

ANNEX 2: SEWAGE SLUDGE MANAGEMENT IN EUROPE

1.1 Existing practices

The management of sewage sludge, which is the sludge originating from the process of treatment of wastewater, is a problem of great concern in Europe.¹ Sludge disposal methods vary significantly from one country to another.² Statistics for sludge production in 2016 showed that 89 % of the total volume of treated sewage sludge was used as fertilizer for agricultural in 8 EU Member States: Germany, France, Poland, Czech, Sweden, Norway, Austria, and Ireland. *

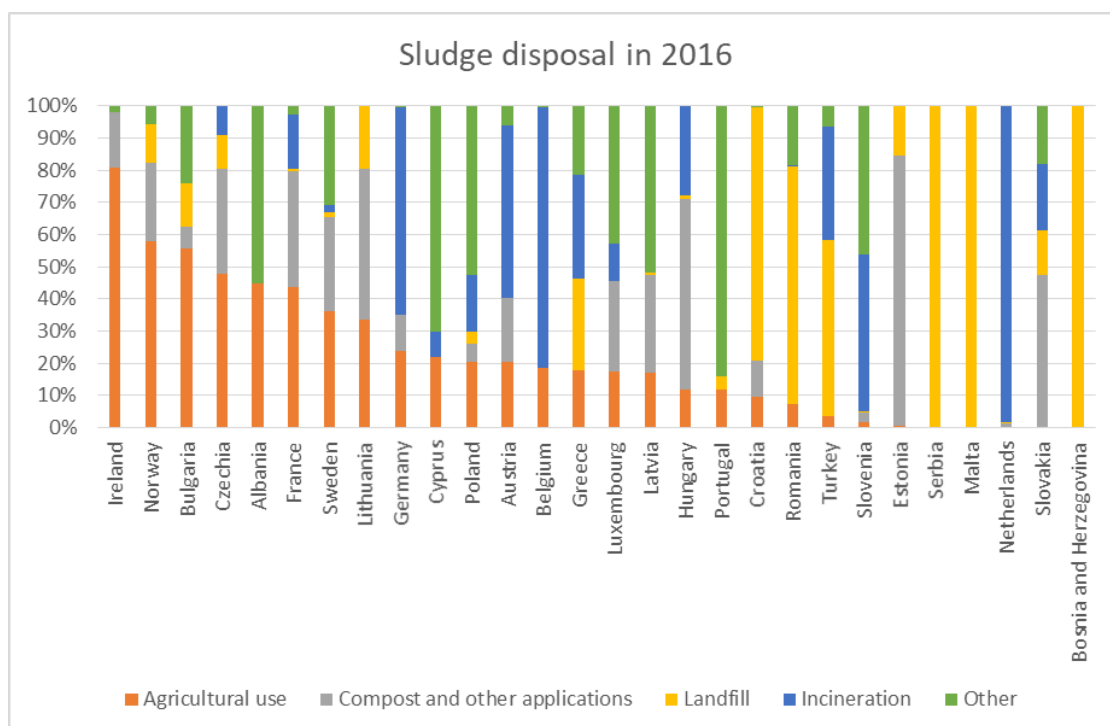


Figure 1: Disposal from urban waste water treatment in 2016^{3*}

*Note: Data not available for Denmark, Italy, Spain, Finland, UK, Iceland, Switzerland.

Table 1: Overview of sludge disposal in 2016^{4*}

Type of sludge disposal	Agricultural use	Compost and other applications	Landfill	Incineration	Other
% of total mass	26	17	6	39	12

* Data available for Germany, France, Poland, Czech, Sweden, Norway, Austria, Ireland, Belgium, Bulgaria, Hungary, Greece, Romania, Portugal, Lithuania, Latvia, Cyprus, Luxembourg, Croatia, Slovenia, Estonia, Malta, Netherlands, Slovakia.

Sludge incineration seems to be the leading practice when observing the percentage of total mass of sludge. However, when seeing the methods used in 24 EU Member states, all practices, except landfilling, are represented evenly. Solutions for safe sludge reuse are a global requirement, and we

¹ https://www.researchgate.net/publication/311273547_Sewage_sludge_management_in_Europe_a_critical_analysis_of_data_quality

² <http://extranet.novacom.eu/environment/waste/sludge/index.htm>

³ http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ww_spd&lang=en

⁴ <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

need to go further and faster toward resource recycling. Sewage may not look like a particularly precious resource, but it is rich in phosphorus and other products.⁵ Resource recovery is a site and contexts specific solution and can provide benefits to society turning waste into a valuable and renewable resource. EU Member States are on the road to economic nutrients recycling.

