

GOOD PRACTICES IN SLUDGE MANAGEMENT -Appendix

DESCRIPTIONS ON NATIONAL LEGISLATION
ON SLUDGE HANDLING IN THE BALTIC SEA
COUNTRIES



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A. SCANDINAVIAN COUNTRIES AND GERMANY

FINLAND

The **main Finnish legal acts** regulating the waste management are being issued by the Ministry of the Environment and are comprised by *the Environmental Protection Act nr 86 of 4/02/2000*, *the Waste Act nr 1072 of 3/12/1993*, *the Decree on Water Resources Management nr 1040 of 30/11/2006* and the *Public Health Protection Act nr 763 of 19/8/1994*.

The latter two should be observed in connection with the handling, transport and use of waste. *The Environmental Protection Act* sets general objectives towards preventing the generation and the harmful effects of waste, and *the Waste Act* confirms “waste hierarchy” by promoting waste recovery and organizing waste management.

Municipalities in Finland set up local regulations of waste handling and they organize collection, recovery and disposal of household refuse and other similar waste, in addition to general supervision of waste management in their own area.

When it comes to the **agricultural use of sludge**, it is regulated by the Government *Decision on the Use of Sewage Sludge in Agriculture* nr 282 of 14/04/1994, which implements the Sludge Directive 86/287 of the EU. It **applies to the sludge** from municipal waste water treatment plants, other sludges of comparable quality and mixtures¹ prepared from these, while the fertiliser products derived from sludge are regulated by the *Fertiliser Act* nr 539 of 29/06/2006².

The decision explicitly states that sludge should be treated before the agricultural use, and provides definitions of **acceptable treatment methods**:

- digestion – treatment of sludge for several weeks under anaerobic conditions at a minimum temperature 33–35 °C;
- lime stabilisation - mixing lime evenly into the entire sludge mass in order to raise its initial pH > 12;

or some other method capable of significantly reducing its pathogen content and odors and harm to health or the environment arising from the use of sludge. No specific limits regarding pathogen content, as well as the organic compounds, are provided by the decision.

When sewage sludge is being used in agriculture, heavy metal concentrations should not exceed the limit values presented in the decision. Limit values for **heavy metals concentrations in sludge, soil and annual average load** set up in Finland, together with the laws of other Scandinavian countries³, are among the strictest in the EU. Particular feature of the Finnish legislation are maximum permissible concentrations of heavy metals in the sludge suitable for use as a raw material in sludge mixtures. Also, the decision specifies that pH value of cultivated soil should be above 5.8, and in case of lime-stabilized sludge – pH above 5.5.

There are further **restrictions concerning surfaces** on which the sewage sludge is to be applied. It is allowed to use it on the soil on which grain, sugar beet, oil-bearing crops or crops not used for human food or animal feed are cultivated. Also, sludge may be spread on grassland only when the grass and nurse crops are sown together and the sludge is ploughed in carefully. However, potatoes, root crops and vegetables may not be cultivated until at least 5 years after sludge was used on the arable land.

The decision does not set up any precise limitations of quantities of sludge used for the agricultural purposes, stating that those quantities should be determined on the basis of soil quality and the nutrient needs of the crops cultivated (keeping in mind annual heavy metal load arising from the use of sludge).

¹ Decision 282/1994 defines sludge mixture as a product obtained by mixing sludge with high-quality admixtures such as peat, lime or pure raw soil but not with a fertiliser product.

² Fertiliser Product Act nr 539/2006 concerns fertilisers, soil improving agents, by-products suitable for use as fertilisers and composting products; it also applies to fertilisers of the EP and Council Regulation (EC) nr 2003/2003 (fertiliser setting). However sewage sludge, when used as such, is excluded from the scope of the Fertiliser Act.

³ For comparison, see table 1.

The decision (annex 2) contains the **analysis requirements** for sludge and cultivated soil: both should be measured for heavy metals concentrations and pH value, and sludge – additionally for dry matter content, ignition residue, total nitrogen and phosphorus. The frequency of performing analyses is determined for the first year and later years and depends on the size of waste water treatment plant (for instance, treatment plants which have a capacity over 100 000 PE must carry out at least 12 analyses the first year, and at least 4 analyses per year the following years). The decision does not state explicitly who is responsible for conducting the above-mentioned analyses, however it requires the holder of sewage treatment plant to provide the users of sludge with the results of sludge analysis (concerning both its quality and relevant information on its origin and treatment) and also to keep records concerning any contracts with sludge users (for at least 5 years) and reporting to municipal environmental protection committees and health committees, and regional water management authorities.

In the framework of the abovementioned *Environmental Protection Act*, waste treatment and recycling activities require a permit. *The Environment Protection Decree* nr 169 of 18/02/2000, supplementing the Act, 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 those plants handle < 5000 tonnes of waste for recovery or disposal per year) or by the Centres for Economic Development, Transport and the Environment (> 5000 tonnes). However, spreading and use of the sewage sludge, when carried out in accordance with the *Decision on the use of Sewage Sludge in agriculture*, is exempted from the requirement of obtaining a permit.

According to the *Decision of the Ministry of Agriculture and Forestry* nr 656/01 of 13/02/2007, soil improving agents, fertilized growing media, compost products and by-products used as such in **forestry** must comply with the requirements on heavy metal concentrations which are the same as those specified in the *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 fertilized growing media are expressed in mg/l in Decision (656/01/2007) and they are numerically identical with those for soil in the Council of State Decision, with one exception: values for Arsenic (25 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.

Incineration of the sewage sludge is included in the scope of the *Government Decree on Waste Incineration* nr 362 of 1/06/2003, implementing the EU Waste Incineration Directive 2000/76. Just like the directive, it provides requirements for plant characteristics, combustion, emission limits and measuring system, however containing a disclaimer about preferable energy recovery from the incineration.

The Government Decision on Landfills nr 861 of 1/10/1997, implementing the EU **Landfill** Directive 1999/31, applies to sewage sludge accordingly, classifying it as biodegradable waste⁴. This decision also regulates handling of landfill gas: the gas produced at closed landfills must be collected and recovered or treated.

It worth noticing that the Finnish waste management strategy, describing actions to reach the targets set in the Landfill Directive was already in the past quite effective in reduction of landfilling of biodegradable waste to less than 50 % of the volume than 10 years before. Currently, National Waste Plan sets out new objectives to reduce the amounts of biodegradable municipal waste ending up in landfill sites over the period 2006–2016:

- by 2006 – no more than 75 %; and
- by 2016 – no more than 35 % of the total amount of biodegradable municipal waste produced in 1994. This means that only a maximum of 25 % of all the biodegradable waste expected to be generated in 2016 can be landfilled.

⁴In the meaning of this Directive, capable of undergoing aerobic or anaerobic decomposition, which refers to biodegradable household waste or biodegradable waste of a comparable nature and composition from industrial, service or other operations

SWEDEN

The institutions in charge of Swedish wastewater and sludge issues at national level are both the Ministry of Environment and the Swedish Environmental Agency (SEPA), an advisory body contributing to the implementation and enforcement of environmental **legislation**. *The Environmental Code* SFS 1998:808 of 11/06/1998 is the main act regulating environmental pollution and, among others, activities presenting a risk for the environment, which have to obtain a Permit for Environmentally Hazardous Activities.

