg DM from July 1, 2000, according to SO 1996/823, however the SO 2000/56 has maintained 0,8 mg/kg DM for cadmium.

^b For private gardening, lead value is reduced to 60 mg/kg DM or 5000 mg/kg P.

^c For private gardening.

This Statutory Order also specifies that the maximum quantity of sludge to be spread on land is 10 tonnes of dry matter per hectare per year.

Limit values for pathogens in sludge

The only specific requirements on pathogens which exist in Danish legislation concern advanced treated sludge, which must have no occurrence of salmonella and faecal streptococci must be below 100 per g⁶¹.

⁶¹ SO 2000/49

Limit values for organic compounds in sludge

The Statutory Order 2000/56 includes limit values for xenobiotic organic compounds in sludge for agricultural use, which are described in the table below:

*Limit values for organic compounds in mg/kg of dry matter
(SO 2000/56)*

	<30 June 2000	1 July 2000 – 30 June 2002	>1 July 2002
LAS (Linear alkylbenzene sulphonate)	2,600	1,300	1,300
PAH (Polycyclic aromatic hydrocarbons - 8 elements)	6	3	3
NPE (Nonylphenol and nonylphenoethoxylate)	50	30	10
DEHP Di(2-ethylhexyl)phthalate	100	50	50

Limit values for soil for application

Limit values for heavy metals in soil⁶² are much lower than those established by Directive 86/278/EEC: for instance, the maximum concentration for nickel in soil is two times stricter than the Directive's requirement.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	DK
	6<pH<7	
Cd	1 – 3	0.5
Cr	-	30
Cu	50 – 140	40
Hg	1 – 1.5	0.5
Ni	30 – 75	15
Pb	50 – 300	40
Zn	150 – 300	100

⁶² SO 2000/56

Obligation for treatment

The Danish regulation prohibits the agricultural use of untreated sewage sludge. Annex 3 of the Sludge Order includes the following table which describes the "sanitary requirements for application of waste products":

Treatment requirements for different waste types (SO 2000/49)

		Treatment			
		Untreated	Stabilised ^a	Controlled composting ^b	Controlled pasteurisation ^c
Waste	A) Sludge. from vegetable production	✓	✓	✓	✓
	B) Sludge. from fish farming	Not for gardening	✓	✓	✓
	C) Sludge. from meat production	Not for agricultural purposes	Worked into the soil within 12 hrs after application. Not for gardening ¹ .	✓	✓
	D) Source separated waste	Not for agricultural purposes	Not for edible crops ² or gardening. Worked into the soil within 12 hrs after application ³ .	³	✓
	E) Sewage sludge	Not for agricultural purposes	Not for edible crops or gardening. Worked into ⁴ the soil within 12 hrs after application ⁵ .	Not for edible crops ² or gardening ⁵ .	✓

Notes⁶³:

✓ Can be used without sanitary restrictions.

¹ The restriction does not apply to stabilisation in biogas plants.

² Edible crops are crops which can be eaten raw excluding fruit tree crops.

³ In fields rearing cloven-footed animals, compost shall be applied and worked into the soil before sowing.

⁴ Working into means ploughing, harrowing, direct injection or other methods of working wastes into the soil.

⁵ In areas where sewage sludge is applied, until one year after last application only cereal or seed crops grown to maturity can be grown, and grass or the like for industrial dry fodder production. Moreover, edible crops may not be grown. For instance potatoes, grass and maize for silage or sugar beets shall not be grown

^a Stabilisation is defined as one of the following treatments; anaerobic digestion; aeration; composting without temperature control; addition of lime; 6 months storage.

^b Controlled composting is defined as composting with daily temperature measurement to ensure temperatures in all material not get below 55 °C for no less than two weeks.

^c Controlled pasteurisation is defined as one of the following treatments; pasteurisation at 70°C for not less than 1 hour; addition of lime, to ensure pH 12 in all material for a minimum of three months; thermophilic digestion or a combination of thermophilic and mesophilic digestion. At the time of delivery advanced treated products must have no occurrence of salmonella and faecal streptococci must be below 100 per g

⁶³ These notes are all taken from the Danish regulation

Surfaces on which use of sludge is prohibited

Sludge can not be applied on surfaces where sludge is likely to run off to lakes, watercourses or drains because of sudden thaw and rainfall, on surfaces where sludge is likely to cause pollution of groundwater and on surfaces where sludge is likely to cause significant nuisances or unsanitary conditions⁶⁴.

As regards the use of waste products by the user, it is stated that sludge, "*which can be applied to the soil under this Order shall be used for fertilisation purposes and form part of fertilisation planning*"⁶⁵. Furthermore, sanitary requirements specified for the application of waste products (see table in previous section) must be observed.

Further quality related restrictions

Certification and information requirements

At least every three months⁶⁶ the waste water treatment plant has to carry out representative analyses of heavy metals concentration in sewage sludge; as well as total phosphorus and total nitrogen content. At least once every twelve months, sludge has to be analysed to identify concentrations of organic compounds.

The manager of the waste water treatment plant has also to provide a declaration containing relevant information for the user and an annual report for the regional council before March 1st every year⁶⁷. The frequency of the analyses depends on the size and the capacity⁶⁸ of the waste water treatment plant (at least every three months).

In addition, the sludge producer and user must make a written agreement prior to delivery of sludge. The sludge producer is responsible for ensuring that the declaration accompanies the sludge and that the information provided is correct.

Codes of practice and guides

No guides or codes of good practice exist in Denmark for use of sludge in agriculture

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements on this matter in Denmark.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The local council can allow use of sludge in cultivated forests based on a need for fertilisation⁶⁹. The council can also establish specific restrictions for use.

⁶⁴ SO 2000/49

⁶⁵ SO 2000/49

⁶⁶ Annex 5 of SO 2000/49

⁶⁷ Point 12 of SO 1996/823

⁶⁸ Annex 1 of SO 2000/56

⁶⁹ Paragraph 5, part 2 of SO 2000/49

Natural forest and reforested area

No specific elements address natural forest in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

Sludge used in green areas must be pasteurised.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use.

Finland

Reviewed by Juhani Puolanne, March 2001

Finnish Environment Institute

Competence and legal structure

Competence

The Ministry of the Environment defines national regulation and controls the implementation of Finnish waste legislation. The Finnish Environmental Institute conducts research and training, disseminates information on new ideas and methods, and monitors all developments related to waste issues, while also participating in drawing up new legislation and guidelines related to waste.

Regional environment centres guide and monitor the implementation of the Waste Act in their own regions. Local authorities organise the collection, recovery and disposal of household refuse and other similar waste, and supervise waste management in general in their own area. They also set local regulations on waste management.

Legal structure

The main legislation concerning the use of sludge in agriculture is the Council of State Decision No.282/1994 on the use of sewage sludge in agriculture⁷⁰. This Decision was implemented in the context of the Waste Act 1072/93 and makes reference to the regulations of the Water Act No. 264/61 and of the Health Protection Act No. 469/65 which have to be observed in connection with handling, transport and use of sludge. The purpose of the State Decision is both to regulate the agricultural use of sewage sludge and *"to promote the appropriate use of sludge"*⁷¹. Fertilisers products derived from sludge are regulated by the Fertiliser Act No. 232/93⁷².

Types of sludge covered by legislation

The State Decision applies to sludge *"generated in municipal treatment plants, other sludge of comparable quality and sludge mixtures prepared from these"*. Sludge mixture is described⁷³ as follows: *"a sludge mixture shall mean a product obtained by mixing sludge with high-quality admixtures such as peat, lime or pure raw soil but not the fertiliser products referred to in section 2, paragraph 3"* (fertiliser products prepared from sludge, regulated by the Fertiliser Act).

⁷⁰ Council of State Decision No. 282 on the use of sewage sludge in agriculture of 5.12.94, OJ 282 of 14.4.94 (*Valtioneuvoston päätös puhdistamolietteen käytöstä maanviljelyksessä*).

⁷¹ Section 1 of the Council of State Decision

⁷² Section 2 of the Council of State Decision mentions this provision. The Fertiliser Act No. 232/93 concerns fertiliser products such as fertilisers, soil improvement agents, by-products suitable for use as fertilisers and composting products. However sewage sludge, when used as such, is excluded from the scope of the Fertiliser Act.

⁷³ Section 3

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

Limit values in Finland are actually among the strictest in the European Union, with Denmark and Sweden. For instance, the limit for concentration in sludge for Mercury (Hg) is 8 times stricter than the one specified in the Directive 86/278/EEC. In addition, the Decision goes further than the Directive since it provides for the maximum permissible concentrations of heavy metals in sludge suitable for use as a raw material in sludge mixtures. Another interesting feature in the Finnish legislation is that for certain heavy metals (Cd, Hg, Pb), target limit values were established as objectives for 1998 (in parenthesis). No new voluntary targets have been set since.

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Finland
	Annex 1 B	
Cd	20 – 40	3 (1,5)
Cr	-	300
Cu	1000 – 1750	600
Hg	16 – 25	2 (1)
Ni	300 – 400	100
Pb	750 – 1200	150 (100)
Zn	2500 – 4000	1500

In addition, the Finnish regulation specifies limit values for annual average load of heavy metals to land, as follows.

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Finland
	Annex 1 C	
Cd	150	1.5
Cr	-	300
Cu	12000	600
Hg	100	1
Ni	3 000	100
Pb	15 000	100
Zn	30 000	1500

Limit values for pathogens in sludge

No limit values for pathogens are specified in the State Decision, although treatment obligations described in stress the need to reduce the pathogen content⁷⁴.

Limit values for organic compounds in sludge

There are no limit values for organic compounds in sludge.

⁷⁴ Section 4

Limit values for soil for application

As for heavy metals in sludge, the limit values for heavy metals in soil for sludge application are amongst the lowest in the EU. Limit values which are strictly lower than those set by the Directive are highlighted in the table below.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Finland
	6<pH<7	pH>5,8 ^a
Cd	1 – 3	0.5
Cr	-	200
Cu	50 – 140	100
Hg	1 – 1.5	0.2
Ni	30 – 75	60
Pb	50 – 300	60
Zn	150 – 300	150

^a pH>5,5 for lime stabilised sludge

Obligation for treatment

The State Decision specifies that *"sludge shall be treated before agricultural use with digestion or lime stabilisation or with some other method capable of significantly reducing its pathogen content"⁷⁵ and odours and harm to health or the environment arising from the use of sludge."*

Surfaces on which use of sludge is prohibited

Sludge may be used only on soil on which grain, sugar beet, oil-bearing crops or crops not used for human food or animal feed are cultivated. Sludge may be spread on grassland only when the grass and nurse crops are sown together and it must be ploughed in carefully. In addition, potatoes, root crops and vegetables may not be cultivated on arable land until at least five years have passed after sludge was used on it⁷⁶.

Further quality related restrictions

Certification and information requirements

The Decision requires that sludge and cultivated soil analysis may be taken at short intervals in order to control their quality. The frequency of the analyses depends on the size of the waste water treatment plant (for instance, treatment plants which have a capacity superior to 100 000 PE must carry out at least 12 analyses the first year, and at least 4 analyses per year the following years).

This control must be provided in conjunction with the information given to the users of the sludge by the operator of a sewage treatment plant who is required to keep records and reporting.

In the framework of the Environment Act (86/2000), waste treatment and recycling activities require a permit. The Environment Protection Decree (169/2000) states that landfills, incinerators, composting plants as well as any waste treatment or recycling plants have to be licensed, either by the local authorities (if the quantities are less than 5000 tonnes per year) or by the regional environmental centre (for quantities superior to 5000 tonnes). However, spreading and use of sewage sludge, when carried out in accordance with the Council of State Decision on the use of Sewage Sludge in Agriculture, is exempted from the requirement of obtaining a permit.

⁷⁵ However, the regulation does not further specify this aspect, and does not provide any limit values on pathogens content. (Section 4)

⁷⁶ Section 6

Codes of practice and guides

Recommendations on the use of sewage sludge in agriculture have been established in 1991 by the Finnish authorities. A great number of elements from these recommendations have been transposed in the State Decision.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements on sewage sludge in Finland, to our knowledge.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

According to the Decision of the Ministry of Agriculture and Forestry (46/1994), soil improving agents, fertilised growing media, compost products and by-products used as such must comply with requirements on heavy metal concentrations which are the same as those specified in the Council of State Decision on the use of Sewage Sludge in Agriculture, but expressed in mg/kg fresh weight (soil improving agents and compost products). The limit values given for fertilised growing media are expressed in mg/l in Decision (46/1994) and they are numerically identical with those for soil in the Council of State Decision, with one exception: Chromium is replaced by Arsenic (10 mg/l). Soil improving agents used in public green areas or for landscaping purposes do not need to comply with the requirements, as landscaping often takes place on road slopes and landfills, where certain pollution levels already exist.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use.

France

Reviewed by Jacques Wiart, March 2001

Agence de l'Environnement et de la Maîtrise de l'Energie - ADEME

Competence and legal structure

Competence

Environmental issues are regulated by the central government in France. Different types of legislation exists, as laws are rules adopted by the National Assembly while Statutory orders or Decrees are decisions made by the Government which may have the same validity as the laws.

Local authorities are responsible for the collection, treatment and disposal of municipal waste, including urban sludge. Local authorities usually also collect waste from small businesses, although industries are responsible for their own waste, under the supervision of French administration (*Direction Régionale de l'Industrie, de la Recherche et de l'Environnement*). Non-hazardous waste management is planned at a county (*Département*) level, whereas hazardous waste management is planned at a regional (*Région*) level. This means that the disposal or recycling of sludge is to be realised within the county, although it is not always the case at present.

Legal structure

Agricultural use of sludge is regulated by the Decree No. 1133 of December 8, 1997⁷⁷ and by the Enforcement Order dated January 8, 1998⁷⁸. The use of industrial sludge is covered by the Order of August 17, 1998⁷⁹. This recent legislation was implemented in the broader context of the 1992 Water Act⁸⁰, the 1975 and 1992 Waste Acts⁸¹ and the Health Code. In particular, the 1992 Waste Act restricts the landfilling of sewage sludge from 2002 onwards, as the landfilling of waste will then be limited to waste that cannot be recovered at reasonable cost (defined as "ultimate waste").

Types of sludge covered by legislation

Sludge is defined as "the residual sediment from sewage treatment plants and from sewage biological, physical or chemical pre-treatment of waste water"⁸². This sludge is considered a waste

⁷⁷ Decree No. 97/1133 on sludge spreading of 8.12.97, *Journal Officiel* 10.12.97 (*Décret n. 97/1133 relatif à l'épandage des boues issues du traitement des eaux usées*)

⁷⁸ Order of 8.1.98 on the technical requirements for the use of sludge in agriculture, *Journal Officiel* 31.1.98 (*Arrêté fixant les prescriptions techniques applicables aux épandages de boues sur les sols agricoles pris en application du décret n. 97/1133*)

⁷⁹ Order of 17.8.98 concerning the emissions from some industrial activities, *Journal Officiel* 17.11.98 (*Arrêté modifiant l'arrêté du 2 février 1998 relatif aux prélèvements et à la consommation d'eau ainsi qu'aux émissions de toute nature des installations classées pour la protection de l'environnement soumises à autorisation*).

⁸⁰ Water Act No. 92/3 of 3.1.92, *Journal Officiel* 4.1.92 (*Loi n. 92/3 sur l'eau*)

⁸¹ Waste Act No. 75/633 of 15.7.75, *Journal Officiel* 16.7.75 (*Loi n. 75/633 relative à l'élimination des déchets et à la récupération des matériaux*) and law on waste disposal No. 92/646 of 13.7.92, *Journal Officiel* 14.7.92 (*Loi n. 92/646 relative à l'élimination des déchets ainsi qu'aux installations classées pour la protection de l'environnement*)

⁸² Chapter 1, provision 1, Decree 97/1133;

as defined in the 1975 law⁸³. However, the Decree does not apply to products composed of sludge which are covered either by an authorisation of use or a national standard ("*homologation*"), in accordance with the 1979 Law on fertilisers⁸⁴.

The Order of August 17, 1998 covers landspreading of industrial sludge or waste, and states that only waste products likely to be of positive or nutritive effect for the crops can be used in agriculture⁸⁵. This Order sets requirements similar to those set by the Enforcement Order dated January 8, 1998, but prohibits landspreading of certain types of abattoir sludge.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge described in the Order dated January 8, 1998 correspond in most cases to the lower limits set by the Directive 86/278/EEC. Limit values which are strictly lower than those set by the Directive are highlighted in the table below.

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	France
	Annex 1 B	
Cd	20 – 40	15 ^a
Cr	-	1 000
Cu	1000 – 1750	1 000
Hg	16 – 25	10
Ni	300 – 400	200
Pb	750 – 1200	800
Zn	2500 – 4000	3 000

^a 10 mg/kg DM from January 1, 2004

Limit values for metals maximum annual input in land are also⁸⁶. A different set of values must be applied if sludge is applied on pasture land or on soil with a pH below 6, as follows:

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	France	
	Annex 1 C	General use	Pasture land or soil pH < 6
Cd	150	15	15
Cr	-	1 500	1200
Cu	12000	1 500	1200
Hg	100	15	12
Ni	3 000	300	300
Pb	15 000	1 500	900
Zn	30 000	4 500	3000
Se^b			120

^b Only for pasture land

⁸³ Article 2

⁸⁴ Law on Fertilisers No. 79/595 of 13.7.79, *Journal Officiel* 14.7.79 (*Loi n. 79/595 relative à l'organisation du contrôle des matières fertilisantes et des supports de culture*)

⁸⁵ Section 4, provision 36, Order of August 17, 1998.

⁸⁶ Annex I, Order of January 8, 1998

Limit values for pathogens in sludge

Sludge for agricultural use will be considered as “hygienised” sludge only if the following limit values for pathogens in sludge are respected⁸⁷:

- Salmonella: 8 MPN⁸⁸/10 g of dry matter;
- enterovirus: 3 MPCN⁸⁹/10 g of dry matter and
- helminths eggs: 3/10 g of dry matter.