Phosphorus recovery from sludge is already mandatory in Switzerland and Germany. The terms of the Swiss Waste Avoidance and Disposal Act (VVEA), which was passed in 2016, requires the operators of wastewater treatment plants in Switzerland to recover the phosphorus from their sewage sludge before sludge disposal. Given a ten-year grace period, phosphorus recovery will have to be implemented until 2026.⁶ In Germany, the central element of the new Sewage Sludge Ordinance is the obligation to recover phosphorus (P) from sewage sludge or sewage sludge incineration ash.⁷ The WWTP above 100,000 PE will have to fulfill the new phosphorus recovery requirements by 2029, after a 12 years transition period. The WWTP of 50.000 to 100.000 PE gets three additional years for implementation. All affected WWTP have to develop phosphorus recovery concepts by 2023.⁸ Until then, sewage sludge from these wastewater treatment plants may continue to be used as a fertilizer on soil in compliance with the criteria of waste and fertilizer legislation. Sewage sludge from smaller wastewater treatment plants (≤ 50.000 PE) may continue to be used indefinitely on soil in the future.⁹ It has to be noted that in 2016 in Germany 64 % of sludge was incinerated. Thus, it makes sense to recover incineration ash, while countries that do not have incineration plants will probably focus more on other methodologies on how to recover nutrients from sludge.

1.2 Relevant EU legislation for sewage sludge disposal

EU legislation that regulates sewage sludge treatment and its utilization on soil¹⁰:

- 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 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. 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 waste (e.g. sludge) are applied additionally to the Waste Framework Directive.
- The Council Directive of 21 May 1991 concerning urban wastewater treatment (91/271/EEC), known as the Urban Waste Water Treatment Directive, is aimed at protecting the environment from the adverse effects of wastewater discharges. The Directive 91/271/EEC supports the use of sewage sludge in article 14: "sludge arising from wastewater treatment shall be re-used whenever appropriate. Disposal routes shall minimize the adverse effects on the environment".
- 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).

⁵ <https://ec.europa.eu/programmes/horizon2020/en/news/new-life-sewage-sludge>

⁶ <https://www.ebp.ch/en/projects/phosphorus-recovery-wwtp-glarnerland-switzerland>

⁷ https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/190116_uba_fb_klaerschlamml_engl_bf.pdf

⁸ <https://phosphorusplatform.eu/scope-in-print/news/1395-new-sewage-sludge-ordinance-passed>

⁹ https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/190116_uba_fb_klaerschlamml_engl_bf.pdf

¹⁰ https://ec.europa.eu/environment/archives/waste/sludge/pdf/sludge_disposal2.pdf

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 incineration¹¹.

1.3 EU requirements for the use of sludge in agriculture

The Sewage Sludge Directive 86/278/EEC was set up to encourage the use of sewage sludge in agriculture and to regulate its use to prevent harmful effects on soil, vegetation, animals, and human. The Directive also required that sludge should be used in such a way that account is taken of the nutrient requirements of plants and that the quality of the soil and of the surface and groundwater is not impaired.¹²

To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing or grown, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of biosolids. The Directive also requires that sludge should be used in such a way that account is taken of the nutrient requirements of plants and that the quality of the soil and of the surface and groundwater is not impaired.¹³

1.3.1 Limit values for heavy metals

While sewage sludge contains nutrients and organic matter that are beneficial for the soil, it can also contain contaminants such as heavy metals, organic compounds and pathogens. The Directive sets limit values for seven heavy metals (cadmium, copper, nickel, lead, zinc, mercury and chromium), both in soil and in sludge itself (Table 2).¹⁴

¹¹ https://ec.europa.eu/environment/archives/waste/sludge/pdf/sludge_disposal2.pdf

¹² https://ec.europa.eu/environment/archives/waste/sludge/pdf/part_iii_report.pdf

¹³ <https://ec.europa.eu/environment/waste/sludge/index.htm>

¹⁴ https://ec.europa.eu/environment/archives/waste/sludge/pdf/part_i_report.pdf

Table 2: Limit values for concentrations of heavy metals (HM) in soil to which sludge is applied, in sludge for use in agriculture and amounts, which may be added annually to agricultural land, based on a ten-year average¹⁵

Parameter	HM IN SOIL (mg/kg of dry matter)	HM IN SLUDGE (mg/kg of dry matter)	HM ANNUALLY ADDED AMOUNT (kg/ha/yr)
Cadmium	1-3	20-40	0,15
Copper	50-140	1.000-1.750	12
Nickel	30-75	300-400	3
Lead	50-300	750-1.200	15
Zinc	150-300	2.500-4.000	30
Mercury	1-1,5	16-25	0,1
Chromium	-	-	-

In case sludge after long term storage and treatment on reed beds does not meet limit values, its use in agriculture is prohibited. The common alternative to spreading sludge on land is transport to nearest incineration plant.

