Sewage sludge handling in the Baltic Sea region in 2018

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Authors: Dmitry Frank-Kamenetsky

Layout: Laura Ramos Tirado

Preface

This document presents an overview of sewage sludge handling practices in the Baltic Sea Region based on the data reported by the Contracting Parties to the Helsinki Convention in 2019-2020, responding to the first call for the data on the implementation of HELCOM Recommendation 38/1. This overview is a living document. It reflects status as it was in 2018 and will be updated when new data is available.

Contents

Introduction

HELCOM Recommendation on sewage sludge handling was adopted by HELCOM 38-2017. The Recommendation identifies general principles for sustainable handling of sewage sludge and upstream measures to improve the quality of the sludge and paves the way for a regional dialog to elaborate regionally agreed parameters assuring maximum utilization of the valuable components of the sludge and minimize potential negative effects.

HELCOM Recommendation 38/1 stipulates the reporting on sewage sludge handling practices to the Helsinki Commission every three years, starting in the end of 2019 with data from 2018. Reporting format in annex to the Recommendation. In order to compile more comprehensive information on the use of sewage sludge in the BS region, PRESSURE 7-2017 agreed on an extended reporting format for the first reporting on HELCOM Recommendation 38/1. The extended reporting format contains three sections. Section A is information on measures undertaken to reduce input of contaminants to sewerages at source. Section B is report on the amounts of generated sewage sludge, handling practices and technical solutions applied to recycle valuable components of the sludge. Section C is information on concentrations of hazardous substances (including national limit values).

Compiled data has been utilized as a background information for the development of measures in the wastewater management sector as a part of the Regional Nutrient Recycling Strategy. The data is also intended to serve as a starting point to resume regional dialog on parameters assuring environmentally safe application of the sewage-based products.

The document presents analysis singularly based on reported data. Since, the data was not reported by all HELCOM countries, sewage sludge handling in some HELCOM contracting parties is not included in the overview. However, the overview is a living document which will be updated when new information is available.

Overview of the data reported by individual countries.

Relatively complete reports on sewage sludge handling practices were submitted by Estonia, Finland, Germany, Latvia, Lithuania, Russia and Sweden. However, almost neither report contains all requested information. Compilation of reported data on sewage sludge handling is given in table 1. Rough estimation of sewage sludge generation per capita in the Baltic Sea region can be made utilizing Eurostat population data on 1 January 2018. Annual sewage sludge generation per capita vary from 13 to 25 kg per year, with average 20 kg/y. Assuming, that connectivity to municipal WWTPs in 2017 in the region was about 80% (according to PLC-7 thematic report on effectiveness of measures to reduce nutrient input), annual generation of sewage sludge in the region can be estimated as about 2.5 mln tonnes. Due to incomplete reporting, the reported data does not allow to conclude on the use of sewage sludge in the Baltic Sea region, but for individual countries only. Figure 1 illustrates a summary of sewage sludge handling practices in HELCOM countries.

Table 1. Generation and application of sewage sludge in the Baltic Sea region. Please, note that the sum of sewage sludge use categories is not always equal to the reported value of generated sewage sludge.

Generation and application of sewage sludge (t dry weight)	**EE**	**DE**	**FI**	**LV**	**LT**	**RU**	**SE**
Total generation	33 371	1 747 230	138 000	24 591	49 876	119 491	210 881
Biogas generation	149	-	110 400	-	5 118	-	-
incineration, co-combustion	-	761 959	-	-	1 884	-	2 816
incineration, mono	-	496 463	-	-	-	81 187	-
landfilling	2 337	-	-	71	-	-	2 299
landfilling, mono	-	-	-	-	260	27 817	-
landscaping/green areas/land reclamation	15 807	122 615	72 900	656	1 679	6 408	54 039
agriculture/horticulture	9 485	280 325	53 800	12 475	13 592	-	82 288
forestry	-	-	-	-	-	-	137
other usages	5 742	85 868	11 400	10 926	1 494	-	57 295
Sum of ss use categories	33 371	1 747 230	138 100	24 128	18 909	115 412	198 874