At the local level, municipalities organize the collection and disposal of waste and are in charge of the management of any waste water treatment plants. The municipal board informs the regional authority, County, on the quantities of sewage sludge produced, the quality of the sludge as well as the quantities recycled in agriculture, and the Counties later transmit annual reports on these issues to the SEPA.

The use of sludge in **agriculture** in Sweden is defined 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 of 30/05/1994. Given order implements the EU Sludge Directive 86/287 and **applies to sludge** from municipal waste water treatment plants, septic tanks, or similar installations for the treatment of domestic or urban waste water, and from other plants treating wastewater of similar composition.

The order envisages following ways of sludge **treatment**: biological, chemical or heat treatment, long-term storage or any other process to significantly reduce the health hazards resulting from its use. On the contrary to the other Scandinavian countries (and most of the EU countries too), Swedish legislation **allows the use of untreated sludge** 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. Additionally, the order states that sludge should be used in accordance with the nutrient needs of the plants and in a way that the quality of the soil and surface and groundwater is not impaired.

Limit values for the **heavy metal concentrations in sludge, in soil and average annual loads** defined by the Order are much stricter than the ones required by the EU Sewage Sludge Directive. No limit values for pathogens or organic compounds in the sludge are specified.⁵

The Order provides a list of **surfaces on which the use of sludge is prohibited**:

- grazing land;
- 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;
- land bearing crops of berries, potatoes, root vegetables, vegetables or fruit (excepting fruit on trees); and
- 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 10 months prior to harvesting.

Swedish regulation requires the producer of the sludge to conduct sludge **analysis**, measuring its dry matter content, pH, total nitrogen and phosphorus, ammonium nitrogen and heavy metal concentrations, with a frequency depending on waste water treatment plant's load, ranging from 12 times per year for plants with capacity of more than 20 000 PE to once per year for plants with capacity of 200 PE and less. The sludge producer is obliged also to provide the user of sludge with the declaration of contents (describing origin, way of treatment, composition and quality of sludge), keep records on the amounts of sludge manufactured and provided to the farmers (for the period of at least 10 years) and report to the authority supervising control over the sewage

⁵Limit values of organic compounds were set up by an agreement among SEPA, the Federation of Swedish Farmers (LRF), and the Swedish Water and Wastewater Association (VAV), signed in 1994. The purpose of this agreement was to facilitate usage of up to 1/3 of all generated sludge in agriculture, but it was broken in October 1999, when LFR recommended its members stop using sludge, mainly due to the concerns over increasing concentrations of brominated flame retardants found in the sludge, accumulation of silver in the soils where sludge was spread, and hygienic risks related to wastewater from hospitals.

treatment plant. Agricultural soil before the first application of sludge should be analysed for heavy metals concentrations, pH value and dry matter content.

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. In addition, the Swedish SEPA publishes documents which can be considered as codes of good practices in certain areas. 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 dry matter loads when the sludge is used in **silviculture, landscaping, gardening and land reclamation**.

Incineration of sewage sludge, as well as all the other waste, has to comply with the SEPA *Regulations on incineration of waste* NSF 2002:28 of 11/12/2002 (amended by SNFS 2010:3), which are based on the EU Directive 2000/76 on incineration of waste and contain requirements for plant characteristics and emission limits.

As for the **landfill** option, from 2005 onwards, no organic waste (including sewage sludge) is accepted to the landfills by application of waste regulations, mainly the Environmental Code. The landfilling of any burnable waste had been banned in Sweden since 2002; consequently, ash from sludge incineration should generally be accepted to landfills.

DENMARK

The *Statutory Order on protection of the environment* nr 879 of 26/06/2010 and *Statutory Order on waste* nr 224 of 07/03/2011 by the Danish Ministry of Environment provide the **legal framework** which obliges the local authorities to manage waste. These laws define waste hierarchy, the municipalities' responsibility in establishing capacity for waste management and for providing information on how to dispose of the waste, and oblige them to prepare both short and long term waste strategies and waste management plans (covering 2 and 12 years respectively).

The *Statutory Order on Application of Waste for Agricultural Purposes* (The "Sludge" Order) nr 1650 of 13/12/2006 came into force on 1 January 2007 and implements the EU Sludge Directive 86/278/EEC. It describes the extent to which waste products can be used for **agricultural purposes** without damaging the environment and applies to waste from private households, institutions and enterprises, including composted waste, process waste water and sewage sludge (from both municipal wastewater and industrial sewage discharge systems), whenever the wastes are suitable for agricultural purposes and do not exceed the limit values of substances presenting hazards to the environment.

The scope of the Sludge Order's application area can be divided into two strands: waste products, specifically listed in the order and those not listed. The wastes listed in the Annex 1 may be used for agricultural purposes without permission, provided the rules of the Order are otherwise followed. Those wastes include organic waste, sewage sludge and sludges from e.g. crop production, aquaculture and processing of animal raw materials. A prerequisite for the waste product that may be spread on agricultural land (or forest) is that the waste product has real value as a soil improver, e.g. contains nitrogen, phosphorus, potassium, sulphur or lime. For not listed waste products, the municipality assesses whether a permit can be granted.

Limits for **heavy metals concentrations, pathogens and organic compounds** are defined not only in the sludge order, but also in *The Statutory Order describing the control of sewage sludge for agricultural use* nr 56 of 24/01/2000. Danish legislation leaves the possibility for the waste producer to choose between dry matter related limit values or phosphorus related heavy metals limit values in the sludge, which is justified by the compulsory dephosphatation imposed to every treatment plant with a capacity above 5000 PE. Both orders also specify pathogen requirements concerning sludge with advanced treatment, which must have no occurrence

of Salmonella and below 100 per gram of fecal streptococci. Limit values for organic compounds in sludge for agricultural use include limits on DEHP (bis(2-ethylhexyl)phthalate), PAHs (polycyclic aromatic hydrocarbons), NPE (Nonylphenole (and ethoxylates)) and LAS (linear alkylbenzene sulphonates). Most of these are also defined as EU level priority hazardous substances (but no limit values are at least by far set in the EU level).

Annex 3 of the Sludge Order describes the “sanitary requirements for application of waste products”, which apply separately to the various **kinds of sludge** and differentiates appropriate **types of treatment** according to the intended **purposes of use**. Therefore,

- sewage sludge **could not be used untreated**;
- stabilized sewage sludge could not be used for gardening or edible crops (which can be eaten raw, except fruit tree crops) and should be worked into the soil within 12 hours after application in fields rearing cloven-footed animals, compost shall be applied and worked into the soil before sowing;
 - stabilizing defined by one of the following treatments: anaerobic digestion; aerobic digestion; composting without temperature control; addition of lime; 6 months storage
- sewage sludge that has undergone controlled composting could not be used for edible crops or gardening (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);
 - composting shall be done with daily temperature measurement to ensure temperatures in all material not get below 55 °C for no less than two weeks
- usage of sewage sludge that has undergone controlled pasteurization is not restricted
 - pasteurization defined by one of the following treatments: pasteurization 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, advancedly treated products must have no occurrence of salmonella and fecal streptococci must be below 100 per g.