Limit values for organic compounds in sludge

Limit values for organic compounds are specified in the legislation⁹⁰. Different values are specified differentiating limit values in sludge and the maximum cumulated flux between the general use and the spreading on pasture land. Therefore, there are four limit values for each organic compound, as follows:

Limit values for organic compounds in sludge

	<i>Limit value (mg/kg DM)</i>		<i>Maximum load over a ten years period (mg/m³)</i>	
	<i>General use</i>	<i>Pasture land</i>	<i>General use</i>	<i>Pasture land</i>
PCB(7 elements)	0.8	0.8	1.2	1.2
Fluoranthene	5	4	7.5	6
Benzo(b)fluoranthene	2.5	2.5	4	4
Benzo(a)pyrene	2	1.5	3	2

Limit values for soil for application

The limit values for heavy metal levels in soil⁹¹ are very similar to those set by the Directive 86/278/EEC, as described below. In addition, landspreading is not authorised if the soil pH is below 5.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	France
	6<pH<7	
Cd	1 – 3	2
Cr	-	150
Cu	50 – 140	100
Hg	1 – 1.5	1
Ni	30 – 75	50
Pb	50 – 300	100
Zn	150 – 300	300

Obligation for treatment

Sludge has to be treated before being used in agriculture⁹². Treated sludge is defined in the same provision, identically to the definition provided by Directive 86/278/EEC. Untreated sludge may be

⁸⁷ Provision 16, Order of 8 January 1998

⁸⁸ Most Probable Number

⁸⁹ Most Probable Cytophatic Number

⁹⁰ Annex I,

⁹¹ Annex I,

⁹² Provision 7, Decree 97/1133

used if it is directly injected in the soil⁹³. Further treatment requirements can be specified by the local authorities depending on the quality of the soils.

Surfaces on which use of sludge is prohibited

Land spreading of sewage sludge is prohibited when the soil is frozen or heavily covered with snow, during periods of heavy rains, on other surfaces than those that are regularly worked out, and on sloping lands. In addition to these prohibitions, the land spreading of sludge is not permitted on lands which are close to rivers, coastal waters (in specific cases) and other areas presenting a risk for groundwater⁹⁴.

Further quality related restrictions

Certification and information requirements

The 97/1133 Decree also establishes that before any landspreading of sludge, a preliminary study must be carried out by the sludge producer⁹⁵, identifying in particular sludge treatment and quality as well as soil quality. In addition, a landspreading plan (*programme prévisionnel*) must be established each year⁹⁶, specifying the quantities of sludge to be spread on land, the scheduling of each landspreading operation as well as the parcels which will receive sludge. A report (*bilan*) on the sludge spread on land and on the resulting impacts on soil qualities must be established⁹⁷ at the end of the year (defined as the end of the "agricultural campaign"). Both the landspreading plan and annual report must be transmitted to the local authorities (*préfet*) by the sludge producer. The local authorities (*préfet*) also have the possibility to ask an independent organisation to monitor sludge landspreading⁹⁸.

The sludge producer is required⁹⁹ to carry out a preliminary analysis in order to assess the ability of soil to receive sludge, to ensure the regulatory compliance of the practice, and to describe the operating process of the sludge spreading. The sludge producer shall also regularly control the quality of the sludge. The conditions of the analysis to be undertaken are specified in annex IV of the Order of 8 January 1998. The number of analyses per year is related to the tons of dry matter spread on land, and can reach 48 the first year landspreading is carried out, when the quantities used on land are superior to 4800 tons DM. The sludge producer has the obligation to keep a register on the quality of sludge, the quantities spread on land, as well as information on the areas where sludge has been spread. These informations are to be communicated to users of sludge.

Codes of practice and guides

Several codes of good practice have been developed by local agricultural chambers, in order to provide guidance on the use of sewage sludge in agriculture.

Voluntary agreements on disposal and recycling of sewage sludge

No voluntary agreements on sewage sludge exist in France, although ongoing discussions could lead to the signature of such an agreement in the near future.

⁹³ Article 12, Order of January 8, 1998

⁹⁴ Article 15, Decree 97/1133

⁹⁵ Article 2

⁹⁶ Article 3

⁹⁷ Article 4

⁹⁸ Article 18

⁹⁹ Article 8,

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

Requirements defined for the use of sewage sludge on agriculture also apply to natural forest areas, whether public or private, under the conditions that risks for humans as well as for the fauna are minimised¹⁰⁰.

Land reclamation

Use of sewage sludge for land reclamation must be adapted to the particularities of the soil (considering other substances which may have been introduced in the soil). In addition, use of sludge is prohibited in mines or quarries¹⁰¹.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

In accordance with the Order of September 9, 1997 on landfills¹⁰², sludge from waste water treatment plants can be landfilled only if its dry matter content is above 30%.

However, the disposal to landfill of sewage sludge should be reduced, as the Waste Act 92/646 prohibits the landfilling of all wastes except "ultimate" waste from 2002 onwards.

¹⁰⁰ Article 16

¹⁰¹ Article 17

¹⁰² Order on landfills of 9.9.97, *Journal Officiel* 2.10.97 (*Arrêté relatif aux décharges existantes et aux nouvelles installations de stockage de déchets ménagers et assimilés*)

Germany

Reviewed by Claus-Gerhard Bergs, August 2000

Bundesumweltministerium

Competence and legal structure

Competence

The German legal framework concerning environment is issued by the federal authorities but each relevant authority in the Länder may decide more detailed regulations and is also responsible for the implementation and enforcement of Federal laws and regulations.

Legal structure

The Agricultural use of sludge is regulated by the Sewage Sludge Ordinance¹⁰³ of April 15, 1992 modified by the Ordinance of March 6, 1997. Agricultural use of sludge is also governed by several laws such as the 1977 Fertiliser Act¹⁰⁴ and its enforcement orders, and the Fertiliser Ordinance¹⁰⁵ which regulate the quality and application of fertilisers; the waste recycling act of October 7, 1996; the Waste Act of 27 August, 1986 and the Soil Protection Act of 1998¹⁰⁶ as well as the Soil Protection Regulation 1999 which both regulate the protection of soil quality, soil uses and clean-up of contaminated soils.

Types of sludge covered by legislation

The sludge covered by the Ordinance of April 15, 1992 concerns sludge produced from urban waste water treatment plants (as well as mixtures of sludge and other elements which are used on agriculture). Only sewage sludge issued from the treatment of domestic, urban or similar waste water is allowed on agricultural land¹⁰⁷.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals defined in the Ordinance of 1992 are mostly stricter than those set by the Directive 86/278/EEC, such as mercury for which permissible concentration in sludge is 8 mg/kg dry matter (16-25 according to the Directive) and for Cadmium which permissible concentration is 10 mg/kg dry matter (20-40 according to the Directive). In addition, the German legislation provides for a limit value for Chromium (100 mg/kg dry matter).

¹⁰³ Sewage Sludge Ordinance of 15.4.92, BGBl I of 28.4.92 S. 912 (*Klärschlammverordnung*), modified by the Ordinance (*Verordnung*) of 6.3.97, BGBl I S.446.

¹⁰⁴ Fertiliser Act of 15.11.77, (*Düngemittelgesetz*) modified in 1997.

¹⁰⁵ Fertiliser Ordinance of 11.8.99, BGBl I S. 42. (*Düngemittelverordnung*)

¹⁰⁶ Soil Protection Act of 17.3.98, BGBl I S. 502 (*Gesetz zum Schutz des Bodens*)

¹⁰⁷ Paragraph 4 of the Sewage Sludge Ordinance

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Germany
	Annex 1 B	
Cd	20 – 40	10
Cr	-	900
Cu	1000 – 1750	800
Hg	16 – 25	8
Ni	300 – 400	200
Pb	750 – 1200	900
Zn	2500 – 4000	2 500

Limit values for Cadmium and Zinc are lowered to 5 and 2000 mg/kg DM respectively when soils are classified as light soils “within the scope of soil rating” and whose clay content is below 5 per cent, or for soils with a pH value between 5 and 6¹⁰⁸.

Maximum quantities of sludge for use in agriculture are also specified by German legislation. These limits are 5 tonnes of dry matter per hectare every three years.

Limit values for pathogens in sludge

The Ordinance on sewage sludge contains no specific requirements concerning pathogens.

Limit values for organic compounds in sludge

German legislation provides limit values for the following organic compounds:

AOX	500	mg/kg dry matter
PCB ¹⁰⁹	0,2	mg/kg dry matter
PCDD/PCDF	100	ngTE/kg dry matter

Limit values for soil for application

The limit values for soil provided for in the Ordinance of 1992 are very similar to those set by the directive 86/278/EEC. In addition, the limit values for chromium is 100 mg/kg dry matter.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Germany
	6<pH<7	
Cd	1 – 3	1.5
Cr	-	100
Cu	50 – 140	60
Hg	1 – 1.5	1
Ni	30 – 75	50
Pb	50 – 300	100
Zn	150 – 300	200

As for heavy metals levels in sludge, limit values for Cadmium and Zinc are lowered to 1 and 150 mg/kg DM respectively when soils are classified as light soils “within the scope of soil rating” and whose clay content is below 5 per cent, or for soils with a pH value between 5 and 6¹¹⁰.

¹⁰⁸ Section 1, paragraph 12

¹⁰⁹ For each one of the six congeners.

Obligation for treatment

Untreated sludge can not be used on agricultural land¹¹¹. No treatment specifications are however provided in the regulation.

Surfaces on which use of sludge is prohibited

Sludge can not be used on the surfaces used to grow fruits and vegetables, forests, pasture land and meadows, or on areas close to water sources and river shores.

Further quality related restrictions

Certification and information requirements

The Ordinance of 1992 specifies that the manager of a waste water treatment plant must analyse specific elements in the agricultural soil before using sewage sludge for the first time (such as lead content, or copper content). The soil analysis must be repeated every 10 years. The local authority may ask for another analysis in a shorter interval if the results of this analysis reveal that the limits fixed in the regulation have not been respected. Regulations in several Länder, such as Brandenburg and Lower Saxony provide for additional analysis concerning other pollutants. Sludge can not be used on land if analyses on metals and organic compounds content have been carried out more than 6 months before landspreading. Competent authorities can reduce the period between two analyses to 2 months.

Codes of practice and guides

No information is available on these aspects.

Voluntary agreements on disposal and recycling of sewage sludge

No voluntary agreements exist in Germany on sewage sludge.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas¹¹²

Silviculture (plantation)

The use of sludge on land for silviculture is prohibited.

Natural forest and reforested area

The use of sludge on natural forest land is prohibited.

Land reclamation

No specific elements address these aspects in the regulation.

¹¹⁰ Section 1, paragraph 8

¹¹¹ Paragraph 4

¹¹² Section 4

Green areas

The use of sludge on green areas is prohibited by the regulation.

Specific requirements or legislation for other routes

Incineration

No specific elements address these aspects in the Sludge Ordinance. Therefore the legislation on waste (Waste act¹¹³ and Technical instruction on wastes from human settlements¹¹⁴) applies, as well as the Ordinance on the implementation of the Federal law on protection against emissions¹¹⁵.

Disposal to landfill

No specific elements address these aspects in the Sludge Ordinance. However, the landfilling of sludge should be strongly reduced from 2005 onwards in Germany, as only waste containing less than 5% of organic matter will be accepted in landfills.

¹¹³ Law on the reduction, recycling and elimination of waste of 6.10.94, BGBl. I S. 2705 (*Gesetz zur Vermeidung, Verwertung und Beseitigung von Abfällen*)

¹¹⁴ Technical instruction on wastes from human settlements of 14.5.93, *Beil. Banz. Nr. 9* (*Technische Anleitung Siedlungsabfall*)

¹¹⁵ Ordinance on the implementation of the Federal law on protection against emissions, of 23.11.90, BGBl. I S. 2545 (*Siebzehnte Verordnung zur Durchführung des BundesImmissionsschutzgesetzes - Verordnung über Verbrennungsanlagen für Abfälle und ähnlich brennbare Stoffe – 17. BImSchV*)

Greece

Competence and legal structure

Competence

The organisation in charge of environmental issues at national level is the Ministry of Environment, Physical Planning, and Public Works. Local authorities have the responsibility for the collection and treatment of waste water, which is carried out by 138 municipal waste water treatment companies.

Legal structure

In Greece, the main regulation concerning the use of sludge in agriculture is the Ministers' Decision of 1991 No. 80568/4225/91¹¹⁶ which implements both article 11(3) of Law 1650/86 on the protection of the environment and the Directive 86/278/EEC.

In addition, Decision No. 114216/97 (1997) complements the Decision of 1991 on the use of sludge by establishing a general framework for technical measures in order to treat solid waste, including sludge produced by waste water treatment plants¹¹⁷.

Types of sludge covered by legislation

The types of sludge covered by the Greek legislation are exactly the same covered by Directive 86/278/EEC¹¹⁸.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge are the same as those defined in the Directive 86/278/EEC¹¹⁹. In addition, Greek legislation has introduced limit values for chromium: 500 mg/kg of dry matter for Cr(III) and 10 mg/kg of dry matter for Cr(IV).

Limit values for pathogens in sludge

The regulation contains no specific requirements concerning pathogens in sludge.

¹¹⁶ Ministerial Decision 80568/4225 of 22.3.91 on the use of sewage sludge in agriculture, FEK B641/91 of 7.8.91

¹¹⁷ Ministerial Decisions 114216/97 and 113944/97 on technical standards and measures for waste management and national planning, FEK 1016/97,

¹¹⁸ Article 2 of the Decision of 1991

¹¹⁹ Annex I B to article 12 of the Decision of 1991. Both high and low limit values of the Directive 86/278/EEC are included in the Decision.

Limit values for organic compounds in sludge

The regulation contains no specific requirements concerning organic compounds in sludge.

Limit values for soil for application

The limit values for heavy metals in soil are strictly the same as those defined in the Directive 86/278/EEC. As well as for heavy metals in sludge, both high and low limit values of the Directive have been included in the Decision of 1991.

Obligation for treatment

The use in agriculture of untreated sludge is forbidden. "Treated" sludge in the Greek decision is defined as in article 2 of the Council Directive 86/278/EEC.

Surfaces on which use of sludge is prohibited

The surfaces on which the use of sludge is prohibited are defined as in the Council Directive 86/278¹²⁰.

Further quality related restrictions

Certification and information requirements

The Greek regulation stipulates that a licence has to be required to the Prefecture's Agricultural and Forestry Directorate for the use of sludge in agriculture¹²¹. The same provision specifies the relevant information that has to be provided.

In addition to the previous requirements, sludge and soil on which it is used must be analysed¹²². The methods of analysis and sampling are specified in Annex II C of the same Decision, and are identical to the requirements set out in Directive 86/278/EEC.

Codes of practice and guides

There are no codes of practice or guides on the use of sludge in agriculture in Greece, on the basis of the information collected.

Voluntary agreements on disposal and recycling of sewage sludge

There are no voluntary agreements concerning the use of sludge in agriculture in Greece.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

¹²⁰ Article 5

¹²¹ Article 4 2.(a) (i)

¹²² Article 6.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use. The general requirements for waste incineration therefore apply¹²³.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use. The general requirements for waste landfilling therefore apply¹²⁴.

¹²³ Ministerial Decree 82805/2224/93 on the prevention of air pollution from waste incinerators, FEK 699/93

¹²⁴ Ministerial Decree 69728/824/96 concerning the harmonization with the Directive 91/156/EC on solid waste, FEK 358/96 and Ministerial decisions 114216 and 113944 on technical standards and measures for waste management and technical standards and measures for the waste management and the national planning national planning, FEK 1016/97

Ireland

Reviewed by Gerard O'Donoghue, March 2001

Department of the Environment and Local Government

Competence and legal structure

Competence

Competence for environmental policy lies in the Department of the Environment. The 88 local authorities (*county councils, boroughs, urban district councils*) are in charge of water distribution, waste water collection and treatment.

Legal structure

The use of sludge is regulated by the *Waste Management (use of sewage sludge in Agriculture) Regulations*¹²⁵ and by the *Waste Management Regulations*¹²⁶. These regulations give effect to the provisions of Council Directive 86/278/EEC.

In a larger context, the main legislation concerning the hydraulic resources is the *Local government (Water Pollution) Act, 1977*¹²⁷ and as regards the waste products, the *Waste Management Act, 1996*¹²⁸.

Types of sludge covered by legislation

The types of sludge covered by the Irish legislation regulating the use of sludge are exactly the same as the ones defined in Article 2 of Directive 86/278/EEC.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

Sludge may not be used on land where the concentration of one or more heavy metal in the said sludge exceeds the values specified in the Waste management Regulations¹²⁹. These limit values correspond to the lowest values set up by the 86/278/EEC Council Directive. It must be noted that no specific limit on concentration for chromium is given in the Irish legislation on sludge. In addition, the maximum quantity of sludge for use in agriculture set by the regulation is 2 tonnes of dry matter per hectare per year.

¹²⁵ Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 (Statutory Instruments No. 148/1998).

¹²⁶ Waste Management (Amendment of Waste Management Act, 1996) Regulations, 1998 (Statutory Instruments No. 146/1998).

¹²⁷ Local government (Water Pollution) Act, 1977 (No. 1/1997).

¹²⁸ The scope of Section 51(2) of the Waste Management Act, 1996 (N. 10 of 1996) concerning the recovery of sludge and agricultural waste was amended by the Waste Management (use of sewage sludge in Agriculture) Regulations

¹²⁹ Part II of the Schedule, Statutory Instruments n° 148 of 1998

Limit values for pathogens in sludge

The regulation contains no specific requirements concerning pathogens in sludge.

Limit values for organic compounds in sludge

The regulation contains no specific requirements concerning organic compounds in sludge.

Limit values for soil for application

The limit values specified in the regulation¹³⁰ correspond to the lowest values set up by the Council Directive 86/278/EEC, and no specific limit on concentration for chromium is given.