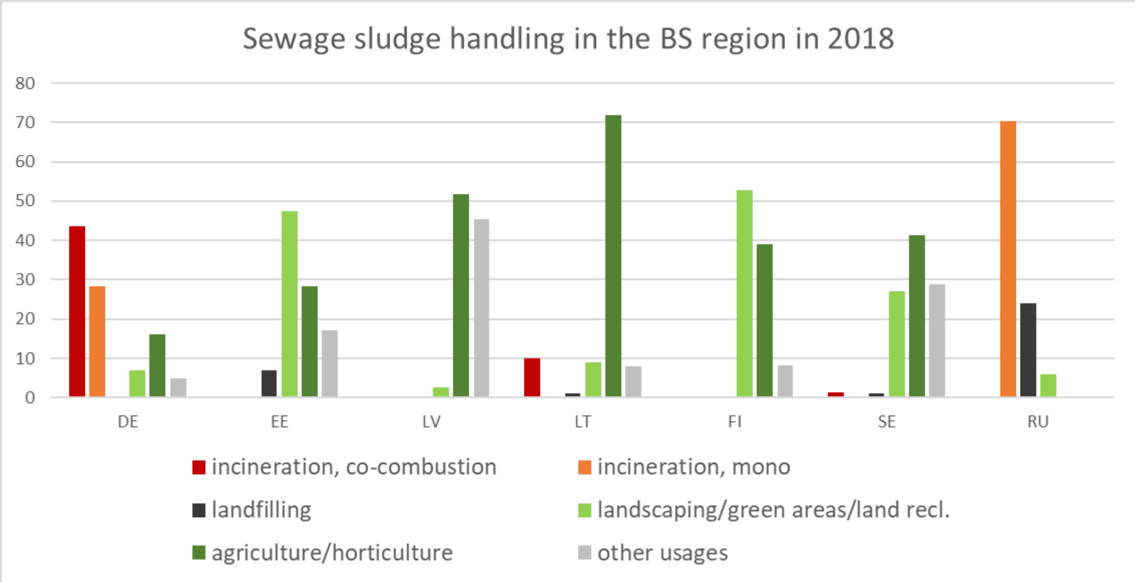

Fig 1. Sewage sludge handling practices in the Baltic Sea region. Percentage is calculated using the sum of reported sewage sludge use categories.

Data on nutrient content in sewage sludge, concentration of hazardous substances as well as national limit values set for several contaminants in soil and sludge are summarized in separate chapter.

Estonia

Measures at sources in Estonia are limited by onsite wastewater treatment in specific industries, to the extend needed, to reduce the content of pollutants in wastewater before it is discharged to the public sewerage system. In Estonia wastewater collection and treatment systems belong to municipalities. Thus, municipalities are responsible for ensuring that collection systems and treatment plants are operational and comply with respective requirements. At national level there are additional requirements aimed to prevent discharges of some hazardous substances to public sewerage systems and protect public sewerage systems ensuring quality of wastewater treatment processes.

More than 30 thousand tons of dry solids were generated by wastewater management sector in Estonia in 2018. Most of this sludge (about 75%) is used for landscaping/land reclamation and agriculture. Only minor amount of sludge (about 7%) is still landfilled, while other use constitutes of about 17%. There was no specification for other use given in the report. Very small amount of sludge, about 150 tonnes of dry weight, was utilized for biogas production. Estonia did not technically recover phosphorus from wastewater or sludge in 2018.

Provisions of HELCOM Recommendation 38/1 were implemented through setting national regulation on requirements for sewage sludge treatment and quality standards for treated sludge and soil where the sludge is supposed to be applied. In addition, quality parameters for production of compost from sewage sludge were set.

Finland

Measures at sources in Finland are regulated by environmental permits and industrial wastewater contracts. More than 130 thousand tonnes of sewage sludges were generated in Finland in 2018 and 80% of it was used for biogas production. More than 90% of sludge was applied for green areas, land reclamation and agriculture. Only about 8% of total amount was reported as other use without specification.