The Order contains several restrictions concerning the use of sludge, specifying that **it may not be used on surfaces where**:

- the sludge is likely to run off to lakes, watercourses or drains because of sudden thaw and rainfall;
- the sludge is likely to cause pollution of groundwater; and
- the sludge is likely to cause significant nuisances or unsanitary conditions.

It also limits **maximum quantity** of sludge to be spread on land to 7 tonnes of dry matter per hectare per year.

According to the Sludge order, the sludge producer has to carry out representative **analyses** of heavy metals concentration in the sewage sludge every 3 months, as well as total phosphorus and total nitrogen content. Every 12 months the sludge has to be analysed to identify concentrations of organic compounds. Municipal councils can decide to increase or decrease the frequencies of performing analyses, and also to reduce or add parameters of analyses. Additionally, the sludge producer must provide a declaration (on sludge’s origin, treatment and appropriate designation, fractions and proportions of mixed in other materials, results of analyses and storage options) for the user and annual report for the municipal council before 1st of March.

Sewage sludge might be used in cultivated **forests** based on a need for fertilization, if the local council allows so. The council can also establish specific restrictions. To be used in **green areas**, the sludge must be pasteurized.

In Denmark, **incineration** of waste, including sewage sludge, is regulated by the *Statutory Order on plants incinerating waste* nr 162 of 11/03/2003, which implements the EU Incineration of Waste Directive. No specific requirements are known for the **landfilling** of sewage sludge – it is regulated together with the other types of waste by the *Statutory Order on landfills* nr 650 of 29/06/2001. The requirements laid down in this order are expected to lead to the closure of 40–60 landfill facilities (out of the approx. 150 existing facilities) before 2009. It should be pointed out that only around 6 % of all Danish waste is destined for landfilling, and the national strategy aims at even diminishing this number.⁶

GERMANY

The German environmental **legal framework** is developed by the federal institutions but each relevant regional authority (Länder) may decide more detailed regulations and is additionally responsible for the implementation and enforcement of Federal laws.

The agricultural use of sludge is regulated by the *Sewage Sludge Ordinance* (AbfKlärV) of 15/04/1992. However, it is also governed by other laws such as the *Fertiliser Ordinance* (DüMV) of 16/12/2008 which regulates the quality and application of fertilisers. To some extent these legal acts collide: since being issued by the different federal ministries they contain different regulations regarding treatment and limit values for heavy metals, pathogens and organic compounds. Additional laws that apply are the *Soil Protection Act* (BBodSchG) of 17/03/1998 and the *Soil Protection and Contaminated Sites Ordinance* of 12/07/1999 which both regulate the protection of soil quality, soil uses and cleanup of contaminated soils.

The Ministry of Environment's *Sewage Sludge Ordinance* covers the **sludge** produced from urban waste water treatment plants (as well as mixtures of sludge and other elements which are used in agriculture). According to the Section 4 of the ordinance, only sewage sludge issued from the treatment of domestic, urban or similar waste water is allowed on agricultural land. **Untreated sludge cannot be used** on agricultural land – yet no treatment specifications are provided.

The *Sewage Sludge Ordinance* contains limit values for **heavy metals in soil and in sludge**⁷, for **organic compounds** AOX, PCB (6), and PCDD/PCDF, however no specific requirements concerning pathogens.

Section 6 of the ordinance specifies the **maximum quantities** of sludge used in agriculture: 5 tonnes of dry matter per hectare per 3 years. Furthermore, sludge **cannot be used on the surfaces** destined to grow fruits and vegetables, forests, pasture land and meadows, on the soils in nature conservation areas, national parks, national nature monuments, protected landscape elements and legally protected biotopes, or on areas close to water sources and river shores. The use of any kind of sludge on land for **silviculture, natural forest land, and on green areas is prohibited**.

In the Ordinance, it is stated that the waste water treatment plant operator must **analyse** specific elements – heavy metal concentrations, pH value, content of plant-available phosphate, potassium and magnesium – in the agricultural soil before using sewage sludge for the first time and repeat the analysis every 10 years. Sludge should be measured for heavy metals, organic compounds, total ammonia and nitrogen, phosphate, potassium, magnesium, dry matter and pH value, and such analysis is to be repeated every 6 months. In some Länder (e.g. Brandenburg and Lower Saxony), regulations may provide for additional analysis concerning other pollutants. Additionally, operators of waste water treatment plants shall keep records regarding volumes of sludge generated, supplied to agriculture (with data of recipients), properties, treatment methods and analyses results of the sludge, and report this information annually to the authorities responsible for enforcement of *the Sewage*

⁶(7.10.2011)

⁷Additional limits for Cd and Zn when sludge used on the soils classified as light soils and whose clay content is below 5%, or for soils with a pH of 5-6.

Sludge Ordinance and to the responsible supreme Land authorities (which further submit the collected data to the Federal Ministry of Environment).

Currently, the given ordinance is under revision and 2nd draft of its new version contains several modifications, most notably, the new limit values for heavy metals concentrations in sludge according the phosphorus content (divided in 2 groups of limit values – for sludge < 5 % P₂O₅ and > 5 % P₂O₅), new limits for organic compounds, and compulsory Disinfection/Hygienisation (method of which is comprehensively explained in the annex 2 of the ordinance) to eliminate *Salmonella* (50 gram sludge sample). It is expected that the new law will come into force no sooner than 2013.

The Fertiliser Ordinance, issued by the Ministry of Food, Agriculture and Consumer Protection, in turn, contains the same Disinfection/Hygienisation⁸ (no method is provided though) and *Salmonella* requirements as the 2nd draft of the revised *Sewage Sludge Ordinance*. The result product ceases being waste, and is labeled as “nitrogen-phosphorus fertiliser of sewage sludge”. Furthermore, the Ordinance allows for the waste water treatment plant to give sludge to the disposition of a fertiliser company, when no treatment is required.

The fertiliser ordinance specifies more limitations of allowed raw materials and some additional treatment requirements and instructions. The annex 2 indicates limit values for Cd, Pb, Cr^{VI}, Ni, Hg, As, Tl, PFOS/PFOA (though no limits for Cu, Cr, Zn), applicable to fertiliser products derived from sludge from 2015 onwards. Additionally, according to the same ordinance, the prohibition of non-biodegradable synthetic polymers usage in WWT will come into force in 2014. The prolongation to 2018 is under discussion and the amendment is planned for the 2nd half of 2012.