Obligation for treatment

As specified in the Council Directive 86/278/EEC, the Irish legislation holds that sludge must be subjected to biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use¹³¹.

Untreated sludge may be used in agriculture provided that it is previously injected or otherwise worked into land. Residual sludge from septic tanks may be used on grassland provided that the grassland is not grazed within six months following such use.

Surfaces on which use of sludge is prohibited

Sludge cannot¹³² be used on:

- land on which fruit other than fruit trees or vegetable crops are growing, or
- land intended for the cultivation of fruit or vegetable crops which are normally in direct contact with the soil and eaten raw, for a period commencing ten months prior to harvesting and during harvesting.
- grassland or forage crops where the grassland is to be grazed or the forage crops to be harvested within three weeks of such use¹³³.

Further quality related restrictions

Certification and information requirements

Before using sludge on agricultural land, the soil has to be analysed¹³⁴ as specified in Part III of the Schedule which restates the requirements of Annex II C of Directive 86/278/EEC. Furthermore, *"a supplier of sludge for use in agriculture shall regularly provide users of the sludge with results of sludge analyses carried out in accordance with Part IV of the Schedule"*¹³⁵. In addition, he has to

¹³⁰ Part I of the Schedule of the Statutory Instruments No.148 of 1998

¹³¹ Section 3 (2),

¹³² Provision 5

¹³³ Section 5 (2)

¹³⁴ Section 7

Section 8 (1)

provide the local authority with some information for entry in the "sludge register" which has to be established and maintained by each local authority¹³⁶. Part IV and Part V of the Schedule specify the methods, frequency¹³⁷ (which is the same for sludge as in the Council Directive) and conditions applying to sludge and soil sampling and analysis. These information requirements do not apply to sludge¹³⁸ from septic tanks or from sewage treatment plants with a treatment capacity below 5000 p.e.

It should also be noticed that according to the *Waste Management Act* (1996)¹³⁹ the recovery (defined as the injection of waste into land for the purpose of benefiting the carrying on of any agricultural or silvicultural activity or an ecological system) of relevant waste shall not be carried out without the prior written consent of the local authority.

Codes of practice and guides

The *Department of Agriculture, Food and Forestry* has launched in 1994 the *Rural Environment Protection Scheme*, aimed at improving management of animal manure. In addition, a *Code of Good Practice for the Use of Biosolids in Agriculture* has recently been published. This code contains revised recommendations on limit values for pollutants in sludge.

Voluntary agreements on disposal and recycling of sewage sludge

There are no voluntary agreements concerning sludge use in Ireland.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

¹³⁶ Section 8 (2)

¹³⁷ the minimum frequency for analysis is of once in ten years.

¹³⁸ Provision 9

¹³⁹ Article 51(4), of the Waste Management Act of 1996

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use.

Italy

Reviewed by Andrea Rossi Marcelli, September 2000

Ministry of the Environment.

Competence and legal structure

Competence

In Italy the institution in charge of environmental issues at national level is the Ministry of Environment. However, all legislative decisions on the use of sludge for agricultural purposes have to be taken in co-ordination with the Ministries of Agriculture and Forest, of Industry and of Health.

The Regions are the authorities responsible for issuing authorisations in the field of sludge management (sewage sludge collection, transport, storage and its use on land spreading). In addition, the Regions may establish further restrictions and provisions mainly for the use of sludge on land depending on the characteristics of the sites concerned, the crops as well as of the sludge treatment and composition. The Provinces are responsible for controlling the collection, transport, treatment and landspreading of sewage sludge.

Legal structure

The use of sludge is mainly regulated in Italy by the Decree 99/92 of January 27, 1992 concerning the disposal on land of sewage sludge¹⁴⁰, which gives effect to the Directive 86/278/EEC.

In addition, the main regulations governing water management are the Decree 152/99 (water protection) which replaces rules established by the Act 319/76 (effluents), the Decree 132/92 (protection of groundwater), the Decree 133/92 (industrial emissions of dangerous substances in water). The Decree 152/99 of 11 May 1999¹⁴¹ gives effect to Directives 91/271/EEC concerning urban waste water treatment and Directive 91/676/EEC concerning water protection against nitrates pollution.

¹⁴⁰ Decree 99/92 on the use of sewage sludge on land, *Supplemento Ordinario* No. 28, *Gazzetta Ufficiale*, 15.2.92 (*Decreto legislativo in attuazione della Direttiva 86/278/CEE concernente la protezione dell'ambiente, in particolare del suolo nell'utilizzazione dei fanghi di depurazione in agricoltura*)

¹⁴¹ Decree 152/99 of 11.05.1999 on water protection, *Supplemento Ordinario* No. 124, *Gazzetta Ufficiale* of 29.05.1999 (*Decreto Legislativo del Governo n° 152 del 11.05.1999 - disposizioni sulla tutela delle acque dall'inquinamento e recepimento della direttiva 91/271/CEE concernente il trattamento delle acque reflue urbane e della direttiva 91/676/CEE relativa alla protezione delle acque dall'inquinamento provocato dai nitrati provenienti da fonti agricole*).

Types of sludge covered by legislation

According to the Decree 99/92, sludge shall mean "any residue deriving from the treatment of:

- municipal waste waters as defined in law 690/76;
- mixed waste waters from municipal or industrial installations having characteristics similar to those of sludge of the precedent point 1);
- exclusively industrial waste waters as defined by the law 319/76: the sludge must have quality similar to that of point 1) and comply with the subsequent Article 3 point 1". This Article 3, point 1 specifies that before use in agriculture, sludge must be treated, must have fertilising or amending effects on the soil, and must not contain hazardous substances (which are not listed in this article). Italian legislation therefore addresses mostly urban sewage sludge; mixed and industrial sludges can be used on land as long as they have similar characteristics to sludge from urban waste water treatment.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge¹⁴² are the same as the lowest limits specified in the Directive 86/278/EEC. No limit value is specified for chromium. Nevertheless landspreading of sludge is prohibited on soils which demonstrate capacity to oxydise Cr III to Cr IV, according to the Bartlett & James test.

Limit values for pathogens in sludge

Use of sludge is prohibited if it contains more than 1000 MPN/g of salmonella¹⁴³.

Limit values for organic compounds in sludge

There are no specific requirements for organic compounds in sludge.

Limit values for soil for application

The limit values for heavy metals in soil 2 are presented below. It is to be noted that soil destined for agricultural use of sludge must previously be submitted to the rapid test of Barlett and James to evaluate soil capacity to oxidise Cr III to Cr VI.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Italy
	6<pH<7	
Cd	1 – 3	1.5
Cr	-	-
Cu	50 – 140	100
Hg	1 – 1.5	1
Ni	30 – 75	75
Pb	50 – 300	100
Zn	150 – 300	300

¹⁴² Appendix 1B

¹⁴³ Appendix 1B

Obligation for treatment

Sludge use in agriculture is allowed if sludge is treated¹⁴⁴. Treated sludge is defined as in Council Directive 86/278.¹⁴⁵

Surfaces on which use of sludge is prohibited

The use of sludge is forbidden on the following surfaces¹⁴⁶:

- flooded, boggy or with emerging water body or crumbling soils,
- soils with a slope higher than 15% when the DM content is less than 30%,
- soils with a pH lower than 5, and with a cation exchange capacity lower than 8 meq/100 g.
- on pastures or for production of green fodder, within 5 weeks before pasture or harvesting,
- for horticulture and fruit-growing when products are in direct contact with the soil and eaten raw, within 10 months after the sludge spreading,

In addition, it is forbidden to spread liquid sludges with a sprinkling irrigation system.

Further quality related restrictions

Certification and information requirements

Sludge users have to obtain an authorisation from regional authorities, which obliges them to provide detailed information on sludge as well as to apply to the national register of waste disposal companies. The authorisation, which may be given consequently, lasts five years. Applicants must analyse soil in advance and analyses must be repeated every 3 years at most. Sludge must be analysed every 3 months for works with a capacity superior to 100 000 p.e. and every 6 months for others¹⁴⁷; in case of works serving less than 5000 p.e., an analysis once a year is required. Nevertheless, sludge must be analysed before its use in agricultural land if major changes in treatment processes occur¹⁴⁸. In addition to these requirements it is to be noted that sludge users must have a register containing information on soil characteristics, sludge characteristics, and quantities received.¹⁴⁹

Codes of practice and guides

There are no specific codes of practice or guides on the use of sludge in agriculture. Nevertheless, sludge application must be carried out according to the codes of good agricultural practice¹⁵⁰: sludge applied to soil shall be incorporated during or immediately after application, measures are to be taken to prevent flooding and running off of sludge from the plots of land concerned.

Voluntary agreements on disposal and recycling of sewage sludge

There are no voluntary agreements concerning the use of sludge in agriculture in Italy.

¹⁴⁴ Article 3 (1)

¹⁴⁵ Article 2 (b)

¹⁴⁶ Article 4 3

¹⁴⁷ Article 11.1

¹⁴⁸ Article 11.2

¹⁴⁹ Article 15.

¹⁵⁰ Article 12.6 2

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

Regulations to comply with for incineration of sludge are:

- D.P.R. 203/88 (President's Decree), plus regional laws, concerning general atmospheric pollution¹⁵¹;
- D.M. 503/97 (Ministerial Decree) of November 19, 1997¹⁵², implementing Directives 89/369/EEC and 89/429/EEC on prevention of atmospheric pollution caused by urban wastes incineration plants.

In addition to these provisions, the Ministerial Decree of 5 February 1998 (*Decreto del Ministero dell'Ambiente*)¹⁵³ establishes a list of waste that can be submitted to simplified procedures in the framework of specific activities of reuse and energy recovery, detailing also process requirements and emissions limit values for these activities. Therefore energy recovery from sludge can be carried out without a permit for the disposal of waste, through registration with the competent

¹⁵¹ D.P.R. 203/88 (President's Decree), concerning general atmospheric pollution, *Supplemento Ordinario* No. 140, *Gazzetta Ufficiale* of 16.06.1988 (*Decreto del Presidente della Repubblica* No. 203 del 24.05.1988 - *Attuazione delle direttive CEE numeri 80/779, 82/884, 84/360 e 85/203 concernenti norme in materia di qualità dell'aria, relativamente a specifici agenti inquinanti, e di inquinamento prodotto dagli impianti industriali, ai sensi dell'art. 15 della legge 16 aprile 1987, n. 183*).

¹⁵² Ministerial Decree No. 503 of 19.11.97 on the prevention of atmospheric pollution caused by urban wastes incineration plants, *Gazzetta Ufficiale Italiana* No. 23 of 29.01.1998 (*Decreto Ministeriale* No. 503 del 19/11/1997 - *Regolamento recante norme per l'attuazione delle direttive 89/369/CEE e 89/429/CEE concernenti la prevenzione dell'inquinamento atmosferico provocato dagli impianti di incenerimento dei rifiuti urbani e la disciplina delle emissioni e delle condizioni di combustione degli impianti di incenerimento di rifiuti urbani, di rifiuti speciali non pericolosi, nonché di taluni rifiuti sanitari*).

¹⁵³ Ministerial Decree of 5.02.1998, *Supplemento Ordinario* No. 88, *Gazzetta Ufficiale* of 16.04.1998 (*Decreto Ministeriale* del 05/02/1998 - *Individuazione dei rifiuti non pericolosi sottoposti alle procedure semplificate di recupero ai sensi degli articoli 31 e 33 del decreto legislativo 5 febbraio 1997, n. 22*).

authorities, in accordance with the Ministerial Decree of 5 February 1998. In addition, the framework regulation on waste (Decree No. 22 of February 5, 1997)¹⁵⁴ prohibits the incineration of waste without energy recovery since January 1, 1999.

Disposal to landfill

Landfilling is regulated by the Deliberation of 27 July 1984¹⁵⁵, stating that urban non-toxic sludge can be disposed of in category 1 landfills (which accept only solid municipal waste and/or special solid waste assimilated to municipal waste and solid, stabilized and non-toxic urban sludges). Urban sludge is defined as sludge produced from the treatment of domestic and industrial water provided that the latter do not affect the domestic characteristics. In addition, the framework regulation on waste (Decree No. 22 of February 5, 1997) prohibits the disposal to landfill of waste which is not submitted to recycling and recovery operations, from July 16, 2001 onwards.

¹⁵⁴ Decree 22/97 of February 5, 1997 on waste management, *Supplemento Ordinario* No. 38, *Gazzetta Ufficiale* of 15.02.1997 (*Decreto Legislativo del Governo n° 22 del 05.02.1997 - Attuazione delle direttive 91/156/CEE sui rifiuti, 91/689/CEE sui rifiuti pericolosi e 94/62/CE sugli imballaggi e sui rifiuti di imballaggio*).

¹⁵⁵ Deliberation of 27.07.1984, *Supplemento Ordinario* No. 253, *Gazzetta Ufficiale* of 13.09.1984 (*Delibera del 27/07/1984 - Disposizioni per la prima applicazione dell'articolo 4 del D.P.R. 10 settembre 1982, n. 915, concernente lo smaltimento dei rifiuti*).

Luxembourg

Reviewed by Juliette Mathieu, July 2000

Administration of the Environment -Waste division

Competence and legal structure

Competence

The institution in charge of environmental issues at national level is mainly the Ministry of Environment. At local level, 118 municipalities are responsible for the collection of waste water, while treatment is delegated to 6 corporation of municipalities.

Legal structure

The main Regulation is the Grand Ducal Regulation of 14 April 1990 concerning sewage sludge¹⁵⁶, which gives effect to the Council Directive 86/278/EEC. This regulation was amended by another Grand Ducal Regulation on 25 June 1992 and 20 September 1994¹⁵⁷.

Types of sludge covered by legislation

The types of sludge which can be reused for agricultural purposes¹⁵⁸ are the same as the definitions provided in the Directive 86/278/EEC, Article 2.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values are the same as specified in the Council Directive 86/278/EEC. It is to be noted that limit values for Chromium (1000 - 1750 mg/kg dry matter) have been added.

Where the concentration of any heavy metals exceeds the specified limit values, sludge may nevertheless be used on lands which are aimed at eliminating sludge and which commercial crops are exclusively intended for animal food, in accordance with Directive 86/278/EEC.

In addition, the regulation in Luxembourg identifies maximum annual heavy metals load to agricultural land, which are lower than those set in Directive 86/278/EEC (see table below).

¹⁵⁶ Grand Ducal Regulation of 14.4.90 on sewage sludge, *Mém A* No. 21 of 7.5.90 p. 287 (*Règlement grand ducal relatif aux boues d'épuration*)

¹⁵⁷ Grand Ducal Regulations of 25.6.92, *Mém. A* No. 44 of 30.6.1992, p. 1458 and of 20.9.94, *Mém. A* No. 87 of 28.9.1994 (*Règlement grand-ducal concernant l'utilisation de fertilisants organiques dans l'agriculture*)

¹⁵⁸ Art. 2, Grand Ducal Regulation of 14.4.90

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Luxembourg
	Annex 1 C	
Cd	150	120
Cr	-	4 500
Cu	12 000	5 250
Hg	100	75
Ni	3 000	1 200
Pb	15 000	3 600
Zn	30 000	12 000

The quantities of sludge used on land must not exceed 3 tonnes of dry matter per hectare and per year.

Limit values for pathogens in sludge

Sludge must be hygienised before being used on forage and on surfaces bearing crops of berries, potatoes, root vegetables, vegetables or fruit. Hygienised sludge is defined as sludge which do not contain neither more than 100 *enterobacteria* per grams, nor eggs of worm likely to be contagious¹⁵⁹.

Limit values for organic compounds in sludge

The Regulation contains no specific requirements concerning organic compounds.

Limit values for soil for application

In Luxembourg, the limit values are the same as specified in Directive 86/278/EEC. Limit values for chromium (100 - 200 mg/kg dry matter) are also introduced.

The average annual rate of addition to the land by means of sludge is the same for each element as specified in the Directive. As regards Chromium, the maximum load is quite high (4500 g/ha per year) compared with other Member States' requirements.

Obligation for treatment

As a general rule sludge shall be treated before use on land¹⁶⁰. The definition of treated sludge in the Grand Ducal Regulation is the same as in Directive 86/278. Untreated sludge may nevertheless be used if it is worked into the soil before the sowing and the planting in accordance with the Environmental administration's requirements.¹⁶¹

¹⁵⁹ Article 2 (c)

¹⁶⁰ Article 4 (1) (a)

¹⁶¹ Article 2 (1) (a)

Surfaces on which use of sludge is prohibited

Sludge may not be used¹⁶²:

- on forage, on land bearing crops of berries, potatoes, root vegetables or vegetables or fruit when sludge is not hygienised.
- on pasture land or on fodder crops which are to be used for grazing or for harvesting of the fodder crops for a period of one month after sludge spreading,
- on crops of berries, potatoes, root vegetables or vegetables or fruit (excepting fruit trees) during the growing period,
- on land bearing crops of berries, potatoes, root vegetables or vegetables or fruit which are normally in direct contact with the soil and are normally eaten raw, for a period of ten months prior to harvesting and during the harvesting itself .
- on protected areas as defined and specified in accordance with the Act of 11 August 1982 concerning the nature and natural resources protection¹⁶³.
- on swamps, on dry grasslands, on wet grassland and on other biotopes as specified in article 14 of the Act of 11 August 1982 concerning the nature and natural resources protection.

Further quality related restrictions

Certification and information requirements

As specified in the Directive 86/278/EEC, the delivery of sludge to be used shall be accompanied with a bill of delivery containing some information such as the concentration of heavy metals.¹⁶⁴ According to Article 7 of the same Regulations, the producers of sludge must then keep a register.