According to the report, provisions of the HELCOM Recommendation 38/1 were implemented in Finland through recycling of phosphorus in a form of various fertiliser products, assuming that concentrations of harmful substances were below limit values. Sludge handling required environmental permit according to the Environmental Protection Act. All fertilizer products should meet the requirements of Fertiliser Product Act and Decree. There was no technical recovery of phosphorus from wastewater, sludge or ashes in Finland in 2018.

Germany

Germany reported information on sewage sludge handling as status in December 2019. According to the report a number of measures to reduce releases of hazardous substance at source had been implemented such as fat (business), mercury separator (dentists) as well as general requirements for separate treatment of industrial wastewaters.

More than 1.7 million tonnes of dry solids were generated in Germany in 2019. Incineration was major method for handling sewage sludge in Germany. More than 70% of the whole generated sludge was incinerated, 60% of which was co-combustion and 40% - mono incineration. Less than 25% of sludge was applied for green areas, land reclamation and agriculture. Other use category constituted just 5%. In the report, the other use category was specified as production of other material or other types of thermal treatment. Germany did not report numeric data on the use of sewage sludge for biogas production, however pointed out that such treatment was rather common.

Implementation of HELCOM Recommendation 38/1 in terms of P-recovery measures was foreseen through new sewage sludge ordinance. In 2019 technical recovery of phosphorus from wastewater had been already introduced to practice and the work on P-recovery from sludge and ashes was ongoing. However, total amount of P-recovered from sewage was unknown.

Latvia

Latvia reported data on sewage sludge handing for three years 2016, 2017 and 2018. Unfortunately, neither report provides information on measures at source implemented in the country to improve the wastewater quality. In the reported period, total phosphorus removal rate from wastewater in Latvia varied between 85 and 87 percent.

Generation of sewage sludges was gradually reducing throughout the reported three years constituting respectively 25923, 24940 and 24591 tonnes dry weight annually. It demonstrates 5% reduction from 2016 to 2018. The main methods for sewage sludge handling for all three reported years remained application for green areas and agriculture. Proportion of these applications grew from 47% to 52% from 2016 to 2018. At the same time landfilling, which constituted only 6% of all sewage sludge in 2016%, was halved to 3% in 2018. Almost a half of the reported sewage sludge handling was other usage without any specification. However, the amount of sewage sludge falling in this category reduced from 52% in 2016 to 43% in 2018. There is no data on the use of sewage sludge for energy production reported.

Reported data does not provide clear picture of technical recovery of P from wastewater. The report plainly indicates that there are no examples of P recovery from sewage sludge or ashes. However, it is unclear whether phosphorus is recovered from liquid phase. According to the report there were wastewater treatment plants in Latvia charactered by higher phosphorus removal rate from wastewater than other. But the report did not specify whether phosphorus at these WWTPs was recovered from liquid phase in a form of pure phosphate or just sedimented to sludge.

The report provided detailed information on practices for sewage sludge hygienization in Latvia. A list of techniques for sewage sludge treatment and hygienization was given in the Regulation of Cabinet of Ministers No 362 (adopted 2nd May 2006). It included:

- Storage of raw sewage sludge for 12 months at least (cold fermentation);
- mesophillic anaerobic decomposition at a temperature of 35° C (± 3° C), minimum duration of treatment – 21 (± 5) days;
- thermophilic anaerobic decomposition at a temperature of 55° C (± 5° C), minimum duration of treatment – 10 days;
- thermophilic aerobic stabilisation at a temperature of 55° C (± 5° C), minimum duration of treatment – 10 days;
- composting during which the temperature inside the pile, 50 cm from the upper layer of the pile, shall be not less than 60° C for at least three days;
- lime treatment to pH 12 or more, the temperature must be at least 55° C for no less than two hours following the treatment;
- pasteurisation for at least 30 minutes at a temperature of 70° C;
- drying approximately at 100° C until the dry matter in the sludge mass reaches at least 70%.