Any of the abovementioned two ordinances provides no specific elements addressing **incineration** of the sewage sludge, therefore the relevant legislation on waste shall apply: *the Recycling and Waste Management Act* (KrW-/AbfG) of 27/09/94 and the *Technical Instruction on Wastes From Human Settlements* (TASi) of 14/5/93, as well as *the Ordinance on the implementation of the Federal law on protection against emissions* (BImSchV) of 23/11/90.

Implementing the waste incineration directive, they pose requirements for plant design and construction, combustion processes, emission limits and measuring systems.

The Technical Instruction on Wastes From Human Settlements also specifies requirements towards the **landfilling** of waste, which indicate that from July 2005 onwards only waste containing less than 5 % of organic matter will be accepted in landfills⁹, which in practice means that no sewage sludge, but only ashes from sludge incineration can be considered as landfillable waste.

B. BALTIC STATES AND POLAND

ESTONIA

In Estonia, the main **legislative competence** in the field of environmental issues lies in the hands of the Minister of Environment. Regional environmental authorities monitor the implementation of environmental protection measures and requirements. Local municipal councils are in charge of dealing with environmental issues and with wastewater collection and treatment and sewage sludge disposal in particular. The waste handling policies are ruled by the three most important legal documents: *the Law on Environmental Impact Assessment and Environmental Management* of 22/02/2005, the *Waste Act* of 01/28/2004¹⁰ and *the Water Act* of 11/05/1994. When it comes to the **sludge management**, the most relevant Estonian legislation is the *Minister of Environ-*

⁸However, according to the Fertiliser Ordinance, Disinfection/Hygienisation is only obligatory if the product of sludge is to be used outside the zone of own agricultural authority (often, Bundesland).

⁹Same requirement was repeated in the Ordinance on Environmentally Sustainable Deposition of Municipal Waste (AbfAbIV) of 20/02/2001, §6 (2) 1.

¹⁰Here would be analyzed the version which is to be in force since 01.01.2012.

ment Regulation nr 78 on the conditions of the sewage sludge use in agriculture, landscaping and recultivation of 30/12/2002.

The regulation **applies to the sewage sludge**, defined as a suspension derived from the sewage water by physical, chemical or biological methods, which, based on the organic matter content, could later be used treated or untreated. The **treated sludge**, according to the article 3 of the regulation, is the sludge which has undergone either aerobic or anaerobic digestion, including composting¹¹, or chemical or thermal treatment. Whereas **untreated sludge** is defined as dewatered sludge, with possible addition of support materials and which is kept for at least six days in temperature not increasing above 60 °C. Furthermore, the use of the untreated sludge only to landscaping and re-cultivation of land is restricted (article 11), and this sludge should be worked into the soil no later than in two days after it had been spread on the surface (except for the cases when untreated sludge is used as a landfill cover – it should not be worked in).

Sludge used in agriculture, landscaping and re-cultivation should not contain **heavy metals**, concentration of which exceed limit values provided by the article 10 (2) of the regulation, also taking into account provisions of the Minister of the *Environment Regulation nr 75 on requirements for hazardous substances discharged into public sewerage system* of 16/10/2003. The regulation nr 78 provides limit values for heavy metal concentrations in soil, however stating that if the soil's pH ≤ 5 – sludge cannot be applied, and in case pH 5–6 – only lime stabilized sludge can be used. Additionally, values for maximum annual average load of heavy metals to the land are given.

Estonian legislation provides limit values for **pathogens**: the sewage sludge must not be used in agriculture, for landscaping and re-cultivation, if it contains fecal coliforms of more than 1 000 colony-forming units (CFU) in 100 ml, and helminth eggs in 1 liter. No limit values for organic compounds in sludge are given.

According to the regulation, the use of sludge is **prohibited on the following surfaces**:

- fruit and vegetable crops, and also aromatic/culinary or medicine herbs for human and animal consumption may not be grown earlier than 1 year after the application of sludge;
- arable land if fodder crops are to be harvested within two months of the time the sludge is spread;
- areas that are flooded and /or wetlands; and
- frozen and /or snow-covered soil.

The regulation states that prior to the application to land, the provider of sludge should conduct the **analyses** in order to determine sludge's pH, heavy metal concentrations, dry matter and organic matter, nitrogen and phosphorous content. The frequency of sludge analysis depends on the capacity of the waste water treatment plant, varying from 12 times per year for a plant with capacity 100 000 PE, to 2 times per year for a plant with capacity 2000 PE, in case it is the first year when sludge is applied (in the next years, those analyses are less frequent – 4 times and once a year, respectively). Furthermore, the provider of sludge, mixture of sludge and sludge compost for the use in agriculture, green areas or re-cultivation, should present information on sludge treatment, analyses results and instructions for its application to the user. In turn, data on users of sludge and routes shall be submitted by the sludge provider to the Waste Register.

The article 17 regulates sampling and analysing of the soil, if sludge is to be used for agricultural purposes. This includes determining of the soil pH and heavy metals content, and should be done before the first application of sludge – when the vegetation period is over, and after the first application – every 5 years.

The **incineration** of sludge is covered by the same law as incineration of waste in general, that is, by the *Waste Act of 01/28/2004 and the Minister of Environment Regulation nr 99 on Incineration plants' emissions of pollutants into the ambient air and procedure and methods for determination* of 02/08/2004. Just like the waste incineration directive which it implements, the regulation provides requirements for plant characteristics, combustion, emission limits

¹¹Sludge compost in the meaning of the Regulation no.78 is a product derived by aerobic treatment of sludge, later mixed with bark, sawdust, bedding straw, peat or any other compound, while the compost material temperature must be at least six days over 60°C.

and measuring system.

The disposal of sludge to **landfill** is covered by the *Waste Act and Minister of Environment Regulation nr 38 on specifications of landfill construction, operation and closure* of 29/04/2004. Additionally, the Estonian National Waste Plan 2008-2013 proposes to decrease landfilling of biodegradable waste:

- from 16 July 2010 not more than 45 %;
- from 16 July 2013 not more than 30 %; and
- by 2020 not more than 20 % of all generated bio-waste shall be disposed to landfills.

LATVIA

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

The **legal framework** regulating the main environmental issues in Latvia consists of the *Law on Environment Protection* of 02/11/2006, the *Law on Environmental Impact Assessment* of 10/14/1998 and the *Law on Waste Management* of 28/10/2010. In turn, the use of sludge is governed by the Cabinet of Ministers' *Regulation Nr 362 on sewage sludge and compost utilization, monitoring and control* of 02/05/2006.

The regulation 362 concerns **sewage sludge and compost** and determines its **use in agriculture, forestry, green areas and land recultivation**. According to article 2, **sewage sludge** is colloidal sediment obtained from the treatment of municipal, domestic and industrial sewage treatment plants and sludge from septic tanks and other similar equipment for wastewater treatment. Consequently, article 3 defines **compost** as decomposition product of sewage sludge with addition of various plant material (peat, leaves, straw, sawdust and other fillers) undergone an active aerobic microbiological activity.