Codes of practice and guides

The Grand Ducal Regulation of 20 September 1994 specifies the need to establish a code of good agricultural practices¹⁶⁵.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements concerning sewage sludge in Luxembourg.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

¹⁶² Article 4 (b)

¹⁶³ Act on nature and natural resources protection of 11.8.82, *Mém. A* No 69 of 10.8.1982, p. 1486 (*Loi du 11 août 1982 concernant la protection de la nature et des ressources naturelles*)

¹⁶⁴ Article 6 and Article 13 of the Grand Ducal Regulation of 14.4.90

¹⁶⁵ Article 4

Natural forest and reforested area

Sludge may be used on forest soils after licensing from the Environment and Territory Ministry. Licensing is also necessary before spreading on agricultural land at a distance of less than 30 meters of a forest boundary¹⁶⁶.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

Sludge which cannot be used in agriculture has to be eliminated either by incineration or disposal to landfill or *“by any other appropriate mean considered as conform by the Ministry of Environment”*¹⁶⁷. However, the regulation does not define specific conditions or requirements for incineration of sewage sludge. It will therefore be subject to the waste¹⁶⁸ and incineration¹⁶⁹ legislations.

Disposal to landfill

See point 1.51.

¹⁶⁶ Article 5

¹⁶⁷ Article 10

¹⁶⁸ Waste prevention and management act of 17.6.94, *Mém. A* No. 57 of 5.7.1994, p. 1076 (*Loi relative à la prévention et à la gestion des déchets*) as modified by *Mém. A* No. 72 du 10.8.1994, p. 1322.

¹⁶⁹ Grand Ducal Regulation on the reduction of air pollution from incinerators of 20.11.91, *Mém. A* No. 89 of 30.12.1991, p. 189 as modified by *Mém. A* No. 6 of 17.2.1992, p. 313 (*Règlement grand-ducal concernant la réduction de la pollution atmosphérique en provenance des installations d'incinération des déchets municipaux*).

Netherlands

Reviewed by Puck Bonnier, August 2000

Ministry of Agriculture, Nature, Management and Fisheries.

Competence and legal structure

Competence

The national government is responsible for waste management and policy. Organisations such as the Waste Management Council (*Afvaloverlegorgaan* - AOO), the National Institute of Public Health and Environmental Protection (RIVM) and the National Statistics Bureau (CBS) all contribute to monitoring of waste streams on a national level. Sludge collection and treatment is mostly under control of regional waste management organisations.

Legal structure

The 1993 *Dutch Environment Policies Act* brings together all previous legislation on pollution and states the government's policy on the major environmental projects.

The Decree of November 20 1991¹⁷⁰ on the quality and the application on or in soil of miscellaneous organic fertilisers sets "*rules concerning the quality and use of sewage sludge, compost and black turf soil*"¹⁷¹. This Decree gave effect to the Directive 86/278/EEC and introduced changes in the requirements for trace elements in sewage sludge used in agriculture that are so strict that only 4 % of sewage sludge can now actually be used in agriculture.

Types of sludge covered by legislation

Sludge is defined as follows¹⁷²:

- "1. *sludge wholly or mainly from sewage plant treating domestic, urban, industrial or other waste waters of a composition similar to domestic, urban and industrial waters;*
- 2. *sludge wholly or mainly from septic tanks and other similar installations for the collection, removal and treatment sewage, with the exception of grease and sand traps."*

The Dutch legislation on sludge therefore applies to industrial sludge as well as to urban sewage sludge.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values are very stringent compared with the concentrations required by the European Directive. For instance, the permissible concentration for copper is more than 10 times stricter than the one specified in the Directive 86/278/EEC.

¹⁷⁰ Decree of 20.11.91 on the quality and the application on or in soil miscellaneous organic fertilisers, *Staatsblad* No. 613 of 3.12.91, (*Besluit kwaliteit en gebruik overige organische meststoffen*),

¹⁷¹ Defined in Article 1 of the same Decree as "*a mixture of soil constituents and processed organic waste*"

¹⁷² Article 1(a)

The Minister of Agriculture, Nature Management and Fisheries may lay down additional rules concerning sewage sludge composition¹⁷³.

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Netherlands
	Annex 1 B ¹⁷⁴	
Cd	20 – 40	1.25
Cr	-	75
Cu	1000 – 1750	75
Hg	16 – 25	0.75
Ni	300 – 400	30
Pb	750 – 1200	100
Zn	2500 – 4000	300

In addition, the regulation identifies maximum annual heavy metals load to agricultural land, which are lower than those set in Directive 86/278/EEC.

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Netherlands
	Annex 1 C	
Cd	150	25
Cr	-	150
Cu	12 000	150
Hg	100	15
Ni	3 000	60
Pb	15 000	200
Zn	30 000	600

Limit values for pathogens in sludge

The Dutch legislation specifies no limit values for pathogens in sludge, although Article 3 of the Decree mentions that sludge must be treated in order to reduce pathogens content¹⁷⁵.

Limit values for organic compounds in sludge

The Dutch legislation contains no specific requirements concerning organic compounds.

Limit values for soil for application

Heavy metals levels in soil must satisfy the requirements laid down in Annex IV¹⁷⁶ and described in the table below. These requirements are more stringent than those set by Directive 86/278/EEC.

¹⁷³ Article 4.3

¹⁷⁴ Mandatory limit values as of 1 January 1995.

¹⁷⁵ See hereafter section 1.35 on obligation for treatment

¹⁷⁶ Article 17

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Netherlands
	6<pH<7	
Cd	1 – 3	0.8
Cr	-	100
Cu	50 – 140	36
Hg	1 - 1.5	0.3
Ni	30 – 75	35
Pb	50 – 300	85
Zn	150 – 300	140

Obligation for treatment

"Sewage sludge must be treated by biological, chemical or thermal means by long-term storage or any other suitable procedure which results in killing most of the pathogenic organisms present in the sewage sludge"¹⁷⁷.

Surfaces on which use of sludge is prohibited

The mix of sludge with animal manure is prohibited¹⁷⁸ unless the producer or user demonstrates that, for instance, the legal requirements in terms of composition are satisfied before the mix occurred¹⁷⁹. In addition, the following restrictions apply to sewage sludge land spreading:

- It is prohibited to use liquid sludge in larger amounts than 2 tonnes of dry matter per hectare and per year on arable land or maize land, and 1 tonne of dry matter per hectare and per year on grassland¹⁸⁰,
- it is prohibited to use "viscous"¹⁸¹ (sludge in larger amounts than 4 tonnes of dry matter per hectare and per two years on arable land or maize land, and 2 tonnes of dry matter per hectare and per two years on grassland¹⁸². When compost consists entirely of sludge the same provisions apply.

Furthermore, it is prohibited to use sludge:

- on miscellaneous land¹⁸³,
- on undisturbed ground¹⁸⁴,
- on agricultural land, if the land is wholly or partially covered with snow¹⁸⁵,
- on pasture land: during the grazing season, on land used for the cultivation of forage crops,
- on land used for growing vegetables or fruit, with the exception of fruit trees (during the growing period of the vegetables or fruit)
- on land intended for growing vegetables or fruit that are usually in direct contact with the soil and consumed raw (less than 10 months before harvesting and during the harvest). This

¹⁷⁷ Article 3

¹⁷⁸ Article 13, paragraph 1,

¹⁷⁹ Article 13, paragraph 2. Several additional restrictions on the use of animal manure mixed with sludge are mentioned in articles 29 to 34 of the same Decree.

¹⁸⁰ Article 18

¹⁸¹ "Viscous" sludge is defined in Article 1 of the same Decree as "sludge that cannot be pumped".

¹⁸² Article 19

¹⁸³ Article 23, paragraph 1

¹⁸⁴ Article 27

¹⁸⁵ Article 28

prohibition specified by article 28 applies also to any mixture of animal manure with sewage sludge.

Further quality related restrictions

Certification and information requirements

Analysis and sampling of the sludge must be undertaken according to the requirements specified in the Decree of 20 November 1991¹⁸⁶. Sewage sludge must be accompanied at all times during transactions by a copy of the analysis results referred to in the same paragraph 1¹⁸⁷. Furthermore, anyone producing, treating or processing sludge must keep a record¹⁸⁸ containing similar information to the one specified in Article 10 and Annex II A of the Directive 86/278/EEC. Information concerning the content in nitrogen of sewage sludge and the content of phosphate in sludge must also be provided.

Codes of practice and guides

There are no codes of practice or guides on the use of sludge in agriculture.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements concerning sewage sludge.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

Some type of silviculture is considered as agricultural land, for which the regulations for use of sludge on agricultural land apply. The rest of the area with silviculture or forest is considered as miscellaneous land, and therefore may not be subject to sludge landspreading.

Natural forest and reforested area

See point 1.41

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

Green areas are considered as miscellaneous land by the regulation, which therefore does not allow use of sludge on green areas¹⁸⁹.

¹⁸⁶ Article 8, paragraph 1

¹⁸⁷ Article 8, paragraph 3

¹⁸⁸ Article 9

¹⁸⁹ Article 23

Specific requirements or legislation for other routes

Incineration

The Incineration of sewage sludge is regulated by the *Air Emissions Waste Incineration Decree*, 1993¹⁹⁰

Disposal to landfill

The Dutch Decree on Landfilling in the 1993 *Environmental Protection Act*¹⁹¹, allows disposal to landfill of sewage sludge, only if the organic matter content is inferior to 10 % of the dry matter content. Landfilling of sludge is therefore strongly restricted but will remain an option for sewage sludge incineration ashes and residues from sludge dryers.

¹⁹⁰ Air Emissions Waste Incineration Decree, *Staatsblad* No. 451 of 26.08.92 (*het Wijzigingsbesluit Besluit emissie-eisen stookinstallaties Wet inzake de luchtverontreiniging*)

¹⁹¹ Environment Policies Act, *Staatsblad* No. 414 of 2.7.92 (*De Wet Milieubeheer*).

Portugal

Reviewed by Isabel Mertens, August 2000

Ministerio do Ambiente e do Ordenamento do Territorio.

Competence and legal structure

Competence

The Ministry of Environment and Territorial Planning has full legislative power concerning environmental issues in Portugal.

Legal structure

The use of sludge in agriculture is regulated by the Decree 446/91¹⁹² and by regulations¹⁹³ 176/96 and 177/96, established in 1991 on the basis of the Directive 86/278/EEC. Sludge which does not comply with the requirements to allow it to be used in agriculture will fall under the Decrees 488/85 and 121/91 on waste disposal and transport.

Types of sludge covered by legislation

The legislation applies to¹⁹⁴:

- "residual sludge from sewage plants treating domestic or urban waste waters and from other sewage plants treating waste waters of a composition similar to domestic and urban waste waters;
- residual sludge from septic tanks and other similar installations for the treatment of sewage;
- residual sludge from sewage plants treating waste waters from agriculture and cattle raising activities."

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge are the same as the lowest limits defined in the Directive 86/278/EEC. In addition, legislation in Portugal has introduced limit values for chromium (1000 mg/kg of dry matter), as it is the case in most Member States. The Decree also specifies that quantities of sludge used on land should not exceed 6 tonnes per hectare and per year¹⁹⁵.

¹⁹² Decree 446/91 of 22.11.91, *Diario Da Republica I Serie A* No. 269 of 22.11.1991 (*Decreto-Lei n° 446/91*)

¹⁹³ Regulation (*Portaria*) 176/96, *Diario Da Republica II Serie A* No.230 of 3.10.1996 and Regulation (*Portaria*) 177/96.

¹⁹⁴ Article 2 of the Decree 446/91

¹⁹⁵ Article 3; although higher quantities may be spread if heavy metal concentrations in sludge are low

Limit values for pathogens in sludge

The legislation in Portugal specifies no limit values for pathogens in sludge.

Limit values for organic compounds in sludge

The legislation in Portugal contains no specific requirements concerning organic compounds.

Limit values for soil for application

The Decree 446/91 has identified three sets of limit values for heavy metals concentration in soil, depending on the soil's pH ($\text{pH} < 5.5$, $5.5 < \text{pH} < 7$, $\text{pH} > 7$). The requirements for the first category correspond to the lower limits set by the Directive (which applies to soils with a pH superior to 6 and inferior to 7), while the requirements for the second category correspond roughly to the highest limits set by the Directive 86/278/EEC.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Portugal		
	$6 < \text{pH} < 7$	$\text{pH} < 5.5$	$5.5 < \text{pH} < 7$	$\text{pH} > 7$
Cd	1 – 3	1	3	4
Cr	-	50	200	300
Cu	50 – 140	50	100	200
Hg	1 – 1.5	1	1.5	2
Ni	30 – 75	30	75	110
Pb	50 – 300	50	300	450
Zn	150 – 300	150	300	450

Obligation for treatment

Sewage sludge must be treated before use in agriculture in order to eliminate all pathogenic organisms present in the sewage sludge¹⁹⁶.

Surfaces on which use of sludge is prohibited

In addition to the requirements established by the Directive 86/278/EEC, landspreading of sewage sludge is forbidden in Portugal:

- on areas close to rivers and lakes,
- during periods of heavy rain,
- on grassland or forage crops if the grassland is to be grazed or the forage crops to be harvested before a period of 3 weeks,
- on soil in which fruit and vegetable crops are growing, with the exception of fruit trees,
- on grassland or forage crops check two lines above either it is always forbidden or only if there is less than 3 weeks before grazing,
- ground intended for the cultivation of fruit and vegetable crops which are normally in direct contact with the soil and normally eaten raw, for a period of 10 months preceding the harvest of the crops and during the harvest itself".
- in areas close to individual houses and urban settlements
- in areas close to groundwater resources (within 100 meters of drinking water sources).

¹⁹⁶ Article 3

Further quality related restrictions

Certification and information requirements

The sludge producer shall transmit a report every 6 months to the regional directorate of the Ministry of Environment. This document includes:

- sludge quality and the treatment methods which have been used,
- the quantity of sludge spread on agricultural land,
- the name, address of the user (the farmer) of sludge as well as the location of the fields on which sludge has been used.

In addition, the sludge producer shall provide the user with all information concerning sludge quality.

Codes of practice and guides

There are no codes of practice or guides on the use of sludge in agriculture.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements concerning sewage sludge.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use.

Spain

Reviewed by Ana Rodriguez Cruz, March 2001

Ministerio de Medio Ambiente.

Competence and legal structure

Competence

Although the Ministry of Environment regulates most environmental issues in Spain, the regions also have regulatory powers. In particular, the regional authorities (herein after referred to as the autonomous communities) have the responsibility of controlling sludge quality. Local authorities are in charge of the treatment and disposal of sewage sludge.

Legal structure

In Spain, the use of sludge on farmland is regulated by the Royal Decree 1310/1990 of 29 October 1990¹⁹⁷ which regulates the procedures of control through the Autonomous Communities, which must inform the Ministry of Agriculture on the use of sewage sludge. The Royal Decree transposes the Directive 86/278 and draws the limit values for sludge to be used in agriculture and for soils. The Enforcement Order of October 26th 1993¹⁹⁸ was implemented so that the rules provided in the Royal Decree may be applied.

A larger Spanish plan for purification and treatment of urban waste water¹⁹⁹ was approved by the Decision of February 17th 1995. The purpose of this plan is to determine the measures to be taken for the purification and treatment of urban waste water²⁰⁰. In addition to that, the Ministry of Environment has prepared a national sewage sludge plan that is expected to be approved in 2001. The aim of this Plan is to establish measures for the prevention of pollution in sludge, to support new sludge treatment facilities, and to promote the application of high quality sludge on soil as well as to ensure safe disposal of sludge. Another Enforcement Order of 28 may 1998 lays down specific rules related to fertilisers²⁰¹.

As previously mentioned, in Spain the regions may implement their own legislation. For instance, in Cataluña the Decree on procedures of waste management²⁰² regulates different waste

¹⁹⁷ Royal Decree 1310/1990 of 29.10.90 on the use of sewage sludge in agriculture, BOE No. 262 of 1.11.90 (*Real Decreto 1310/1990 , por el que se regula la utilizacion de los lodos de depuracion en el sector agrario*).

¹⁹⁸ Enforcement Order 1993/26572 of October 26th 1993, BOE No. 265/1993 de 05.11.1993 (*Orden de 26 de octubre de 1993 sobre utilización de lodos de depuración en el Sector Agrario*).

¹⁹⁹ National plan for the purification and the treatment of waste water (*Plan Nacional de Saneamiento y Depuración de Aguas Residuales*)

²⁰⁰ in accordance with Council Directive 91/271/EEC, transposed into national regulation by Royal Decree 11/95 of 28.12.95 on standards for urban waste water treatment, BOE nº 312, of 30.12.95 (*Real Decreto-Ley 11/1995, de 28 de diciembre, por el que se establecen las normas aplicables al tratamiento de las aguas residuales urbanas*) amended by Royal Decree 509/96 of 15. 3.96, BOE nº 77, of 29.03.96 (*Real Decreto 509/1996 por el que se establecen las normas aplicables al tratamiento de las aguas residuales urbanas*).

²⁰¹ Enforcement Order on fertilisers of 28.5.98, BOE No. 131 of 2.6.98 (*Orden de 28 de mayo de 1998 sobre fertilizantes y afines*).

²⁰² Decree nº 93/1999 of 6.4.1999 on waste management, DOGC No. 2865 of 12.04.99 (*Décret 93/1999, de 6 d'abril, sobre procediments de gestió de residus*)

management procedures than provided in the Royal Decree 1310/1990, and specifies administrative mechanism for controlling them. In the community of Madrid, the Decree of November 20, 1998²⁰³ also implements specific rules for the use of sludge in agriculture.

Types of sludge covered by legislation

The types of sludge covered by the legislation are defined in section 1 of the Decree 1310/1990. It is similar to the definitions provided in Article 2 of Directive 86/278/EEC.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The Spanish legislation defines two different sets of limit values: for soil with a pH inferior to 7, and for soil with a pH superior to 7²⁰⁴. The limit values are almost the same as the one specified in the Council Directive No 86/278. In addition, Spanish legislation provides limits for annual heavy metal load to soil, which are the same as the ones described in Directive 86/278/EEC. As in most Member States, limit values for Chromium have been introduced in the regulation.