Lithuania

Central Government is responsible for regulations to improve wastewater quality at source. Regulation on Wastewater Management (Order No. D1-236 of the Minister of Environment on 17-05-2006, amended on 04-04-2019) sets requirements for wastewater discharges (also to a sewage system). Industrial wastewater discharges to a municipal sewage system shall not exceed limit values (given in Regulation). In case, industrial wastewater discharged to a municipal sewage system contains hazardous (priority) substances, measures shall be undertaken by the operator of industrial waters to reduce and/or phase out such substances. The operator shall provide information on measures planned and the time limits for their implementation to the operator of municipal sewage system and to the Environmental Protection Agency.

Operators of municipal sewage systems have rights to define more stringent requirements for industrial wastewater discharges than those set in the Regulation. These requirements can be set when measurements (calculations) show that despite industrial wastewater quality complies with the Regulation, the requirements defined in the environmental permit for municipal wastewater discharges cannot be met. This might be caused by multiplication effect of contaminants release from several industries to one municipal sewage system. More stringent requirements can be also set by operator of receiving municipal sewage system when discharges of certain pollutants lead to contamination of sludge to an extent which prevents preferrable methods of its handling.

Actions to reduce leakage of nutrients during sludge handling processes are addressed in the amendment of Order 349 of the Minister of Environment dated 29 by June 2001(LAND

20-2001). The Order prescribes that the sludge treatment plants are designed in a way preventing surface run-off (including during flood events) discharging from plants territory directly to the aquatic environment. It concerns releases of other liquids generated at the plant which can be discharged to the environment only after appropriate treatment. Also, groundwater protection measures should be implemented on sewage sludge treatment sites by installation of a waterproofing layer.

About 50 thousand tonnes of sewage sludge was generated in Lithuania in 2018. About 10% of this sludge was used for biogas generation. The most part of sewage sludge, almost 80%, was applied in agriculture and green areas. This figure also incorporates sludge used in forestry. About 10% of sludge was incinerated at co-combustion plants and about 1% landfilled at mono landfilling sites. Other use category constitutes about 8% of the total amount of sewage sludge. According to specification this sludge was used for reclamation of landfills.

Methods for processing sewage sludge before its application were: aerobic stabilisation, anaerobic stabilisation, composting, stabilisation with lime, drying in temperature (100 °C or more), sludge pasteurisation (when temperature is more than 70 °C), sludge drying in grounds, filters, belt press filters, screw press, centrifugation, cylinder press.

HELCOM Recommendation 38/1 was implemented through realization of National Waste Management Plan for 2014-2020 which commits that sewage sludge disposal at landfill sites or sludge lagoons should have been discontinued after installation of appropriate regional sludge management capacities, but not later than by 1st January of 2015.

Also, the regional sludge management system was developed using the Cohesion Fund. 21 sewage sludge treatment projects were implemented, including construction of 10 drying and anaerobic digestion facilities, 2 sludge drying facilities and 9 composting facilities.

Russia

Russia provided information on sewage sludge handling in three Federal Entities located within the Baltic Sea catchment area: Saint-Petersburg, Kaliningrad area and Pskov area. However, this information provides general view to the most common practices applied for sewage sludges handling in this part of the country.

According to the report, various actions to improve the wastewater quality at source were undertaken. The Rules for Cold Water Supply and Sanitation were adopted at Federal level. The specified Rules established requirements to prevent negative impact of wastewater on centralized wastewater disposal systems (maximum permissible concentrations of pollutants in wastewater received into the wastewater disposal system and lists of substances, waste, materials prohibited for discharge into wastewater disposal systems). Compliance to these requirements should be surveyed by organizations operating sewage systems. Another type of measures was to assist to industries developing declarations about wastewater composition, plans for water protection measures, and to survey water management by water users to identify sources of excessive discharge of pollutants into centralized sewage systems. Water users which repeatedly exceeded permitted level of wastewater contamination were requested to adopt actions ensuring that the compliance of discharged wastewater to the requirements. For example, in 2018 in St. Petersburg, 1089 industries operated 1354 local WWTPs for onsite treatment of wastewater and stormwater.