Further, the regulation distinguishes treated and untreated sewage sludge. The following **methods of treatment** are specified:

- storage, incl. in liquid form, for at least 12 months (cold fermentation) without mixing and handling during storage;
- mesophilic anaerobic digestion 35 °C (± 3 °C), minimum duration of treatment – 21 (± 5 days);
- thermophilic anaerobic digestion 55 °C (± 5 °C), minimum duration of treatment – 10 days;
- thermophilic aerobic stabilisation at 55 °C (± 5 °C), minimum duration of treatment – 10 days;
- composting, during which at least three days the temperature inside the pile, 50 cm from the pile surface is not less than 60° C;
- treatment with lime to a pH of 12 or more, not less than two hours, the temperature must be at least 55 °C;
- pasteurization at least 30 minutes in 70 °C; and
- drying at 100 °C, and dry matter content of the sludge mass of at least 70 %.

Untreated sludge has not undergone any of the abovementioned treatment procedures. The regulation does not provide any specifications concerning the use of untreated sludge.

The regulation provides **heavy metal** concentration limit values for sludge/compost (both treated and untreated), in soil¹² and average annual loads¹³. If the sludge/compost is to be used in agriculture, pH value of the soil must be above 5. The ammonium nitrogen and total phosphorus annual emission limit values are 30 kg/ha and 40 kg/ha respectively. No requirements for pathogens or organic compounds are given.

The sewage sludge should be worked in the soil within three days after spreading on the field. Spreading is forbid-den during the period from December 15 to March 1. Furthermore, sewage sludge and compost cannot be spread and incorporated on the following surfaces:

- slopes with a gradient greater than 7°;
- frozen or snow covered soil;
- flooded and flood risk areas;
- closer than 100 m from individual water-supply points;
- closer than 100 meters from residential buildings, food processing and food trading companies;
- closer than 50 m of water or watercourse shoreline;
- areas under the laws of the protection zones;
- areas covered with vegetables and fruits;
- potatoes, vegetables and fruits growing in the open air area, which is less than 0.10 ha;
- during the vegetation period of crops; and
- pasture land.

Latvian legislation requires the sewage sludge or the batch of compost to **be analysed** for heavy metals concentrations, dry matter content and agrochemical indicators – pH, organic matter, total nitrogen (N) and phosphorus (P) concentration in dry matter, and ammonium nitrogen (NH₄-N) mass concentration in dry matter – by the sludge producer before it is to be used. Frequency of such analysis it depends on the load of waste water treatment plant, varying from 12 times per year for a plant with capacity more than 100 000 PE to once per year for a plant with capacity less than 2000 PE. The sludge producer is also responsible for issuing a quality certificate (containing information on analyses results, types of treatment that it undergone, surfaces on which it can be applied and also maximum permissible proportion of dry matter) for each series of sludge, keeping records about production and usage of sludge for at least 10 years, and reporting all data to the regional environmental authorities. These, in turn, annually submit the summary data on sludge usage to the Latvian Environment, Geology and Meteorology Agency.

The soil analysis should determine heavy metals concentrations and pH, and is to be held prior to the first and fifth application of the sludge/compost.

The regulation nr 362 also deals with the use of sewage sludge and compost in forestry, green areas, for land reclamation, as well as governs its disposal to landfill (chapters V, VI, VII and VIII respectively). Only treated sludge/compost can be used in **forestry** and for **land reclamation**, with heavy metals concentrations not exceeding the limits given for the agricultural use. In plantation forests it is allowed to use both treated sludge and compost, but fertility sands, degraded forest soil and burned-out forests – only compost. Furthermore, sludge/compost should be worked in the soil and cannot be used for the surface fertilization. When used for reclamation of degraded areas, a soil analysis should be conducted before the first application in order to determine pH and granular composition of the soil. The sludge/compost cannot be used in the degraded areas which are

¹²Limit values for heavy metals concentrations in soil vary depending on the types of soil (sand/sandy loam, loam/clay) and its pH (5–6, 6.1–7, and > 7).

¹³The average annual loads of heavy metals to the soil vary only depending on the types of soil (sand/sandy loam, loam/clay).

permanently or temporarily flooded or with pH below 5. Additionally, maximum amounts of sludge/compost for recovery of degraded areas (t / ha) are provided (annex 12), depending on the class¹⁴ of sludge/compost and types of soil (grav-el/sand/sandy loam and loam/clay). Regarding the use in **green areas**, the provisions of the regulation make it obligatory to work the sludge/compost into the soil within 24 hours after spreading, and state that limit values for the heavy metals concentrations in soil in green areas can be increased by 50 % of those for agricultural use.

Incineration of sewage sludge in Latvia is regulated (together with the other types of waste) by *the Law on Waste Management and Cabinet of Ministers Regulation nr 401 of 24/05/2011 – Requirements for waste incineration and waste incineration plant operation* together with the other types of waste.

Landfilling of sewage sludge and compost should be done in accordance with the laws and regulations on waste management, but the regulation nr 362 also contains some more specific requirements. Firstly, in case treated sludge and compost meets municipal landfill waste acceptance criteria, it may be disposed of in the mass of municipal waste landfill, if the treated sewage sludge dry matter content is not less than 15 %. Secondly, treated sewage sludge and compost that corresponds to hazardous landfill waste acceptance criteria, as well as the fifth class of sludge/compost, may be buried in the mass of hazardous waste landfill. And thirdly, sludge/compost (other than the fifth class) may be used for compost dumps and landfill covering after landfill or dump is completely or partially closed.

Latvian Waste Management Plan 2006-2012 sets targets for reduction of the amount of biodegradable municipal waste disposed of in landfills:

- by 2010 – no more than 75 %
- by 2013 – no more than 50 %,
- by 2020 – no more than 35 % of the total amount of biodegradable municipal waste produced in 1995.

LITHUANIA

As in the other Baltic States, Lithuanian Minister of Environment holds full **legislative power** in the realm of environmental policies, while the regional authorities monitor implementation of those regulations. The most important legal acts ruling environmental and waste issues in *Lithuania include the Law on Environmental Protection of 21/01/1992, the Law on Waste Management of 16/06/1998, and also the Hygiene Standards HN 60:2004 - Maximal Concentrations of Hazardous Chemicals in Soil of 08/03/2004* by Minister of Health. The **sludge management** is regulated by the Minister of Environment Order nr 349 on the *Environmental Protection Normative Document LAND 20-2005 - Requirements on the use of Sewage Sludge for Fertilization and Reclamation of 29/06/2001*.

The order nr 249 aims to regulate sewage sludge **in agriculture, energy crops** (fast growing plantations for the direct use as biofuels) and the **cultivation of damaged areas** (quarries, peat empty, closed landfills, road-bed, etc.) and **dumpsites** so that no negative effects are caused on soil, vegetation, animals and humans. Its **requirements apply** to household and municipal or similar industrial (e.g. food) waste water sludge.