Limit values for pathogens in sludge

There are no specific requirements in Spanish legislation on pathogens for the use of urban sewage sludge in agriculture. However, according to provision 10 of the Enforcement Order of 28 May 1998 concerning Fertilisers, use of sludge from processing of animal raw material is prohibited if the following limit values are not respected:

- salmonella: 0 in 25 g of fresh matter
- streptococcus faecal: $1.0 \times 10(3)$ MPN/g
- bacteria total: $1.0 \times 10(3)$ units/g.

Limit values for organic compounds in sludge

The legislation in Spain contains no specific requirements concerning organic compounds.

Limit values for soil for application

The Spanish legislation provides two different sets of limit values²⁰⁵ which vary according to the soil pH (which can be either superior or inferior to pH 7). The limit values for heavy metals in soil with pH inferior to 7 correspond to the lowest option specified in the Council Directive 86/278/EEC. In addition a limit value is defined for Chromium (100-150).

²⁰³ Decree 193/1998, of 20.11.1998, on the use of sewage sludge in agriculture in the Community of Madrid, BOCM No. 287 of 3.12.98 (*Decreto 193/1998, de 20 noviembre, por el que se regula, en la Comunidad de Madrid, la utilizacion de lodos de depuradora en agricultura*)

²⁰⁴ Annex I A and B. The same limit values have also been included in the Decree 193/1998, of 20.11.1998, on the use of sewage sludge in agriculture in the Community of Madrid, BOCM No. 287 of 3.12.98.

²⁰⁵ Appendix I

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Spain	
	6<pH<7	pH<7	pH>7
Cd	1 – 3	1	3
Cr	-	100	150
Cu	50 – 140	50	210
Hg	1 – 1.5	1	1.5
Ni	30 – 75	30	112
Pb	50 – 300	50	300
Zn	150 – 300	150	450

Obligation for treatment

Obligations for treatment implemented as provided in the Directive 86/278. These provisions²⁰⁶ prohibit the use in agriculture of untreated sludge, treated sludge being defined as sludge subjected to biological, chemical or heat treatment, long term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use. It is to be noted that the Madrid legislation (Decree 193/1998) concerning sludge also imposes treatment by dewatering.

Surfaces on which use of sludge is prohibited

The use of sludge is prohibited²⁰⁷:

- on grassland which is intended to be grazed or the forage crops to be harvested within three weeks of such use,
- on land on which fruit and vegetables (excepting fruit that may be eaten raw are in direct contact with the ground during their cultivation or for a period of ten months prior and during harvesting.

Further quality related restrictions

Certification and information requirements

Analyses of sludge and soil have to be carried out at least every six months²⁰⁸. These specifications are similar to the ones provided in the Directive 86/278/EEC²⁰⁹. The Spanish autonomous communities shall submit reports to the ministry of agriculture (section 7-2) and Spanish waste water treatment plants will provide all information required²¹⁰.

Codes of practice and guides

Several codes of good practice have been developed at regional level (such as the provinces of Madrid and Catalonia) on the use of sludge in agriculture.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements concerning sewage sludge.

²⁰⁶ Sections 1 to 6

²⁰⁷ Article 3

²⁰⁸ Annex II A, II B and II C

²⁰⁹ Annex II A, II B and II C of the Directive 86/278/EEC

²¹⁰ Section 6 of the Royal Decree 1310/1990

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the regulation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the regulation.

Green areas

No specific elements address these aspects in the regulation.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use.

Sweden

Reviewed by Björn Wallgren, August 2000

Swedish Environment Protection Agency

Competence and legal structure

Competence

The organisations in charge of environmental issues at national level are both the *Ministry of the Environment* and the *Swedish Environmental Protection Agency* (SEPA), which is an advisory body contributing to the implementation and enforcement of legislation, and has the responsibility of water management in Sweden.

At regional level, 23 *County Administrative Boards* are responsible for controlling water quality as well as other activities presenting a risk for the environment. The Counties also deliver permits for waste water treatment plants when their capacity is superior to 2000 PE. However, a permit is not compulsory for plants with a treatment capacity of 2000 PE or less. In this case, a notification to the municipal board is sufficient. In a general manner, those who perform activities that may affect the environment have to obtain a permit either from one of the five regional *Environmental Courts*, the *County Administrative Boards*, the municipality, or to give notification to the municipal board.

At local level, 288 communities are responsible for the local protection of the environment. Their responsibilities include water distribution, as well as collection and disposal of waste. In most cases, the municipalities are in charge of the management of the local waste water treatment plant. The municipal board has the obligation to inform the County on the quantities of sewage sludge produced, the quality of the sludge as well as the quantities recycled in agriculture. The Counties transmit each year a report on these issues to the SEPA.

Legal Framework

The Environmental Protection Act (SFS 1969/387) was the main act regulating environmental pollution, and is now replaced by the Environmental Code (SFS 1998/808) which has come into force on January 1st, 1999²¹¹. This *Code* includes the regulation of activities presenting a risk for the environment, which have to obtain a Permit for Environmentally Hazardous Activities.

The use of sludge in agriculture in Sweden is regulated by the Ordinance on certain products hazardous to Health and to the Environment (1985/840), reviewed in 1993, and by the Order containing regulations on the protection of the environment, in particular the soil, when sewage sludge is used in agriculture (SNFS 1994/2)²¹².

²¹¹ Environmental Code of 11.6.1998 (SFS 1998 : 808), *Miljöbalk*

²¹² Order containing regulations on the protection of the environment, in particular the soil, when sewage sludge is used in agriculture of 30 May 1994, Environment Protection Order 1994:2 (SNFS 1994 : 2), (*Kungörelse med föreskrifter om skydd för miljön, särskilt marken, när avloppsslam används i jordbruket*)

Types of sludge covered by legislation

Sludge addressed by regulation (SNFS 1994: 2) is defined as follows: *"sludge from sewage plants, septic tanks, or similar installations for the treatment of domestic or urban waste water, or from other sewage plants treating waste water of a similar composition"*. This definition is therefore similar to the one provided in Article 2 of Directive 86/278/EEC.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The Ordinance 1985/840 on certain products hazardous to Health and to the Environment, specifies the limits for heavy metals concentration in sludge for agricultural use. The limits on trace element content are much lower than the requirements set by the Directive 86/278/EEC. For example, for Cadmium and Mercury, the limits for concentrations in sewage sludge intended to be recycled in agriculture are 10 times stricter than those specified in Directive 86/278/EEC.

Limits for heavy metals in sludge (mg/kg dry matter)

	86/278/EEC	Sweden
	Annex I B	
Cd	20 – 40	2
Cr	-	100
Cu	1000 – 1750	600
Hg	16 – 25	2.5
Ni	300 – 400	50
Pb	750 – 1200	100
Zn	2500 – 4000	800

In addition, the Swedish regulation provides limit annual average load of heavy metals to agricultural land.

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Sweden
	Annex I C	
Cd	150	1.75
Cr	-	100
Cu	12 000	600
Hg	100	2.5
Ni	3 000	50
Pb	15 000	100
Zn	30 000	800

Limit values for pathogens in sludge

The regulation contains no specific requirements concerning pathogens.

Limit values for organic compounds in sludge

The regulation contains no specific requirements concerning organic compounds. However, restrictions on the concentration of organic compounds in sewage sludge for use in agriculture have been introduced in the agreement between SEPA, the *Federation of Swedish Farmers* and the *Swedish Water and Waste Water Association* signed in 1994. This agreement specifies that concentrations in sewage sludge for agriculture should not be higher than:

Nonylphenol:	100 mg/kg DM
Toluene:	5.0 mg/kg DM
PAH: (6 compounds)	3.0 mg/kg DM
PCB: (7 compounds)	0.4 mg/kg DM, as an annual mean.

Limit values for soil for application

The Order SNFS 1994/2 containing regulations on the protection of the environment, in particular the soil, when sewage sludge is used in agriculture defines maximum concentrations of heavy metals in arable soil as well as maximum annual quantity of metals which may be introduced into arable soil as a result of the use of sludge.

Here again, Swedish legislation appears very stringent compared to the requirements set out by Directive 86/278/EEC. Swedish legislation also specifies limits on concentration of Chromium (60 mg/kg dry matter).

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Sweden
	6<pH<7	
Cd	1 – 3	0.4
Cr	-	60
Cu	50 – 140	40
Hg	1 - 1.5	0.3
Ni	30 – 75	30
Pb	50 – 300	40
Zn	150 – 300	100 - 150

Obligation for treatment

Sludge has generally to be treated before being used in agriculture. Treated sludge is defined as "sludge which has undergone biological, chemical or heat treatment, long-term storage or any other process so as significantly to reduce the health hazards resulting from its use."²¹³ Untreated sludge may nevertheless be used if it is worked into the soil within a maximum of 24 hours after having being spread and its use does not cause a nuisance to local residents.

²¹³ SNFS 1994/2

Surfaces on which use of sludge is prohibited

According to regulation (SNFS 1994/2), sludge has not to be used:

- on grazing land,
- in arable land which is to be used for grazing or if fodder crops are to be harvested within ten months of the time the sludge is spread;
- on land bearing crops of berries, potatoes, root vegetables, vegetables or fruit (excepting fruit on trees);
- on land intended for forthcoming cultivation of berries, potatoes, root vegetables, or vegetables which are normally in direct contact with the soil and are normally eaten raw, for a period of ten months prior to harvesting.

Further quality related restrictions

Certification and information requirements

In addition to the information requirements specified in the Directive 86/278/EEC, which have to be transmitted to the authority exercising supervisory control over the sewage treatment plant, the Swedish regulation also requires sludge producers to provide the users with a declaration of contents describing:

- the origin of the sludge and the treatment it has undergone,
- constituents if it has been mixed with other material,
- the composition of the sludge before being mixed with other material,
- suitable dose with respect to the phosphorus, nitrogen and metal content.

It has recently been agreed to set up a voluntary quality certification scheme for landspreading, which should be established in the next three years.

Codes of practice and guides

The *Federation of Swedish Farmers* (LRF) and the *Swedish Water and Waste Water Association* (VAV) have issued guidelines on additional quality assurance for the use of sludge in agriculture (see next point). In addition, the SEPA publishes documents which can be considered as codes of good practices in certain areas, the so-called *General Advises* (in particular, the General Advises 90:13 on Sludge from municipality treatment plants).

Voluntary agreements on disposal and recycling of sewage sludge

In 1994 the SEPA, the LRF and the VAV signed a voluntary agreement (the Sewage Sludge Agreement) on sludge spreading in agriculture. Among other things, this agreement recommends maximum concentrations of certain micro-pollutants (see point 1.33) in sludge.

In addition, a *national consultative group* has been formed in order to develop the work on the measures agreed upon in the framework of this agreement. Consultative groups have also been established at local level to work on possibilities to improve sewage sludge quality, and to conduct audits on the quality of sludges ("sewage sludge audits").

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

No specific elements address these aspects in the legislation. However, the General Guidelines 1990:13 from the SEPA, Sludge from municipal sewage treatment plants, contain recommended maximum values for heavy metals and recommendations on hygienic safety and DM-loads when sludge is used in silviculture, landscaping, gardening and land reclamation.

Natural forest and reforested area

No specific elements address these aspects in the regulation.

Land reclamation

No specific elements address these aspects in the legislation. However, the recommendations in the General Guidelines 1990: 13 apply also to silviculture, landscaping, gardening and land reclamation.

Green areas

No specific elements address these aspects in the legislation. The General Guidelines 1990:13 apply, however.

Specific requirements or legislation for other routes

Incineration

Incineration of waste has to comply with the *SEPA* Regulations on emissions into the air from waste incineration (SNFS 1993/13 or SNFS 1993/14²¹⁴). These regulations are based on the Council Directive 89/429/EEC on the reduction of air pollution from existing municipal waste-incineration plants. Permits issued by Swedish regional authorities tend to be more stringent than the requirements set in the regulation. However, at present incineration of sewage sludge remains limited in Sweden.

Disposal to landfill

No specific elements address these aspects in the regulation on sludge use. However, from 2005 onwards, no organic waste (including sludge) will be accepted in landfills, by application of waste regulations²¹⁵.

²¹⁴ Regulations on emissions into the air from waste incineration (NFS 1993:13) replaced by NFS (2000:5) of 24.5.2000 (*NFS om utsläpp till luft från anläggningar för förbränning av kommunalt avfall med en nominell kapacitet mindre än 6 ton per timme och som beviljats tillstånd enligt miljöskyddslagen (1969:387) före den 1 januari 1994*).

Regulations on emissions into the air from waste incineration (NFS 1993:14) replaced by NFS (2000:6) of 24.5.2000 (*NFS om utsläpp till luft från anläggningar för förbränning av kommunalt avfall som beviljats tillstånd enligt miljöskyddslagen (1969:387) eller miljöbalken (1998:808) efter den 1 januari 1994 och anläggningar med en nominell kapacitet lika med eller större än 6 ton per timme som beviljats tillstånd enligt miljöskyddslagen före den 1 januari 1994*).

²¹⁵ Environmental Code of 11.6.1998 (SFS 1998 : 808), *Miljöbalk (15 Kap. Avfall och Producentansvar)*.

United Kingdom

Reviewed by Jonathan Tweney, August 2000

Department of the Environment, Transport and the Regions

Competence and legal structure

Competence

The Department of the Environment, Transport and the Regions (DETR) has the responsibility for the development of environmental policy. Nevertheless, the Environment Agency is the lead authority responsible for enforcing waste regulations in England and Wales. In Scotland, the responsible authority is the Scottish Environment Protection Agency (SEPA). The Environment Agency is in the process of revising exemption from waste management licensing for the landspreading of waste. The responsibility for enforcement of the regulations in Northern Ireland is the Department of the Environment in Northern Ireland.

Legal Structure

In Great Britain, the use of sludge is regulated by the Sludge (Use in Agriculture) Regulation of 1989 No. 1263²¹⁶ and by the Sludge (Use in Agriculture) (Amendment) Regulation 1990 No. 880²¹⁷ which amends the first Regulation. In Northern Ireland, the use of sludge in Agriculture is regulated by the Sludge (Use in Agriculture) Regulations 1990 No. 245²¹⁸.

In addition to these Regulations, the Code of Practice for Agricultural Use of Sewage Sludge of 1996 applies to the use of sewage sludge in Agriculture in the United Kingdom and the Codes of Good Agricultural Practice for the Protection of Water, Air and Soil provide general orientations for the use of sludge by the farmers.

Types of sludge covered by legislation

The Sludge Regulation 1989 No. 1263 covers sewage sludge defined similarly as in Directive 86/278/EEC, Article 2.

²¹⁶ Sludge (Use in Agriculture) Regulations No. 1263 of 24.7.89, ISBN 0110972635, published on 28.7.1989.

²¹⁷ Sludge (Use in Agriculture) (Amendment) Regulations No. 880 of 5.4.90, ISBN 0110038800, published on 17.4.1990.

²¹⁸ Sludge (Use in Agriculture) Regulations 1990 No. 245 (for Northern Ireland), ISBN 0337802459, published on 3.7.1990.

Several types of industrial sludge, applied to agricultural land, are exempt from licensing under waste regulations to permit the beneficial recovery of certain wastes in accordance with Part II of the Environmental Protection Act 1990 and the Waste Management Licensing Regulations (WMLR) 1994. Industrial sludges that are exempt from licensing and sludge which can be spread on agricultural land are the following²¹⁹:

- waste food, drink or materials used in or resulting from the preparation of food or drink,
- blood and guts contents from abattoirs,
- lime sludge from cement manufacture or gas processing,
- paper waste sludge,
- effluent treatment sludge from a tannery.

However, notification must be given to the Environment Agency before the spreading is carried out. Once notified to and accepted by the Agency, the activity will be registered as exempt. No more than 250 tonnes per hectare may be spread on the land in a twelve-month period.

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The UK legislation has the specificity of not providing any limit values for heavy metals in sludge. The only specifications given by UK legislation on this aspect is the maximum annual average load of heavy metals to soil through application of sludge.

The maximum loads identified in the regulation are similar to the requirements of the Directive 86/278/EEC, however the UK regulation is slightly stricter for copper and zinc and does not contain any specific requirements as regards chromium. In addition, limit values can be exceeded if sludge is applied on *dedicated sites*²²⁰ defined as "area of agricultural land which on 17th June 1986 was dedicated to the disposal of sludge but on which commercial food crops were being grown exclusively for animal consumption".

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	UK
	Annex 1 C	
Cd	150	150
Cr	-	-
Cu	12 000	7 500
Hg	100	100
Ni	3 000	3 000
Pb	15 000	15 000
Zn	30 000	15 000

Limit values for pathogens in sludge

The regulations contain no specific requirements for pathogens in sludge.

Limit values for organic compounds in sludge

The regulations contain no specific requirements for organic compounds in sludge.

²¹⁹ Schedule 3, paragraph 7 of the the *Waste Management Licensing Regulations* of 1994

²²⁰ Provision 3 (4) (a) of the *Sludge Regulation* 1989 n.1263

Limit values for soil for application

UK regulation²²¹ identifies four different limit values for heavy metals according to the pH of soil (from 5 to more than 7). In comparison with the limit values for heavy metals in soil with pH between 6 and 7 specified in the Directive 86/278/EEC, the maximum permissible concentrations in soil with pH between 6 and 7 correspond to the highest values set up by the Directive (except for mercury). In addition, limit values can be exceeded on dedicated *sites*²²². Lower limit values have been adopted for zinc, copper and nickel when the soil's pH decreases.

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	UK			
	6<pH<7	5<pH<5.5	5.5<pH<6	6≤pH≤7	pH>7
Cd	1 – 3	3	3	3	3
Cr	-	-	-	-	-
Cu	50 – 140	80	100	135	200
Hg	1 - 1.5	1	1	1	1
Ni	30 – 75	50	60	75	110
Pb	50 – 300	300	300	300	300
Zn	150 – 300	200	250	300	450

The limit of detection for each metal shall not exceed 10 % of the limit values specified in the table above and 25 mg/kg of dry matter for chromium²²³.