1.3.2 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.¹⁶

In most EU countries' national legislation checks the presence of salmonella (with the exception of Lithuania, Luxembourg, and Slovakia) and, in many cases, other pathogens are included.¹⁷ Types of pathogens and limit values are presented in the following table.

¹⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31986L0278&from=EN>

¹⁶ https://ec.europa.eu/environment/archives/waste/sludge/pdf/sludge_disposal2.pdf

¹⁷ Collivignarelli, Maria & Abbà, Alessandro & Frattarola, Andrea & Carnevale Miino, Marco & Padovani, Sergio & Katsoyiannis, Ioannis & Torretta, Vincenzo. (2019). Legislation for the Reuse of Biosolids on Agricultural Land in Europe: Overview. Sustainability. 11. 6015. 10.3390/su11216015.

Table 3: Limit values for pathogens in the biosolids¹⁸

Legislation	Types of Pathogens	Limit	Units of Measure (u.m.)	References
Directive 86/278/EEC	-	-	-	[37]
Austria ¹				
	Enterococci	<10 ³	CFU g _{DM} ⁻¹	[66–69]
	Escherichia Coli	100	CFU g _{DM} ⁻¹	
	Helminths eggs	Absent	eggs kg _{DM} ⁻¹	
	Salmonella	No occurrence in 1g		
Bulgaria				
	Salmonella	Absent	MPN 20 ⁻¹ g _{WW} ⁻¹	[87]
	Escherichia Coli	100	MPN g _{WW} ⁻¹	
	Clostridium perfringens	300	MPN g _{WW} ⁻¹	
	Viable eggs of helminths	1	eggs kg _{DM} ⁻¹	
Czech Republic				
	Salmonella	Absent	CFU g _{DM} ⁻¹	[82,83]
	Thermotolerant coliforms	<10 ³	CFU g _{DM} ⁻¹	
	Enterococci	<10 ³	CFU g _{DM} ⁻¹	
Denmark ²				
	Salmonella	No occurrence		[73,74]
	Faecal streptococci	<100 g ⁻¹		
Finland				
	Salmonella	1000	Not detected in 25 g	[72]
	Escherichia Coli		CFU g ⁻¹	
France				
	Salmonella	8	MPN 10 ⁻¹ g _{DM} ⁻¹	[62]
	Enterovirus	3	MPCN 10 ⁻¹ g _{DM} ⁻¹	
	Helminths eggs	3	eggs 10 ⁻¹ g _{DM} ⁻¹	
Italy				
	Salmonella	1000	MPN g _{DM} ⁻¹	[63,64]
Lithuania				
	Escherichia Coli	1000	CFU g ⁻¹	[85]
	Helminths eggs	0	Units kg ⁻¹	
	Enterobacteria	0	CFU g ⁻¹	
	Clostridium perfringens	100,000	CFU g ⁻¹	
Luxembourg				
	Enterobacteria	<100 g ⁻¹		[79]
	Helminths eggs	No eggs of worm likely to be contagious		
Malta				
	Salmonella	Absent	CFU 50 ⁻¹ g _{WW} ⁻¹	[92]
Poland				
	Salmonella	Biosolids cannot be used in agriculture if it contains salmonella in 100 g _{DM}		[80]
	Helminths eggs	0	eggs kg _{DM} ⁻¹	
Portugal				
	Salmonella	1000	No occurrence in 50 g	[71]
	Escherichia Coli		CFU g ⁻¹	
Slovakia				
	Thermotolerant coliforms	2×10 ⁶	CFU g _{DM} ⁻¹	[86]
	Fecal streptococci	2×10 ⁶	CFU g _{DM} ⁻¹	

¹⁸ Collivignarelli, Maria & Abbà, Alessandro & Frattarola, Andrea & Carnevale Miino, Marco & Padovani, Sergio & Katsoyiannis, Ioannis & Torretta, Vincenzo. (2019). Legislation for the Reuse of Biosolids on Agricultural Land in Europe: Overview. Sustainability. 11. 6015. 10.3390/su11216015.

1.3.3 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.¹⁹

1.3.4 Obligations for treatment

Directive 86/278/EEC specifies in that treated sludge means 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, Member States may nevertheless authorize, under conditions to be stated by them, the use of untreated sludge if it is injected or worked into the soil.²⁰

1.3.5 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

¹⁹ https://ec.europa.eu/environment/archives/waste/sludge/pdf/sludge_disposal2.pdf

²⁰ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31986L0278&from=EN>