Article 5.2 of the order defines **treated sludge** as biologically, chemically or thermally affected, stored for long time or undergone any other process that reduce its fermentability and the health hazards. The order provides limit values for **heavy metal** concentrations in sludge, soil and average annual loads. Two kinds of limit values are provided for the concentrations of heavy metals in soil – background limits (which influence the frequency of performing soil analysis), and maximum permitted concentration values – for sand/sandy loam and loam/clay soils.

¹⁴Classification of sewage sludge/compost is provided in the Annex 6 of the regulation nr 362 – it distinguishes 5 classes of sludge/compost, depending on heavy metals concentrations.

Furthermore, the sludge is differentiated to categories (I, II, III – depending on heavy metal concentrations) and classes (A, B, C – depending on microbiological and parasitological parameters). Lithuanian legislation regulates the pathogen content of sludge – parameters taken into account are the following: *Escherichia coli*, *Clostridium perfringens*, helminth eggs and larvae as well as pathogenic enterobacteria¹⁵. Sludge of **III category or C class**, as well as **untreated sludge cannot be used**. Also, according to general rules on the use of sludge, regardless of category/class, it is **forbidden to use sewage sludge** on the areas near drinking water bodies, areas of surface water protection zones, and extensive karst areas.

For agricultural purposes:

- none of the categories/classes of sludge can be used on the areas planted with fruits and vegetables (excluding fruit trees), and also areas where soil pH is < 5.5;
- the use of II category sludge is prohibited on the grasslands, areas devoted for vegetables, fruits or crops, as well as if the concentration of heavy metals in the soil exceeds 70 % of the maximum permissible concentrations; it also cannot be used more often than every 3 years;
- on the areas for cultivation of vegetables and grassland or forage/feed crops, only A class and I category sludge may be used; areas for the cultivation of fruit crops and vegetables that are in direct contact with the soil and eaten raw, fertilized no later than 10 months before harvest and during harvest, grassland or forage crops – not later than three weeks before use (mowing or grazing);
- maximum amounts nutrients applied with sludge are: nitrogen – not more than 170 kg/ha per year, phosphorus – not more than 40 kg/ha per year; and
- sludge should be worked into the soil within 2 days after spreading on the surface, and it cannot be spread if the air temperature is higher than 20 °C.

The order 249 regulates also the use for **recultivation** and for **fertilization of energy crops**. In both cases, maximum allowed amount of sludge to be used is 100 tonnes of dry matter per hectare, but this can be increased if justified by a site remediation project and are proven to be environmentally safe. Moreover, there are limitations of these ways of sludge application – it cannot be used on surfaces when up to 0.5 km deep there is flow of underground water extracted for drinking water preparation; or the highest ground water level depth of the sludge application layer pad is less than 1 meter. Additionally, sludge can be used for energy crops fertilization only in areas where in the upper soil layer (not less than 1 m) the average filtration rate is less than 10–2 m/d. In turn, the sludge-re-cultivated damaged areas later (though, not defined exactly) can be used to grow agricultural crops for human or animal consumption.

The Order contains rules of performing **analyses** of soil and sludge before its use. Before delivering the sludge to the user (not earlier than 30 days), the sludge must be analysed in order to determine the dry matter content, pH value, total nitrogen (N) and phosphorus (P) concentration in dry matter, and microbiological/parasitological indicators. The latter, however, are not required to be measured if the sludge:

- was treated by raising the temperature above 70 °C and maintaining that for longer than 1 hour;
- was dried at 100 °C and higher temperatures;
- has undergone anaerobic, aerobic or lime (by increasing sludge pH>12 for longer than 2 hours, after 24 hours pH should be maintained at > 11.5) stabilisation;
- was prepared for composting – temperatures above 55 °C, maintaining at least 2 weeks.

The frequency of sludge analyses for heavy metal concentrations are determined depending on the load of

¹⁵E.g. sludge class C: *Escherichia coli* >100 000 colonies/g, *Clostridium perfringens* > 10 000 000 colonies/g, helminthes > 100 units/kg, pathogenic enterobacteria > 1 colony/g

waste water treatment plant, ranging from 12 times per year for a plant with capacity more than 50 000 PE to once per year for a plant with capacity less than 10 000 PE¹⁶. At the same time, the Order does not explicitly indicate who is responsible for the conducting this analysis. However, it is stated as the responsibility of sludge supplier to keep the records regarding sludge usage (treatment, analyses results, and data on users of sludge).

Before the first application of sludge for agricultural purposes, soil should be also analysed in order to determine its quality indicators: concentrations of heavy metals, texture and pH level. Further frequency of soil analysis depends on the results of the first tests (whether heavy metal concentrations do or do not exceed background limit values), and on category of sludge applied.

And two legal acts governing waste **incineration** are *Minister of Environment Order nr 699 on the Environmental Protection Requirements for Waste Incineration* of 31/12/2002 and *Order nr 342 on the Environmental Protection Normative Document LAND 19-99 - the Main Requirements for Waste Incineration* of 27/10/1999. Those legal acts provide requirements for plant characteristics, combustion processes, emission limits and measuring system.

The landfilling and incineration of sewage sludge in Lithuania is regulated together with the other types of waste. Minister of Environment *Order nr 444 of on the Requirements on Construction, Operation, Closure and After Care of Landfills of Waste* of 18/10/2000 implements the EU **Landfill** Directive. Lithuanian National Strategic Waste Management Plan sets targets for reduction of the amount of biodegradable municipal waste disposed of in landfills:

- by 2010 – no more than 75 %
- by 2013 – no more than 50 %,
- by 2020 – no more than 35 % of the total amount of biodegradable municipal waste produced in 2000.

POLAND

The **most important regulations** on environmental matters, issued by the Polish Parliament are the *Law on Environmental Protection* of 27/04/2001 and the *Law on the Protection of Nature* of 16/04/2004, while the Minister of Environment has main legislative and supervisory power over these issues. Additionally, 7 regional boards for water management (RZGW) are responsible for monitoring water quality as well as all waste water treatment plants. Environmental law enforcement is carried out by the national inspectorate of environment protection (GIOS) and by the regional inspection service for environmental protection. Locally, municipalities are in charge of water supply and waste water treatment.

In Polish **legal framework**, waste, waste water and sewage sludge issues are governed respectively by the *Law on Waste* of 27/04/2001, and the Minister of Environment *Decree on conditions to be fulfilled by wastewaters discharged into the bodies of water or soil, and on substances particularly hazardous for water environment* of 24/07/2006 and *Decree on urban sewage sludge* of 13/07/2010. The *Law on Waste* is a comprehensive legal act, covering all waste-related questions from rules and strategies of waste management to responsibilities of waste producers, transporters and local governments, containing, lists of types of waste, hazardous wastes, and recovery and disposal processes. The article 43 of this law regulates sewage sludge management and states that Minister of Environment is responsible for defining further conditions of the usage of urban sewage sludge.

Consequently, the Minister's Decree on *urban sewage sludge* in its essence is an executive act of the article 43 of the *Law on Waste*. Both regulations specify five possible routes of using residual sewage sludge:

- agriculture;
- land reclamation:

¹⁶Only in case sludge is not contaminated with hazardous substances from industrial effluent, and the results of previous analysis determined its category as I. Otherwise, frequency of performing analysis is 4 times per year.