Obligation for treatment

In accordance with Directive 86/278/EEC, British legislation specifies that "*treated sludge means sludge or septic sludge which has undergone biological, chemical or heat treatment, long term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use*". The regulation does not include obligations for treatment, however it is specified that "*where any untreated sludge has been used on agricultural land without being injected into soil, the occupier of the land affected shall, as soon as reasonably practicable thereafter, cause such sludge to be worked into the soil of the land affected*"²²⁴.

Surfaces on which use of sludge is prohibited

Sludge shall not be used on²²⁵:

- land on which fruit or vegetable crops, other than fruit trees, are growing or being harvested in the soil at the time of the use,
- land on which fruit and vegetable crops, which are grown in direct contact with the soil and normally eaten raw, are to be harvested within ten months of such use
- soil on which the pH value is less than 5.

²²¹ Soil table of Schedule 2

²²² Provision 3(4) (b)

²²³ Paragraph 6 of Schedule 1

²²⁴ Provision 4 (2)

²²⁵ Provision 3 (6)

In addition, sludge or septic tank sludge shall not be used or supplied for use on agricultural land where such land is to be grazed within three weeks of such use.

Further quality related restrictions

Certification and information requirements

Sludge and soil shall be analysed²²⁶ at least every six months for the sludge as specified in provision 6 (b) of Directive 86/278/EEC and every twenty years for soil (but every five years when the sludge producer is requested to do so in writing by the occupier of the land or by the Secretary of State)²²⁷. The methods and conditions applying to sludge and soil analysis are specified in the Sludge Regulation of 1989.

In addition to the analysis to be carried out, the sludge producer shall keep a register as specified in the Directive 86/278/EEC²²⁸ and maintain this same register for inspection by the Secretary of State²²⁹. The information contained in the register must include the area on which sludge was used and the quantities used, the date of use, and the name of the person which supplied sludge if it is not the sludge producer

Codes of practice and guides

As previously mentioned²³⁰, several codes of Practice apply to the use of sewage sludge on agricultural land in the United Kingdom. In the Code of Practice for Agricultural Use of Sewage Sludge, several requirements are stricter than in the sludge regulation (for example, the recommended maximum concentration of zinc in soil is lower than in the regulation). In addition some additional requirements not stated in the Sludge Regulation are included in this code, such as maximum permissible concentrations of selenium, arsenic or fluoride. This Code of practice also gives examples of the most effective sludge treatment processes so as to reduce the potential health hazard posed by the pathogens²³¹.

Voluntary agreements on disposal and recycling of sewage sludge

An agreement between the main sludge producers (regrouped in Water UK) and the main food retailers (British Retailers Consortium) has been reached in 1998. This agreement has led to the common adoption of a "Safe Sludge Matrix" by the UK Water Industry and the British Retailer Consortium (BRC). This "safe sludge matrix" provides additional restrictions for the use of sewage sludge on agricultural land, as well as categories of crops on which sludge may not be used. One of the main elements of this agreement is the ban on use of untreated sludge except on non-food industrial crops on which untreated sludge is allowed to be applied until the end 2001.

²²⁶ Schedule 1 for the sludge and Schedule 2 for the soil on land

²²⁷ Section 2 of Schedule 2

²²⁸ Provision 6

²²⁹ Provision 7

²³⁰ See sub-chapter Competence and legal structure

²³¹ Provision 2.2 of the Code of practice for Agriculture Use of sewage Sludge

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The regulation contains no specifications on this aspect.

Natural forest and reforested area

In Great Britain, the use of sludge in natural forest and reforested areas is addressed by a "Manual of Good Practice for the Use of Sewage Sludge in Forestry".

Land reclamation

A manual of good practice for the use of sewage sludge in land reclamation is also available²³².

Green areas

This aspect is not addressed by the regulation.

Specific requirements or legislation for other routes

Incineration

There are no specific requirements for sludge in the legislation on incineration. In addition, no specific elements address incineration in the regulation on sludge use. Thus the *Environmental Pollution Act 1995* applies to the incineration of sludge, as for all other waste.

Disposal to landfill

There are no specific requirements for sludge in the legislation on landfilling. In addition, no specific elements address landfilling in the regulation on sludge use. Disposal to landfill is covered by the *Waste Management Licensing Regulations 1994*.

²³² WRc, Manual of good practice for the use of sewage sludge in land reclamation, 1999, ISBN 1 898 920 389

Accession countries

Estonia

Competence and legal structure

Competence

The Minister of Environment has full legislative competence for environmental issues in Estonia. Local authorities (regions, towns) are in charge of dealing with local environmental issues, and in particular of waste water collection and treatment, and of sewage sludge disposal. In most cases these tasks are then delegated to private companies.

Legal structure

The regulation of the Minister of Environment of 11th November 1999 on instructions for use of wastewater sludge in agriculture, green area creation and recultivation is the most relevant legislation for sludge management²³³.

Types of sludge covered by legislation

The regulation defines²³⁴:

- "sewage sludge" as "a suspension derived from the sewage water by physical, chemical and biological methods",
- "Sludge mixture" as "a mixture of sludge and peat, mould, bedding straw, lime or any other compound",
- "Sludge compost" as "a product derived by aerobic treatment of sludge, which does not contain dangerous substances neither micro-organism in the extent as to cause health hazards to humans, animals or the environment".

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge when sludge is to be used in agriculture, green area creation and recultivation are presented in the following table²³⁵ (limit values which are lower than those set by the Directive 86/278/EC are highlighted in grey).

²³³ Instructions for use of wastewater sludge in agriculture, green area creation and recultivation of 11.11.99, *Riigi Teataja* Lisa No. 156 of 19.11.99 (*Reoveesette põllumajanduses, haljastuses ja rekultiveerimisel kasutamise eeskiri*)

²³⁴ Section I: general provisions

²³⁵ Article 21

Limit values for heavy metals in sludge for use in agriculture, green area creation and recultivation (mg/kg of DM)

	Directive 86/278/EEC	Estonia
Cd	20-40	15
Cr	-	1200
Cu	1000-1750	800
Hg	16-25	16
Ni	300-400	400
Pb	750-1200	900
Zn	2500-4000	2900

In addition, the regulation specifies limit values for average yearly heavy metals load (on a ten years basis). These limit values correspond to the requirements of Directive 86/278/EEC, with the exception of chromium. These limit values are presented in the table below:

Maximum annual average load of heavy metals to agricultural land (g/ha/y)

	86/278/EEC	Estonia
	Annex 1 C	
Cd	150	150
Cr	-	4 500
Cu	12 000	12 000
Hg	100	100
Ni	3 000	3 000
Pb	15 000	15 000
Zn	30 000	30 000

Limit values for pathogens in sludge

The regulation does not provide any limit values on pathogens in sludge, but specifies that *"It is prohibited to use sludge, mixture of sludge or sludge compost which contains dangerous substances, preparations, micro-organisms, intestinal parasites or eggs of intestinal parasites in the extent that it is hazardous to human health or to environment."*²³⁶

Limit values for organic compounds in sludge

No specific requirements in the legislation on this issue.

Limit values for soil for application

The Estonian regulation defines maximum concentrations of heavy metals in soil. These limit values correspond in most cases to the requirements of Directive 86/278/EEC. However, the regulation also specifies limits on concentration of Chromium (100 mg/kg dry matter), which are not imposed by EU legislation.

²³⁶ Article 11

Limits for heavy metals in soil (mg/kg dry matter)

	86/278/EEC	Estonia
	6<pH<7	6<pH
Cd	1 – 3	3
Cr	-	100
Cu	50 – 140	50
Hg	1 - 1.5	1.5
Ni	30 – 75	50
Pb	50 – 300	100
Zn	150 – 300	300

Obligation for treatment

There are no specific requirements on sludge treatment in the regulation. However, *"for green areas creation and recultivation it is allowed to use **untreated** sludge and mixture of sludge produced from untreated sludge from small treatment plants with the capacity of 2000 p.e. in addition to treated sludge, mixture of sludge and sludge compost produced from treated sludge"*²³⁷.

Surfaces on which use of sludge is prohibited

The use of sludge, mixture of sludge and sludge compost is prohibited on the following surfaces:

- on fruit and vegetable crops except fruit trees. Vegetables for human and animal consumption may not be grown earlier than 1 year after the application of sludge;
- on arable land if fodder crops are to be harvested within two months of the time the sludge is spread;
- on soil with a pH value inferior to 6;
- on wet areas,
- on frozen soil and on snow.

Further quality related restrictions

Certification and information requirements

According to the regulation, sludge samples are taken from the sludge, mixture of sludge or sludge compost before providing it to the user, the sampling frequency depending on the capacity of treatment plant.

The provider of the sludge, mixture of sludge and sludge compost for the use of agriculture, green area creation or recultivation must present to the user information on sludge treatment, sludge analysis and instructions for using sludge, mixture of sludge or sludge compost.

In addition, the handler of sludge, mixture of sludge or sludge compost must present the data on users of sludge, mixture of sludge or sludge compost, their names and addresses and information how it is used to the Waste Register

Codes of practice and guides

No information is available on this aspect.

Voluntary agreements on disposal and recycling of sewage sludge

There have been no voluntary agreements.

²³⁷ Article 12

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The regulation contains no specific element on these aspects.

Natural forest and reforested area

The regulation contains no specific element on these aspects.

Land reclamation

This route is covered by the same regulation as for use in agriculture.

Green areas

This route is covered by the same regulation as for use in agriculture on "*Instructions for use of wastewater sludge in agriculture, green area creation and recultivation*".

Specific requirements or legislation for other routes

Incineration

The regulation on sludge use contains no specific element on these aspects. Incineration of waste is covered by the 1998 Act on Ambient Air Protection²³⁸ and by the 1999 Regulation establishing procedures for applying and issuing air pollution and special pollution permit²³⁹.

Disposal to landfill

The regulation on sludge use contains no specific element on these aspects. Disposal of waste to landfill is covered by the 1998 Waste Act²⁴⁰.

²³⁸ Ambient Air Protection Act of 22.04.1998, RT I 1998, 41/42, 624; 1999, 10, 155; 95, 843; 2001, 24, 133, (*Välisõhu Kaitse Seadus*)

²³⁹ Regulation of the Minister of the Environment nr 47 from 28.04.1999 on Establishing procedure for issuing and applying for the pollution permit and special pollution permit, RTL 1999, 79, 984; 2000, 37, 517 (*Keskkonnaministri määrus nr 47 28.04.1999, Välisõhu saasteloa ja erisaasteloa taotlemise ja väljaandmise kord*)

²⁴⁰ Waste Act of 10.06.1998, RT I 1998, 57, 861; 1999, 23, 353; 10, 155; 95, 843; 2001, 16, 72; 43; 239; 56; 340 (*Jäätmeseadus*)

Latvia

Competence and legal structure

Competence

The Minister for Environmental Protection and Regional Development has full legislative competence for environmental issues in Latvia. In addition, the regional environmental authorities are in charge of monitoring the implementation of environmental protection requirements. In the context of sludge management, the observance of the agro-technical requirements are carried out by the departments of agriculture of the relevant regions, while the state sanitary inspectorate controls that sludge landspreading is carried out in compliance with safety requirements.

Legal structure

The main regulations related to environmental protection in Latvia are the Law on Hazardous Waste of 1993²⁴¹, supplemented by the Regulation on Classification of Hazardous Waste and Criteria for hazardousness of 1997²⁴², the Law on Municipal Waste of 1998²⁴³, and the Law on Environmental Impact Assessment of 1998²⁴⁴.

The use of effluent sludge in agriculture is regulated by the Regulation No. 316 of September 1997 for the use of effluent sludge in the fertilisation of soil and in organising territorial public services²⁴⁵.

Types of sludge covered by legislation

The regulation defines "effluent sludge" as being "colloidal sediment obtained in the treating of effluent in purification plants".

Effluent sludge is divided into the following groups:

- treated or composted effluent sludge (sludge which has been biologically, chemically, thermally or otherwise treated or has been kept for a long period of time;
- untreated effluent sludge (sludge not treated as above mentioned);
- fresh effluent sludge (treated or untreated effluent sludge which has not been once frozen through within the thickness of the layer);

²⁴¹ Law on Hazardous Waste of 1993, "Latvijas Vestnesis" of 15.04.1993, No.14 (*Likums par bīstamajiem atkritumiem*), substituted with the Law on Waste Management "Latvijas Vestnesis" No.473, 29.12.2000 (*Atkritumu apsaimniekošanas likums*)

²⁴² Regulation on Classification of Hazardous Waste and Criteria for hazardousness, "Latvijas Vestnesis" of 15.08.1997, No.204 (*noteikumi Nr.298 : "Noteikumi par bīstamo atkritumu klasifikāciju un bīstamības kritērijiem"*), substituted with the Regulations of the Cabinet of Ministers No.258 on Waste classification and characteristics, that make waste dangerous, "Latvijas Vestnesis" of 22.06.2001, No.258 (*"Noteikumi par atkritumu klasifikatoru un īpašībām, kuras padara atkritumus bīstamus"*).

²⁴³ Law on Municipal Waste of 1998, "Latvijas Vestnesis", of 30.10.1998, No.322 (*likums par sadzīves atkritumiem*), substituted with the Law on Waste Management "Latvijas Vestnesis" of 29.12.2000, No.473 (*Atkritumu apsaimniekošanas likums*)

²⁴⁴ Law on Environmental Impact Assessment, "Latvijas Vestnesis" of 30.10.1998, No.322 (*Likums par ietekmes uz vidi novērtējumu*)

²⁴⁵ Regulation No. 316 of September 1997 for the use of effluent sludge in the fertilisation of soil and in organising territorial public services "Latvijas Vestnesis" of 12.09.1997, No.225 (*noteikumi Nr.316: "Noteikumi par notekudenu dūmu izmantošanu augsnes meslošanā un teritoriju labiekārtošanā"*)

- naturally moist effluent sludge (effluent sludge with an appropriate moisture content).

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge when sludge is to be used in agriculture are defined by the Regulation No. 316, and correspond to the lowest limits imposed by Directive 86/278/EEC. These limit values are presented in the following table.

Limit values for heavy metals in sludge for use in agriculture (mg/kg of DM)

	Directive 86/278/EC	Regulations No. 316
Cd	20-40	20
Cr	-	2000
Cu	1000-1750	1000
Hg	16-25	16
Ni	300-400	300
Pb	750-1200	750
Zn	2500-4000	2500

Limit values for pathogens in sludge

No specific requirements in the legislation on this issue.

Limit values for organic compounds in sludge

No specific requirements in the legislation on this issue.

Limit values for soil for application

The limit values for heavy metals in soil vary depending on the types of soil, as follows:

*Limit values for heavy metals in soil
mg/kg of DM*

	Directive 86/278/EC	Regulations No. 316 Granulometric content groups			
		sand	Sandy loam	Light and medium Loam	Heavy loam and clay
Cd	1-3	0.3	0.5	0.7	1.00
Cr	-	15	20	25	30
Cu	50-140	10	12	15	25
Hg	1-1,5	0.1	0.12	0.14	0.15
Ni	30-75	8	10	15	30

Pb	50-300	15	20	25	30
Zn	150-300	35	45	60	100

This table shows that the requirements established by the Latvian legislation are in most cases stricter than the limit values specified in Directive 86/278/EEC.

Obligation for treatment

There are no specific requirements in the legislation on this issue.

Surfaces on which use of sludge is prohibited

Land spreading of sludge is prohibited on the following surfaces:

- On slopes with a gradient greater than 10,
- On frozen soil,
- Closer than 50 meter from public water supply plant, dwelling houses and "food undertakings", and closer than 25 meters from individual drinking water equipment if no different decisions have been made in territorial planning,
- On allotments and covered areas for growing vegetables. Field vegetables (carrots, cabbage, beet root, etc.) and potatoes may not be grown earlier than 2 years after the application of sludge,
- On pasture land.

The Latvian regulation also provides very detailed instructions on limitations concerning crops and dates of application of sludge, which are not presented here²⁴⁶.

Further quality related restrictions

Certification and information requirements

Sludge and soils must be analysed in Latvia, if sludge is to be used on these soils. The producer of effluent sludge prepares and issues an effluent quality certificate for each series of effluent sludge, based on the results of the effluent sludge quality tests carried out by an approved laboratory.

Concerning soils, the analyses must be performed by an authorised laboratory. Determining the agronomic properties and the background heavy metal content in the soil is not compulsory if the previous agrochemical analyses of the soil are no more than 5 years old.

Codes of practice and guides

No information available on this aspect.

Voluntary agreements on disposal and recycling of sewage sludge

No voluntary agreements exist in Latvia on this issue.

²⁴⁶ Sections XI and X of Regulation

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The regulation contains no specific element on these aspects.

Natural forest and reforested area

The regulation contains no specific element on these aspects.

Land reclamation

The regulation contains no specific element on these aspects.

Green areas

When sludge is used for "*greenery in inhabited places*", the state's relevant administration and the national environmental health centre will carry out a joint examination and "*issue a resolution*"²⁴⁷.

Specific requirements or legislation for other routes

Incineration

The regulation on sludge use contains no specific element on these aspects.

Disposal to landfill

The regulation on sludge use contains no specific element on these aspects.

²⁴⁷ Article 41

Poland

Competence and legal structure

Competence

The Minister of Environment, Natural Resources Protection and Forests has full legislative competence for environmental issues in Poland. In addition, 7 regional directions for water management (RZGW) are in charge of monitoring water quality as well as waste water works. Environmental law enforcement is carried out by the national inspectorate of environment protection and by the regional inspection service for environment protection. At local level, 2468 municipalities (*gminas*) are in charge of water supply and waste water treatment.

Legal structure

The main regulations related to environmental protection in Poland are the Law on Environmental Protection and Management of 1980²⁴⁸, the law on the Protection of Nature of 1991²⁴⁹, the Law on Waste of 1997²⁵⁰ as well as the law on the protection of soil dedicated to agriculture or silviculture 1995²⁵¹.

The use of sludge in agriculture is regulated by the Decree of August 11, 1999²⁵². This Decree defines the requirements for use of residual sludge for non industrial purposes, and specifies that sludge can be used in 4 different routes:

- Land reclamation
- Use in agriculture
- Green areas
- Production of compost (including land spreading on crops used for producing compost).