According to the report about 120 thousand tonnes of sludge was generated in three above-mentioned regions of Russia. Most part of this sludge, about 70%, is mono-incinerated. About 6% of the sludge was used for green areas and land reclamation after dewatering and composting. The rest of the sludge was mono-landfilled. Sewage sludge was not used for biogas generation.

There was no new legislation introduced in Russia as direct implementation of the HELCOM Recommendation 38/1. However, introduction of new legal framework assuming the use of best available technics (BAT) resulted in adoption of technical guides:

- (BRIEF/ITS 10-2015) “Wastewater treatment using centralized wastewater systems in settlements and urban districts”, reflecting various aspects related to sewage sludge handling.
- ITS 9- 2015 "Waste neutralization by thermal method (waste incineration, in which, the parameters of BAT during the combustion of municipal sewage sludge are determined).

National legislation regulates hygienization of sludge through Federal decree (SanPin 3.2.3215-14) on sanitary rules and norms. The decree establishes requirements for complex of organizational, sanitary and anti-epidemic (preventive) measures, to prevent the occurrence and spread of pathogens. Sewage sludge treatment process includes dewatering, hygienization and composting during 5-6 months at constant temperature at least 60 degrees. In some cases, mechanically dewatered sludge dries at sludge fields for at least 3 years.

Sweden

Actions to improve wastewater quality at source were undertaken in Sweden. Any new connections to the sewage system must be reported and approved by the receiving WWPT. According to Swedish law, more stringent regulations should be applied to the activities considered as ”environmentally hazardous” within the application process for new environmental permits. Locally, most WWTPs monitored releases from already connected significant industries/businesses. Half of households in Sweden were connected to WWTPs complying to voluntary “Revaq certification”, establishing more stringent requirements for the sludge applied on farmland than current national legislation. This certification included activities aimed to reduce contamination of sewage water.

In addition to the effort at national level (e.g. within REACH etc) to phase out unwanted chemicals, and above-mentioned environmental permitting process, there were also regional and local initiatives aiming to reduce the use of, or substitute by ”greener” alternatives of certain pharmaceuticals (e.g. ”Kloka Listan” [link to older version in English]. Locally, all Swedish WWTPs which had been certified according to the Revaq framework were obligated to maintain active ”upstream work”. Such activities among other measures included public awareness campaigns and identification of significant polluters for continued dialogue to find ways to decrease their emissions to wastewater.

About 210 tonnes of sewage sludge was generated in Sweden in 2018. Most part of sludge about 40% was applied on agricultural land and almost 30% used for green areas and land reclamation. Quite large amount of sewage – almost 30% - was reported under category “other use” without specification. Landfilling and incineration of sewage sludge constituted about 1% each category from the total reported amount. Information on biogas production was not available for the reporting.

”Greppa näringen” was an initiative to overall reduce nutrient leakage from fertilizing. It can be considered as action to reduce phosphorus leakage, though it does not directly target sewage sludge. The project was supported by the Federation of Swedish Farmers, Swedish Board of Agriculture and a number of actors in the agricultural sector.

HELCOM Recommendation 38/1 was implemented in Sweden through introduction of voluntary Revaq certification for sludge application on farmland. Requirements of Revaq certification to sewage sludge quality were stricter than Swedish legislation, while current national legislation was more stringent than respective EU directive. National legislation calls for and focuses on the state of the receiving soil (e.g. metal content), use of the farmland (grazing cattle, type of crop), and yearly rates of metal accumulation, and frequency of sludge sampling. In 2019 Swedish government planned to investigate alternatives/feasibility for a (partial) ban of sludge application on farmland with focus on its effects on P recovery. There were installations for technical recovery of P from sewage operating mainly on project basis. No exact figures illustrating P recovery were available but supposedly the percentage was very low.