- green areas;
- for production of compost (including spreading on land where crops used for producing compost are cultivated); and
- for growing non-eatable crops.

However, article 43 paragraph 2 of the Law on Waste also defines stabilisation as a mandatory **treatment** for sewage sludge, stating that it should be supplemented by any other kind of treatment appropriate for intended further use of sludge, like biological, chemical or heat treatment, or any other process capable of eliminating health and environment hazards coming from the **untreated sludge**. It is also forbidden to irrigate previously dewatered sludge.

The limit values of **heavy metal** concentrations in soil and sludge, which cannot be exceeded when the sewage sludge is to be used for the agricultural purposes, are provided by the decree's annexes. The decree also defines limit values for the **pathogens** in sludge destined for agriculture – no occurrence of *Salmonella* in 100 gram sample, and no eggs of parasites (ascaris, trichuris, toxocara) in 1 kg of dry matter. No specific requirements concerning organic compounds in the sludge are provided.

Polish legislation specifies three different limit values for each heavy metal in soil, depending on the type of soil – light, medium or heavy, which are not, however, defined by the decree. Additionally, the soil's pH must be higher than 5.6 and maximum quantity of sludge applicable to soil for agricultural purposes is 3 tonnes per hectare per year.

Generally, according to the decree (art. 2 paragraph 6 and 7), sludge cannot be applied to soil if it decreases the quality of soil or surface or/and ground waters, and if the application takes place during the vegetation period of the crops destined for direct consumption. In turn, article 43 paragraph 6 of the *Law on Waste* specifies **surfaces on which use of sludge is prohibited**:

- national parks and protected areas;
- areas close to sources and any drinking water equipment;
- areas close to rivers, lakes, and other bodies of water;
- wet zones and swamps;
- frozen soils and soils covered with snow;
- soils with high permeability;
- inclined agricultural land (with a slope higher than 10 %);
- areas close to individual housing and human settlements;
- 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;
- grazing and pasture land; and
- crops grown in greenhouses.

Additionally, article 9 paragraphs 3 and 4 of the *Law on Waste* should be taken into account, as they further limit the area of possible sewage sludge application, stating that it can be used only on the territory of the same province (voivodship) where the sludge originates from, or alternatively, in the neighboring province if the dis-

tance to the intended place of application is shorter than to the place of application in the province of origin.

The decree regulates the **analysing** and sampling methods for sludge and soil. According to article 5, when sludge is to be used for the purposes regulated by the decree, it should be measured for pH, dry matter in total mass of sludge (%), organic matter (%), concentrations of nitrogen, phosphorous, calcium, magnesium (all in %), concentrations of heavy metals and occurrence of pathogens. The frequency of conducting sludge analysis depends on the waste water treatment plant capacity and varies from 6 times per year for a plant with capacity over 100 000 PE, 3 times per year for a plant with capacity between 10 000 and 10 0000 PE, to twice per year for a plant with capacity below 10 000 PE. Article 6 states that when analysing the soil on which sludge is to be applied, its pH should be measured, as well as concentrations of nitrogen, phosphorous and heavy metals, and such analysis has to be conducted each time when the sludge is to be used on the soil. Polish legislation explicitly states that the producer of sewage sludge is responsible for analysing both sludge and soil to which it should be applied. Additionally, the sludge producer is required to supply the sludge user (in the meaning of the *Law on Waste* – the owner of land plot where sludge is to be applied) with all the analyses results, as well as information regarding maximum amounts of sludge allowed to be applied on particular soils. The sludge user in turn, has to keep records on quality and amounts of sludge applied for at least 5 years.

Polish laws specify the routes of possible usage of sewage sludge, and **any other ways – e.g. in forestry, are prohibited**. The Decree on urban sewage sludge provides separate heavy metal limit values in sludge that is to be used for **land reclamation**, and for so called **nonagricultural purposes** (in green areas, etc.), stating that in both cases the concentration of eggs of parasites (ascaris, trichuris, toxocara) in 1 kg of dry matter should not be higher than 300; and it defines maximum quantities of sludge that could be applied – again for both land reclamation and in green areas – as 15 tonnes per hectare per year.

Regulations regarding **incineration** and **landfilling** are provided by chapters 6 and 7 of the *Law on Waste* respectively, and they apply to all types of waste, including sewage sludge. Article 16a¹⁷ of the same law, defines task for the local governments to reduce the amounts of biodegradable waste placed in the landfills as follows:

- until 31.12.2011 – no more than 75 %;
- until 31.12.2013 – no more than 50 %; and
- until 31.12.2020 – no more than 35 % of the total amount of biodegradable municipal waste produced in 1995.

C. RUSSIA AND BELARUS

RUSSIA

On the national level in Russia, the **main legislative powers** in the realm of environmental and waste policies are concentrated in the hands of two Ministries: the Ministry of Natural Resources and Environment and the Ministry of Health and Social Development. The *Federal Law "On Production and Consumption Wastes"* N 89-FZ of 24 June 1998 defines responsibilities of state-level institutions as adoption of federal laws and waste handling policies, licensing of the collection, use, disposal, transportation of wastes, and organization of waste reporting register. Same law also states that local authorities shall ensure organization of collection and disposal of municipal waste, and organization of recovery and recycling of municipal and industrial waste. Additionally, state environmental monitoring includes, among others, government supervision in the field of waste management.

Sludge handling in Russia is governed by two complementary acts: first being State Standard GOST-R "Nature

¹⁷However, this article comes in force only 01.01.2012.

protection. Soils. Requirements for sewage sludge use for fertilization” 17.4.3.07-2001, developed by technical committee for standardization TC 409 Environmental Protection, adopted by the Decision of State Standard of Russia, and the second - Sanitary Norms SanPin “Hygienic requirements to wastewater and sewage sludge use for land irrigation and fertilization” 2.1.7.573-96 – by State Committee on sanitary-epidemiological surveillance, adopted by Government Decision. Mostly these laws contain repetitive requirements, however SanPins have broader scope, regulating also the use of wastewaters for irrigation of agricultural fields – including designing, operation of such fields, and control of sanitary-epidemic norms, while GOST’s being the only sewage sludge-specific legislation in Russia¹⁸.