Types of sludge covered by legislation

The Decree of August 11, 1999 concerns uniquely urban sewage sludge.

²⁴⁸ Law on Environmental Protection and Management of 31.01.1980, *Dziennik Ustaw* 94.49.196 of 15.04.1994 (*Ochrona i kształtowanie Środowiska*)

²⁴⁹ Law on the Protection of Nature of 16.10.1991, *Dziennik Ustaw* 91.114.492, 12.12.1991 (*Ochrona przyrody*)

²⁵⁰ Law on Waste of 27.06.1997, *Dziennik Ustaw* 97.96.592 of 13.08.1997 (*Opady*)

²⁵¹ Law on the protection of agricultural and forest land of 03.02.1995, *Dziennik Ustaw* 95.16.78 of 22.02.1995, (*Ochrona gruntów rolnych i leśnych*)

²⁵² Decree on use of sludge in agriculture of 11.08.1999, *Dziennik Ustaw* 99.72.813 of 31.08.1999 (*Rozporządzenie Ministra Ochrony Środowiska, Zasobów Naturalnych i Leśnictwa z dnia 11 sierpnia 1999 roku w sprawie warunków, jakie muszą być spełnione przy wykorzystaniu osadów ściekowych na cele nieprzemysłowe*).

Specific requirements for use of sludge in agriculture

Limit values for heavy metals in sludge

The limit values for heavy metals in sludge when sludge is to be used in agriculture are defined by the Decree of August 11, 1999. These limit values are actually more stringent than limit values set in the Directive 86/278/EEC, as shown in the following table:

Limit values for heavy metals in sludge (for use in agriculture)
mg/kg of DM

	<i>Directive 86/278/EEC</i>	<i>Decree 11/8/1999</i>
Cd	20-40	10
Cr	-	500
Cu	1000-1750	800
Hg	16-25	5
Ni	300-400	100
Pb	750-1200	500
Zn	2500-4000	2500

Limit values for pathogens in sludge

Sludge may not be used in agriculture, land reclamation or green areas if it contains bacteria such as *Salmonella* and if the concentration of eggs of *parasites (ascaris, trichuris, toxocara)* is higher than 10 per kg of DM in sludge used in agriculture, and 300 per kg of DM for sludge used in land reclamation.

Limit values for organic compounds in sludge

No specific requirements in the legislation on this issue.

Limit values for soil for application

The Decree of August 11, 1999 identifies 3 types of soils (light, medium, heavy)²⁵³. The limit values for soil are therefore the following:

Limit values for heavy metals in soil
mg/kg of DM

	<i>Directive 86/278/EEC</i>	<i>Decree 11/08/1999</i>		
		Light	Medium	Heavy
Cd	1-3	1	2	3
Cr	-	50	75	100
Cu	50-140	25	50	75
Hg	1-1,5	0,8	1,2	1,5

²⁵³ The definition of "light", "medium" and "heavy" soil is not provided in the Decree.

Ni	30-75	20	35	50
Pb	50-300	40	60	80
Zn	150-300	80	120	180

Here again, the requirements are much more stringent than those set by Directive 86/278/EEC. In addition, the soil's pH must be higher than 6.

Obligation for treatment

The Decree specifies that the use of sludge is authorised if sludge is stabilised after chemical treatment, heat treatment or other treatments in order to minimise health risks.

Surfaces on which use of sludge is prohibited

Land spreading of sludge is prohibited on the following surfaces:

- National parks, and protected areas
- Areas close to sources, and any drinking water equipment,
- Areas close to rivers, lakes, and other bodies of water,
- Areas close to individual housing and human settlements,
- Soils with high permeability,
- Wet zones and swamps,
- Frozen soils and soils covered with snow,
- Grazing and pasture land,
- Inclined agricultural land (with a slope higher than to 10%),
- Crops grown under greenhouses,
- On land bearing crops of berries, potatoes, root vegetables or vegetables or fruit which are normally in direct contact with the soil and are normally eaten raw, for a period of 18 months prior to harvesting and during the harvesting itself.

Further quality related restrictions

Certification and information requirements

Sludge and soils must be analysed in Poland, if sludge is to be used on these soils. The main elements which are analysed are the concentrations of heavy metals, pathogens, nitrogen, phosphorus, calcium and magnesium. The frequency of the analyses varies from once every year to once every 6 years, depending on the size of the waste water treatment plant.

The main elements which are analysed in the soil are the pH, heavy metals concentration and P_2O_5 . The analyses are carried out once every 5 years.

Codes of practice and guides

No information available on this aspect.

Voluntary agreements on disposal and recycling of sewage sludge

There are no agreements on this issue in Poland.

Specific requirements for use of sludge in silviculture, forest, and reclamation and green areas

Silviculture (plantation)

The regulation contains no specific element on these aspects.

Natural forest and reforested area

The regulation contains no specific element on these aspects.

Land reclamation

Limit values for heavy metals in sludge for land reclamation, are as follows:

Limit values for heavy metals in sludge for land reclamation

	<i>mg/kg of DM</i>
Cd	50
Cr	2500
Cu	2000
Hg	25
Ni	500
Pb	1500
Zn	5000

Green areas

Limit values for heavy metals in sludge for use on non agricultural soil are the following:

Limit values for heavy metals in sludge for use on non agricultural soil

	<i>mg/kg of DM</i>
Cd	25
Cr	1000
Cu	1200
Hg	10
Ni	200
Pb	1000
Zn	3500

Specific requirements or legislation for other routes

Incineration

The regulation on sludge use contains no specific element on these aspects.

Disposal to landfill

The regulation on sludge use contains no specific element on these aspects.

Other Accession Countries

For these countries, regulatory information related to production, disposal and recycling of sewage sludge was very limited, either because specific legislation on sludge is non existent in these countries, or because the information was not available in time for this review.

Bulgaria

In Bulgaria, there is no equivalent legislation to the Directive 86/278/EEC, however Bulgarian authorities have announced to do so before the end of the year 2000. The scope of this planned legislation will be wider than the Directive's as it will comprise also the use of sludge in old mining sites.

At present, limit values for the presence of certain substances in the soil already exist, but they are not specifically related to the application of sewage sludge to land²⁵⁴. Already under the current legislation, application of sewage sludge to agricultural land would be subject to an authorisation procedure.

Czech Republic

The Directive 86/278/EEC is not yet transposed in the Czech Republic but this should be done before the 31/12/2001. For the moment, several major elements of the Directive are not covered by Czech legislation. For example, limit values for heavy metals in sludge are the subject of a Czech standard which is not of compulsory application.

The regulations related to sludge use are for the moment:

- Law 125/1997 on waste ,
- Law 156/1998 on natural fertiliser, soil improvers and the agrochemical examination of the soil;
- Government Decree of 171/1992 on soil quality which regulates the concentration limits of heavy metals and organic compounds in soil;
- Government Decree 13/1994 on protection of agricultural land.

Hungary

The Directive 86/278/EEC has no equivalent in Hungarian legislation for the moment. However, Phytosanitary Institutes for soil protection exist in each region in Hungary. These institutes are responsible for soil and vegetation protection, and also have competence for application on agricultural soil of various wastes including sewage sludge. These institutes apply the Technical Prescriptions concerning landspreading (No. MI-0861735, 30/08/90) which are quite similar to the Directive's requirements.

Lithuania

The Order N.182 was adopted in 1996 by Lithuanian authorities in order to regulate the use of sewage sludge. This order transposes most of the provisions of the Directive 86/278/EEC. For the moment, the Directive is not completely transposed (and no time limit has been set to do so), as some important aspects of the Directive are not taken into account by Lithuanian legislation. For instance, restrictions for sludge application on certain crops and for certain time periods need to be defined, as well as information requirements: record-keeping and reporting to competent authorities also needs to be included in the current Lithuanian legislation.

²⁵⁴ No further information has been made available to us in the course of the study.

Romania

There is at present no specific regulation concerning use of sewage sludge in Romania. However, the 1995 Law on Environmental Protection specified that Romanian authorities should establish regulations on the use of sludge (article 22, paragraph g). Legal requirements on the use of sludge should be included in the future Waste Management Act, which should be adopted by 2003.

Slovakia

There is no equivalent to Directive 86/278/EEC in Slovakia. The provisions of Directive 86/278/EEC should be transposed in Slovakian legislation by year 2002. In particular, information requirements (record-keeping, reporting to authorities) will have to be established. For the moment, there are no regulations specific to use of sludge in Slovakia, but there are non binding "Methodics of application of the stabilised sludges on agricultural soil" and a "Code of good agricultural practice".

Slovenia

The requirements of Directive 86/278/EEC are transposed in Slovenian legislation, with the following decrees:

- Decree on input of dangerous substances and plant nutrients into the soil (OJRS, 68/96)
- Decree on the limit, warning and critical concentration values of dangerous substances in soil

The limit values set by the legislation in Slovenia for heavy metals in sludge as well as for maximum annual load are more stringent than the Directive's requirements. In addition, Slovenian legislation prohibits the use of sludge on agriculture if it contains pathogens (Salmonella and Shigella bacteria).

Appendix 1: EU legislation on sludge management

- Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture, O.J No. L181, 04/07/1986, p.6
- Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment, O.J. No. L135, 30/05/1991 p. 40 - 52
- Waste Framework Directive 91/156/EEC amending Directive 75/442/EEC on waste, O.J No. L78, 26/03/1991, p.32
- Directive 75/442/EEC on waste, O.J. No. L194, 25/07/1975,p.47
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, Official Journal No. L 375 , 31/12/1991 p. 1 - 8
- Commission Decision establishing the ecological criteria for the award of the Community ecolabel to soil improvers (98/488/EC), O.J 1988, No. L219
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, O.J. No. L 182, 16/07/1999, p. 1 - 19
- Council Directive 2000/76/EC of 4 December 2000 on the incineration of waste, O.J. No. L332, 28/12/2000 P. 91
- Commission Decision 2001/118/EC, O.J. No L 047 , 16/02/2001 P. 1 - 31
- Commission Decision 2000/532/EC, O.J. No L 226 , 06/09/2000 p. 3 - 4

Additional documents:

- Report from the Commission to the Council and the European Parliament on the implementation of Community waste legislation Directive 75/442/EEC on waste, Directive 91/689/EEC on hazardous waste, Directive 75/439/EEC on waste oils and Directive 86/278/EEC on sewage sludge for the period 1995 - 1997, COM (1999) 752(01).
- Report from the Commission concerning the implementation of Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment, as amended by Commission Directive 98/15/EC of 27 February 1998 - summary of the measures implemented by the Member States and assessment of the information received pursuant to Articles 17 and 13 of the Directive, COM (1998) 775.
- Communication on the review of the Community strategy for waste management, COM(96) 399, 30/07/1996.

Appendix 2: National legislation on sludge management

Austria	Waste Management Act of 6/6/1990, BGBl. No. 325/1990 ST0140 (<i>Bundesgesetz über die Vermeidung und Behandlung von Abfällen – Abfallwirtschaftsgesetz</i>) Fertiliser Act of 12/7/1990, BGBl. No. 513/1994 ST0160 (<i>Bundesgesetz über den Verkehr mit Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln – Düngemittelgesetz</i>) Fertiliser Ordinance of 21/12/1994, BGBl. No. 1007/1994 ST0309 (<i>Verordnung des Bundesministers für Land- und Forstwirtschaft, mit der Bestimmungen zur Durchführung des Düngemittelgesetzes erlassen werden – Düngemittelverordnung</i>) Water Act of 1959, BGBl. No. 215/1959 (<i>Wasserrechtsgesetz</i>), in der Fassung BGBl. I No. 155/1999. Forest Law of 1975, BGBl. No. 440/1975 (<i>Forstgesetz</i>) in der Fassung der Bundesgesetze BGBl. Nr. 231/1977 und 142/1978 ; revised 12/04/1987, BGBl. No. 576/1987 Länder regulations are as follows: Carinthia – Carinthian order on the waste management of 30/03/99, LGBl. No. 14/1999 (<i>Gesetz vom 17 Dezember 1998, mit dem die Kärntner Abfallwirtschaftsordnung geändert wird</i>), Carinthia – Carinthian order on compost and sludge management of 15/12/2000, LGBl. No. 74/2000 (<i>Verordnung der Landesregierung über die Aufbringung von behandeltem Klärschlamm, Bioabfall und Grünabfall auf landwirtschaftlich genutzte Böden - Kärntner Klärschlamm- und Kompostverordnung</i>). Steiermark – Order on sludge management of 14/12/1987 , LGBl. No. 89/1987 (<i>Verordnung der Steiermärkischen Landesregierung vom 14. Dezember 1987 über die Aufbringung von Klärschlamm auf landwirtschaftlichen Böden (Klärschlammverordnung), Landgesetzblatt für die Steiermark, ausgegeben am 22 Dezember 1987</i>), LGBl 89/1987. Vorarlberg -Order on sewage sludge management of 09/10/1997, LGBl. No. 75/1997 (<i>Verordnung der Landesregierung über die Ausbringung von Klärschlamm (- Klärschlammverordnung), Vorarlberger Landesgesetzblatt, Herausgegeben und versendet am 9 Oktober 1997, LGBl 75/1997.</i> Lower Austria – Lower Austrian order on sewage sludge management of 30/05/2000, LGBl. No. 6160/2-0 (<i>Nieder Österreich Klärschlammverordnung, Stammgesetz 80/1994</i>), Upper Austria – Upper Austrian Order on sewage sludge, compost, and composted waste and sewage sludge management, LGBl. No. 21/1993 (<i>Ober Österreich Klärschlamm-, Müll- und Klärschlammkompostverordnung, LGBl 21/1993.</i> Vienna – Law on the prohibition of sewage sludge application on soil of 02/03/2000, LGBl. No. 8/2000 (<i>Gesetz über das Verbot der Ausbringung von Klärschlamm</i>), LGBl. für Wien Nr. 08/200
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	Burgenland – Sewage sludge and compost management order of 8/02/2001, <i>LGBI No. 4/2001 Stück 4 (Verordnung der Burgenländischen Landesregierung vom 31. Jänner 2001, mit der die Bgld. Klärschlamm- und Müllkompostverordnung geändert wird Ausgegeben und versendet am 8. Feber 2001)</i> Tirol – Law on the protection of agricultural fields of 05/07/2000, <i>LGBI. No. 58/2000 Stück 26 (Gesetz vom 5. Juli 2000 über den Schutz des Feldgutes und die Ausbringung von Klärschlamm (Tiroler Feldschutzgesetz 2000) ausgegeben am 12. September 2000).</i>
Belgium (Flanders)	Decree on waste prevention and waste management of 17.12.97, <i>BS 18.4.98 Het Vlaams Reglement inzake afvalvoorkoming en -beheer (VLAREA).</i> Forest Decree of 13.6.90, <i>BS 28/09/1990 (Bosdecreet),</i> Flemish provision on environmental pollution of 01/06/1995 and 24/03/1998, <i>BS 01/08/1995 and 30/04/1998 (Vlaams Reglement voor Milieuvergunningen; Vlare I: BVR 1 June 1995, BS 1 August 1995; Vlare II: BVR 24 March 1998, BS 30 April 1998).</i>
Belgium (Walloon)	Walloon Government Order on the use of sewage sludge of 12.1.95, <i>Moniteur Belge, 12/04/1995 (Arrêté du Gouvernement wallon portant réglementation de l'utilisation sur ou dans les sols des boues d'épuration ou de boues issues de centres de traitement de gadoues de fosses sceptiques).</i> Decree on groundwater water protection of 24/1/1984, <i>Moniteur Belge 5/6/1984 (Décret du 24 janvier 1984 portant des mesures en matière de gestion des eaux souterraines).</i> Government Order on air emissions from municipal waste incineration of 26.2.93, <i>Moniteur Belge 26.2.93 (Arrêté du Gouvernement wallon relatif à la lutte contre la pollution atmosphérique en provenance des installations d'incinération de déchets ménagers).</i> Government Order on controlled landfills of 23.7.87, <i>Moniteur Belge 29.9.1987 (Arrêté de l'Exécutif régional wallon relatif aux décharges contrôlées).</i>

Denmark	Statutory Order n° 590 of June 6, 1994 on protection of the Environment: <i>Bekendtgørelse af Lov om miljøbeskyttelse (Miljøloven) - (LBK nr 590 af 27/06/1994)</i> Statutory order n° 698 of September 22, 1998 on protection of the environment (in force) : <i>Bekendtgørelse af lov om miljøbeskyttelse (LBK nr 698 af 22/09/1998)</i> Statutory Order n° 49 of January 20, 2000 on Application of Waste Products for Agricultural Purposes (SO 2000/49) : <i>Bekendtgørelse om anvendelse af affaldsprodukter til jordbrugsformål (Gældende) (BEK nr 49 af 20/01/2000)</i> Statutory Order n° 823 of September 16, 1996 on application of sludge, wastewater and compost for agricultural use : <i>Bekendtgørelse om anvendelse af affaldsprodukter til jordbrugsformål (BEK nr 823 af 16/09/1996)</i> Statutory Order n° 56, January 24, 2000 describing the control of sewage sludge for agricultural use : <i>Bekendtgørelse om tilsyn med spildevandsslam m.m. til jordbrugsformål (BEK nr 56 af 24/01/2000)</i>
Finland	Council of State Decision No. 282 on the use of sewage sludge in agriculture of 5.12.94, OJ 282 of 14.4.94 (<i>Valtioneuvoston päätös puhdistamolietteen käytöstä maanviljelyksessä</i>)

France	Decree No. 97/1133 on sludge spreading of 8.12.97, <i>Journal Officiel</i> 10.12.97 (<i>Décret n. 97/1133 relatif à l'épandage des boues issues du traitement des eaux usées</i>) Order of 8.1.98 on the technical requirements for the use of sludge in agriculture, <i>Journal Officiel</i> 31.1.98 (<i>Arrêté fixant les prescriptions techniques applicables aux épandages de boues sur les sols agricoles pris en application du décret n. 97/1133</i>) Order of 17.8.98 concerning the emissions from some industrial activities, <i>Journal Officiel</i> 17.11.98 (<i>Arrêté modifiant l'arrêté du 2 février 1998 relatif aux prélèvements et à la consommation d'eau ainsi qu'aux émissions de toute nature des installations classées pour la protection de l'environnement soumises à autorisation</i>). Water Act No. 92/3 of 3.1.92, <i>Journal Officiel</i> 4.1.92 (<i>Loi n. 92/3 sur l'eau</i>) Waste Act No. 75/633 of 15.7.75, <i>Journal Officiel</i> 16.7.75 (<i>Loi n. 75/633 relative à l'élimination des déchets et à la récupération des matériaux</i>) Waste Disposal Act No. 92/646 of 13.7.92, <i>Journal Officiel</i> 14.7.92 (<i>Loi n. 92/646 relative à l'élimination des déchets ainsi qu'aux installations classées pour la protection de l'environnement</i>) Law on Fertilisers No. 79/595 of 13.7.79, <i>Journal Officiel</i> 14.7.79 (<i>Loi n. 79/595 relative à l'organisation du contrôle des matières fertilisantes et des supports de culture</i>) Order on landfills of 9.9.97, <i>Journal Officiel</i> 2.10.97 (<i>Arrêté relatif aux décharges existantes et aux nouvelles installations de stockage de déchets ménagers et assimilés</i>)
Germany	Sewage Sludge Ordinance of 15.4.92, <i>BGBI I</i> of 28.4.92 S. 912 (<i>Klärschlammverordnung</i>), modified by the Ordinance (<i>Verordnung</i>) of 6.3.97, <i>BGBI I</i> S.446 Fertiliser Act (<i>Düngemittelgesetz</i>) of 15 November, 1977 modified in 1997. Fertiliser Ordinance of 11.8.99, <i>BGBI I</i> S. 42. (<i>Düngemittelverordnung</i>) Soil Protection Act of 17.3.98, <i>BGBI I</i> S. 502 (<i>Gesetz zum Schutz des Bodens</i>) Law on the reduction, recycling and elimination of waste <i>Gesetz zur Vermeidung, Verwertung und Beseitigung von Abfällen</i> of 6 October 1994 (<i>BGBI. I</i> S. 2705) Ordinance on the implementation of the Federal law on protection against emissions of 23.11.90, <i>BGBI. I</i> S. 2545 (<i>Siebzehnte Verordnung zur Durchführung des BundesImmissionschutzgesetzes - Verordnung über Verbrennungsanlagen für Abfälle und ähnlich brennbare Stoffe – 17. BImSchV</i>).