The abovementioned GOST requirements refer to the sewage sludge, resulted from the process of treatment of household, municipal or similar industrial wastewater as well as the products (eg. fertilisers) derived from sludge. Same document contains definition of sludge – the solid fraction of wastewater consisting of organic and mineral substances extracted in the process of wastewater treatment by sedimentation (raw sludge), and a complex of microorganisms involved in the process of biological wastewater treatment and withdrawn from the process (active excess sludge). SanPins state that decontamination and disinfection of sewage sludge can be carried out in the following ways:

- thermophilic fermentation in the digesters or thermal drying;
- infrared irradiation (camera deworming);
- pasteurization at 70 °C with heat exposure time of at least 20 minutes;
- aerobic stabilisation with pre-heating a mixture of raw sludge from the activated sludge at a temperature of 60-65 °C for 2 hours;
- composting (with sawdust, dry leaves, straw, peat, and other water-absorbing means) for 4–5 months, of which 1–2 must occur in the warmer months, under condition of reaching all layers of the compost temperature of at least +60 °C ; and
- storage at the sites in:
 - I and II-climatic regions of a period of not less than 3 years;
 - III-rd climate region – at least 2 years; and
 - IV-climatic region – at least 1 year.¹⁹

Terms storage of sewage sludge in sludge beds are specified by the experimental research institutes or agencies of the state sanitary-epidemiological service on the basis of the results of laboratory studies showing the absence of viable eggs in the sediments of helminthes (roundworm, whipworm, *Ancylostoma*, *Oncospheres tenuid*, *Fasciola*).

GOSTs pose three types of requirements for sludge quality: general **agrochemical indicators**’ values (pH, organic matter content, total Nitrogen and P₂O₅), and differentiating sludge into two groups **heavy metal concentration** limit values (+As) and **pathogen** limit values (bacteria of *E. coli*, pathogens, including *Salmonella*, Helminthes eggs and cysts of intestinal pathogenic protozoa). The **heavy metal concentration limits in soil** are provided by SanPins, annex 9 “Maximum permissible concentrations (MPCs) of heavy metals in the soil, as approved by Ministry of Health of the USSR, N 6229-91 and Tentatively permissible concentration (TPCs) of heavy metals in in soils of different physico-chemical properties, approved by the State Sanitary-Epidemic Control Committee of Russia, GN 2.1.7.020-94”. They state MPCs for Hg, Pb, mobile forms²⁰ of Cu, Ni, Pb, Cr (III), and Zn; TPC for Ni, Cu, Zn, As, Cd and Pb.

¹⁹ www.e-reading.org.ua/chapter.php/121032/36/Krasnik_-_Mezhotraslevye_pravila_po_ohrane_truda_pri_pogruzочно-razgruzочноyh_rabotah_i_--znaniiii.html

Maximum allowed quantities of sludge used for soil fertilization, according to GOST should be calculated separately for each case, taking into account concentrations of heavy metals in sludge and in soil (annex A of the document contains calculation formula); for nonagricultural use of sludge, the doses should be determined based on the cultivation and/or recultivation technologies. SanPins further limit maximum dose for agriculture to the amount of total nitrogen in sludge that is applied to soil, and this amount should not exceed 300 kg/ha/year. Moreover, for medium and heavy texture soils amount of dry matter should not be more than 10 t/ha with frequency of application not less than 5 years, for light sand and sandy loam soils – not more than 7t/ha with frequency of application not less than 3 years.

When it comes to the **surfaces, on which the use of sludge is restricted**, both GOST's and SanPin's generally mention:

- water protection zones and zones of water bodies and coastal buffer zones, as well as within the protected areas;
- surfactant use in the woods, parks, on the hayfields and pastures;
- in flooded and waterlogged soils; and
- in rugged areas, as well as sites that have an inclination towards a water body more than 3°.

Further, GOST's more specific limitations, depending on the group of sludge applied, are as follows: group I can be used for all kinds of crops except vegetables, mushrooms, herbs and strawberries; group II can be used for cereals, legumes, forage and industrial crops.

The GOST document also specifies other possible routes of sewage sludge disposal: groups I and II might be used in industrial **horticulture, green areas, forest** and ornamental nurseries, for biological **reclamation** of land and landfills. Sludge, heavy metal concentrations of which exceed allowable values for group II, but the chemical composition correspond to the 4th class of danger (low-hazard waste²¹, can be used to restore the productivity of damaged land and in forestry and recreational areas of remediation, or be stored on specially equipped landfills. The SanPin's in turn, state that sewage sludge and composts of it might be used as fertiliser on land designed for planting trees and shrub plantings, on catteries, parks, a long-standing cultural hay-pastures, for re-forming grasslands, on forage, silage, and industrial crops and on fallow fields and reclamation land.

The SanPin act contains requirements regarding **soil and sludge analysis**. Each time before the application of sludge, agricultural soil should be analysed to determine its pH, concentrations of mobile forms of phosphorus and heavy metals (Pb, Cd, Cr, Cu, Ni, Hg, Zn). The analysis of sludge shall measure its pH, dry matter content, organic matter content, ash, total nitrogen, N-NO₃, N-NO₄, total phosphorus, P₂O₅, K₂O and total calcium, however the frequency of such analysis is not specified. According to the same act, analysis of sludge should be performed by the organization responsible for its delivery for soil fertilization, and the analyses results should be submitted to the user in a form of accompanying certificate. The GOST further states, that the quality checking of sludge provide analytical laboratories, accreditation of which is and organized by Gosstandart of Russia. The control of contamination and sanitary indicators of soils is being done according technical regulations. Still, nothing is specified regarding record keeping and reporting activities.

Landfilling of sewage sludge is allowed to the municipal solid waste landfills, there is no formal requirement to dry it (if not pre-treated at waste water treatment plant, it could be handled together with other waste mass, e.g. joint composting of sludge and solid municipal waste), but general rule is that dry matter content should be not less than 20 %. Legal acts regulating landfill of waste in Russia are Sanitary Norms SanPiN 2.1.7.1322-03 "Hygienic requirements for the placement and disposal of production and consumption wastes", and SanPin 2.1.7.1038-01

²⁰Which is defined in literature as a condition of a chemical element in rocks, soils, and ores, when the element can easily go into solution and migrate.

²¹As defined by art. 4.1. of the Federal Law "On Production and Consumption Wastes".

“Hygienic requirements for design and maintenance of landfills for solid waste”. No specific provisions regarding incineration of sewage sludge are provided by the Russian legislator.

BELARUS

In Belarus, **main legislative and decision-making powers** in the realm of environmental and waste policies also are concentrated in the hands of two Ministries: the Ministry of Natural Resources and Environmental Protection and the Ministry of Housing and Utilities. *The Law on Waste Management* Nr 271-3 of 20/07/2007 defines principles of waste handling, state regulation and control issues (including competences of President, Council of Ministers, and local councils), waste classification and keeping waste register and statistics. According to the same law, formulation of waste plans and strategies, organization of communal waste collection, recycling and disposal, as well as operation of landfills are the responsibilities of the Belorussian local authorities. Further, landfilling of municipal waste, including sewage is governed by several other legal acts, amongst which a joint decree of the two above-mentioned ministries on *Approval of Regulatory Guidelines for Selection of Temporary Placement Sites and Mini-landfills for Solid Municipal Waste* Nr 14/8a of 19/01/2000.

If sewage sludge is to be used for **agricultural** and related purposes (**reclamation, horticulture, in green areas and forestry**), in Belarus the same norms and standards are being applied as in Russian Federation, namely State Standard GOST-R”*Nature protection. Soils. Requirements for sewage sludge use for fertilization*” 17.4.3.07-2001.

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