Greece	Ministerial Decision 80568/4225 of 22.3.91 on the use of sewage sludge in agriculture, FEK B641/91 of 7.8.91 Law 1650/86 on the protection of the environment Ministerial Decisions 114216/97 and 113944/97 on technical standards and measures for waste management and national planning, FEK 1016/97 Ministerial Decree 82805/2224/93 on the prevention of air pollution from waste incinerators, FEK 699/93 Ministerial Decision 69728/824/96 concerning the harmonization with the Directive 91/156/EC on solid waste, FEK 358/96
Ireland	Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 (SI No. 148/1998). Waste Management (Amendment of Waste Management Act, 1996) Regulations, 1998 (SI No. 146/1998). Waste Management Act, 1996 (No. 10/1996). Local government (Water Pollution) Act, 1977 (No. 1/1997).

Italy	Decree 99/92 on the use of sewage sludge on land,, <i>Supplemento Ordinario</i> No. 28, <i>Gazzetta Ufficiale</i>, 15.2.1992 (<i>Decreto legislativo in attuazione della Direttiva 86/278/CEE concernente la protezione dell'ambiente, in particolare del suolo nell'utilizzazione dei fanghi di depurazione in agricoltura</i>) Decree 152/99 of 11.05.1999 on water protection, <i>Supplemento Ordinario</i> No. 124, <i>Gazzetta Ufficiale</i> of 29.05.1999 (<i>Decreto Legislativo del Governo n° 152 del 11.05.1999 - disposizioni sulla tutela delle acque dall'inquinamento e recepimento della direttiva 91/271/CEE concernente il trattamento delle acque reflue urbane e della direttiva 91/676/CEE relativa alla protezione delle acque dall'inquinamento provocato dai nitrati provenienti da fonti agricole</i>). D.P.R. 203/88 (President's Decree) of 24.05.1988, concerning general atmospheric pollution, <i>Supplemento Ordinario</i> No. 140, <i>Gazzetta Ufficiale</i> of 16.06.1988 (<i>Decreto del Presidente della Repubblica No. 203 del 24.05.1988 - Attuazione delle direttive CEE numeri 80/779, 82/884, 84/360 e 85/203 concernenti norme in materia di qualità dell'aria, relativamente a specifici agenti inquinanti, e di inquinamento prodotto dagli impianti industriali, ai sensi dell'art. 15 della legge 16 aprile 1987, n. 183</i>). Ministerial Decree of 5.02.1998, <i>Supplemento Ordinario</i> No. 88, <i>Gazzetta Ufficiale</i> of 16.04.1998 (<i>Decreto Ministeriale del 05/02/1998 - Individuazione dei rifiuti non pericolosi sottoposti alle procedure semplificate di recupero ai sensi degli articoli 31 e 33 del decreto legislativo 5 febbraio 1997, n. 22</i>). Decree 22/97 of February 5, 1997 on waste management, <i>Supplemento Ordinario</i> No. 38, <i>Gazzetta Ufficiale</i> of 15.02.1997 (<i>Decreto Legislativo del Governo n° 22 del 05.02.1997 - Attuazione delle direttive 91/156/CEE sui rifiuti, 91/689/CEE sui rifiuti pericolosi e 94/62/CE sugli imballaggi e sui rifiuti di imballaggio</i>). Deliberation of 27.07.1984, <i>Supplemento Ordinario</i> No. 253, <i>Gazzetta Ufficiale</i> of 13.09.1984 (<i>Delibera del 27/07/1984 - Disposizioni per la prima applicazione dell'articolo 4 del D.P.R. 10 settembre 1982, n. 915, concernente lo smaltimento dei rifiuti</i>). Ministerial Decree No. 503 of 19.11.97 on the prevention of atmospheric pollution caused by urban wastes incineration plants, <i>Gazzetta Ufficiale Italiana</i> No. 23 of 29.01.1998 (<i>Decreto Ministeriale No. 503 del 19/11/1997 - Regolamento recante norme per l'attuazione delle direttive 89/369/CEE e 89/429/CEE concernenti la prevenzione dell'inquinamento atmosferico provocato dagli impianti di incenerimento dei rifiuti urbani e la disciplina delle emissioni e delle condizioni di combustione degli impianti di incenerimento di rifiuti urbani, di rifiuti speciali non pericolosi, nonché di taluni rifiuti sanitari</i>).
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Luxembourg	Grand Ducal Regulation of 14.4.90 on sewage sludge, <i>Memorial A</i> No. 21 of 7.5.90 p. 287 (<i>Règlement grand ducal relatif aux boues d'épuration</i>), modified by Grand Ducal Regulations of 25.6.92, <i>Mém. A</i> No. 44 of 30.6.1992, p. 1458. Grand Ducal Regulations of 20.9.94, <i>Mém. A</i> No. 87 of 28.9.1994 (<i>Règlement grand-ducal concernant l'utilisation de fertilisants organiques dans l'agriculture</i>) Act on nature and natural resources protection of 11.8.82, <i>Mém. A</i> No 69 of 10.8.1982, p. 1486 (<i>Loi du 11 août 1982 concernant la protection de la nature et des ressources naturelles</i>) Waste prevention and management act of 17.6.94, <i>Mém. A</i> No. 57 of 5.7.1994, p. 1076 (<i>Loi relative à la prévention et à la gestion des déchets</i>) as modified by <i>Mém. A</i> No. 72 du 10.8.1994, p. 1322. Grand Ducal Regulation on the reduction of air pollution from incinerators of 20.11.91, <i>Mém. A</i> No. 89 of 30.12.1991, p. 189 as modified by <i>Mém. A</i> No. 6 of 17.2.1992, p. 313 (<i>Règlement grand-ducal concernant la réduction de la pollution atmosphérique en provenance des installations d'incinération des déchets municipaux</i>).
Netherlands	Environment Policies Act, <i>Staatsblad</i> No. 414 of 2.7.92 (<i>De Wet Milieubeheer</i>). Air Emissions Waste Incineration Decree, <i>Staatsblad</i> No. 451 of 26.08.92 (<i>het Wijzigingsbesluit Besluit emissie-eisen stookinstallaties Wet inzake de luchtverontreiniging</i>). Decree of 20.11.91 on the quality and the application on or in soil miscellaneous organic fertilisers, <i>Staatsblad</i> No. 613 of 3.12.91, (<i>Besluit kwaliteit en gebruik overige organische meststoffen</i>)
Portugal	Decree 446/91 of 22.11.91, <i>Diario Da Republica I Serie A</i> No. 269 of 22.11.1991 (<i>Decreto-Lei n° 446/91</i>)

Spain	Royal Decree 1310/1990 of 29.10.90 on the use of sewage sludge in agriculture, BOE No. 262 of 1.11.90 (<i>Real Decreto 1310/1990 , por el que se regula la utilizacion de los lodos</i>). Enforcement Order 1993/26572 of October 26th 1993, BOE No. 265/1993 de 05.11.1993 (<i>Orden de 26 de octubre de 1993 sobre utilización de lodos de depuración en el Sector Agrario</i>). Royal Decree 11/95 of 28.12.95 on standards for urban waste water treatment, BOE No. 312, of 30.12.95 (<i>Real Decreto-Ley 11/1995, de 28 de diciembre, por el que se establecen las normas aplicables al tratamiento de las aguas residuales urbanas</i>) amended by Royal Decree 509/96 of 15. 3.96, BOE nº 77, of 29.03.96 (<i>Real Decreto 509/1996 por el que se establecen las normas aplicables al tratamiento de las aguas residuales urbanas</i>). Enforcement Order on fertilisers of 28.5.98, BOE No. 131 of 2.6.98 (<i>Orden de 28 de mayo de 1998 sobre fertilizantes y afines</i>). Decree nº 93/1999 of 6.4.1999 on waste management, DOGC No. 2865 of 12.04.99 (<i>Décret 93/1999, de 6 d'abril, sobre procediments de gestió de residus</i>) Decree 193/1998, of 20.11.1998, on the use of sewage sludge in agriculture in the Community of Madrid, BOCM No. 287 of 3.12.98 (<i>Decreto 193/1998, de 20 noviembre, por el que se regula, en la Comunidad de Madrid, la utilizacion de lodos de depuradora en agricultura</i>)
Sweden	Order containing regulations on the protection of the environment, in particular the soil, when sewage sludge is used in agriculture of 30 May 1994, Environment Protection Order 1994:2 (SNFS 1994 : 2), (<i>Kungörelse met föreskrifter om skydd för miljön, särskilt marken, när avloppsslam används I jordbruket</i>). Environmental Code of 11.6.1998 (SFS 1998 : 808), <i>Miljöbalk</i>. Regulations on emissions into the air from waste incineration (NFS 1993:13) replaced by NFS (2000:5) of 24.5.2000 (<i>NFS om utsläpp till luft från anläggningar för förbränning av kommunalt avfall med en nominell kapacitet mindre än 6 ton per timme och som beviljats tillstånd enligt miljöskyddslagen (1969:387) före den 1 januari 1994</i>). Regulations on emissions into the air from waste incineration (NFS 1993:14) replaced by NFS (2000:6) of 24.5.2000 (<i>NFS om utsläpp till luft från anläggningar för förbränning av kommunalt avfall som beviljats tillstånd enligt miljöskyddslagen (1969:387) eller miljöbalken (1998:808) efter den 1 januari 1994 och anläggningar med en nominell kapacitet lika med eller större än 6 ton per timme som beviljats tillstånd enligt miljöskyddslagen före den 1 januari 1994</i>).
United Kingdom	Sludge (Use in Agriculture) Regulations No. 1263 of 24.7.89, ISBN 0110972635, published on 28.7.1989. Sludge (Use in Agriculture) (Amendment) Regulations No. 880 of 5.4.90, ISBN 0110038800, published on 17.4.1990. Sludge (Use in Agriculture) Regulations 1990 No. 245 (for Northern Ireland), ISBN 0337802459, published on 3.7.1990.

Accession countries

Estonia	Instructions for use of wastewater sludge in agriculture, green area creation and recultivation of 11.11.99, <i>Riigi Teataja Lisa</i> No. 156 of 19.11.99 (<i>Reoveesette põllumajanduses, haljastuses ja rekultiveerimisel kasutamise eeskiri</i>) Ambient Air Protection Act of 22.04.1998, RT I 1998, 41/42, 624; 1999, 10, 155; 95, 843; 2001, 24, 133, (<i>Välisõhu Kaitse Seadus</i>) Regulation of the Minister of the Environment nr 47 from 28.04.1999 on Establishing procedure for issuing and applying for the pollution permit and special pollution permit, RTL 1999, 79, 984; 2000, 37, 517 (<i>Keskkonnaministri määrus nr 47 28.04.1999, Välisõhu saasteloa ja erisaasteloa taotlemise ja väljaandmise kord</i>) Waste Act of 10.06.1998, RT I 1998, 57, 861; 1999, 23, 353; 10, 155; 95, 843; 2001, 16, 72; 43; 239; 56; 340 (<i>Jäätmeseadus</i>)
Latvia	Regulation No. 316 of September 1997 for the use of effluent sludge in the fertilisation of soil and in organising territorial public services "<i>Latvijas Vestnesis</i>" of 12.09.1997, No.225 (<i>noteikumi Nr.316: "Noteikumi par notekudenu dunu izmantosanu augsnes meslosana un teritoriju labiekartosana"</i>) Law on Hazardous Waste of 1993, "<i>Latvijas Vestnesis</i>" of 15.04.1993, No.14 (<i>Likums par bīstamajiem atkritumiem</i>), substituted with the Law on Waste Management "<i>Latvijas Vestnesis</i>" No.473, 29.12.2000 (<i>Atkritumu apsaimniekosanas likums</i>) Law on Municipal Waste of 1998, "<i>Latvijas Vestnesis</i>", of 30.10.1998, No.322 (<i>likums par sadzīves atkritumiem</i>), substituted with the Law on Waste Management "<i>Latvijas Vestnesis</i>" of 29.12.2000, No.473 (<i>Atkritumu apsaimniekosanas likums</i>) Law on Environmental Impact Assessment, "<i>Latvijas Vestnesis</i>" of 30.10.1998, No.322 (<i>Likums par ietekmes uz vidi novērtējumu</i>) Regulation on Classification of Hazardous Waste and Criteria for hazardousness, "<i>Latvijas Vestnesis</i>" of 15.08.1997, No.204 (<i>noteikumi Nr.298 : "Noteikumi par bīstamo atkritumu klasifikāciju un bīstamības kriterijiem"</i>), substituted with the Regulations of the Cabinet of Ministers No.258 on Waste classification and characteristics, that make waste dangerous, "<i>Latvijas Vestnesis</i>" of 22.06.2001, No.258 (<i>"Noteikumi par atkritumu klasifikatoru un īpašībām, kuras padara atkritumus bīstamus"</i>).
Poland	Decree on use of sludge in agriculture of 11.08.1999, <i>Dziennik Ustaw</i> 99.72.813 of 31.08.1999 (<i>Rozporządzenie Ministra Ochrony Środowiska, Zasobów Naturalnych i Leśnictwa z dnia 11 sierpnia 1999 roku w sprawie warunków, jakie muszą być spełnione przy wykorzystaniu osadów ściekowych na cele nieprzemysłowe</i>). Law on Environmental Protection and Management of 31.01.1980, <i>Dziennik Ustaw</i> 94.49.196 of 15.04.1994 (<i>Ochrona i kształtowanie Środowiska</i>) Law on the Protection of Nature of 16.10.1991, <i>Dziennik Ustaw</i> 91.114.492, 12.12.1991 (<i>Ochrona przyrody</i>) Law on Waste of 27.06.1997, <i>Dziennik Ustaw</i> 97.96.592 of 13.08.1997 (<i>Opady</i>) Law on the protection of agricultural and forest land of 03.02.1995, <i>Dziennik Ustaw</i> 95.16.78 of 22.02.1995, (<i>Ochrona gruntów rolnych i leśnych</i>)

Appendix 3: CEN work on characterisation of sludge

The reports and guides on characterisation of sludge which should be published by CEN in the near future are listed below:

- *Technical report on physical consistency and centrifugability;*
- *Characterization of sludges - Good practice for sludges management in relation to use or disposal (prEN 13714) ;*
- *Characterization of sludges - Good practice for sludges utilisation in agriculture (prEN 13714);*
- *Characterization of sludges - Good practices for sludge incineration with or without grease and screenings (prEN 13767) ;*
- *Characterization of sludges - Good practices for combined incineration of sludges and household waste (prEN 13768);*
- *Characterization of sludges - Good practices for sludge used in land reclamation (prEN 13783);*
- *Characterization of sludges - Good practices for the landfill of sludge and sludge derived residues ;*
- *Characterization of sludges - Good practices for sludge drying ;*

Other work carried out by CEN/TC308 includes the following :

- Determination of Salmonella in sludge ;
- Detection and enumeration of Escherichia coli in sludge ;
- Determination of PCB ;
- Determination of AOX ;
- Determination of total phosphorus in sludge ;
- Determination of ammoniac nitrogen in sludge ;
- Determination of nitrate nitrogen in sludge ;
- Determination of organic carbon in sludge by instrumental method ;
- Determination of laboratory chemical conditioning procedure ;
- Determination of capillary suction time - CST ;
- Determination of calorific value ;
- Determination of settleability/thickenability ;
- Determination of specific resistance to filtration ;
- Determination of compressibility ;
- Determination of physical consistency ;
- Determination of centrifugability.

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