National legislation in Sweden does not set specific requirements for hygienization of sewage sludge. But hygienization is mandatory for Revaq-certified WWTPs which generate about 50 % of the total sludge amount. Revaq-certification provides a list of methods allowed for sludge hygienization such as long-term storage (> 6 months), various forms of heat treatment (time-temperature-based), urea addition, and other.

Nutrient content in sewage sludge, concentrations of hazardous substances and limit values

Data on phosphorus content in sewage is scarcely reported. Only Estonia, party Russia and Sweden provided this information. According to the reported data P content in sludge deviates from 13 to 30 kg/tonne with average value of about 23 kg per tonne. According to the data reported by Estonia, Germany, Lithuania and Sweden, concentration of phosphorus in sewage sludge used in agriculture ranges from 6 to 28 kg per tonne with average value 19 kg/tonne.

Table 2. Concentration of heavy metals in sewage sludge in mg/kg DS.

	Concentration in sewage sludge (mg/kg DS)			
	EE	LV	RU	SE
Cadmium (Cd)	0,82 (0-2,7)	1,32	11-41	0,741
Copper (Cu)	96,15 (3,2-230)	141	149-300	335
Nickel (Ni)	14,35 (2,6-25)	22,5	30-240	16,75
Lead (Pb)	13,34 (0,1-48)	35,7	64-137	16,11
Zink (Zn)	426,29 (100-1400)	639	557-720	561
Mercury (Hg)	1,66 (0,013-16)	1,29	0,58-1,05	0,459
Chromium (Cr)	36,66 (2,18-190)	48,4	49-270	-
Arsenic (As)	0 ,44 (0,44-0,44)	-	2,6-4,9	-

Data on contamination of sewage sludge by hazardous substances was reported by a few countries and limited by concentrations of heavy metals only. Some countries reported average value the other provided intervals of concentrations. However, the reported information in general gives an impression on the magnitude of sewage sludge contamination by heavy metals. Concentrations of hazardous substances in sludge are given in table 2.

Table 3 gives an overview of reported data on contamination of sludge used in agriculture. Most of the countries reported average values, except for Estonia, which also provided a range of concentrations. This information is manly limited by heavy metals concentrations. Only Germany reported some data on contamination by organic compounds. The comparison shows large variation of concentrations between countries.

Table 3. Concentration of hazardous substances in sewage sludge used in agriculture (mg/kg DS).

	Concentration in sewage sludge used in agriculture (mg/kg DS)				
	EE	DE	LV	LT	RU
Cadmium (Cd)	0,79 (0-1,14)	0,72	1,37	1,682	2
Copper (Cu)	40,44 (3,2-120)	279,21	139	102,71	132
Nickel (Ni)	8,02 (2,6-15)	23,42	23,7	15,225	80
Lead (Pb)	8,73 (0,1-18)	27,34	35,7	18,457	130
Zink (Zn)	231,25 (100-400)	760,55	616	491,797	220
Mercury (Hg)	4,04 (0,01-16)	0,36	1,34	0,439	2,1
Chromium (Cr)	15,54 (2,18-27)	29,09	48,9	-	-
Arsenic (As)	0 ,44 (0,44-0,44)	5	-	-	-
PAH (as BaP)	-	0,093	-	-	-
PCB (7)	-	0,043	-	-	-
Perfluorinated compounds (PFC)	-	0,067	-	-	-
PCDD/F	-	5	-	-	-
Adsorbable organic halides (AOX)	-	150	-	-	-
Iron (Fe)	-	33233	-	-	-
Thallium (Tl)	-	0,15	-	-	-
Cromium Cr(VI)	-	0,3	-	-	-

Limit values for soils, sewage sludge (SS) and sewage sludge used in agriculture reported by countries are compiled in table 4.

Table 4. National limit values for concentrations of heavy metals in sewage sludge and soils.

	Estonia		Germany				Latvia			Lithuania				Russia			Sweden
	soil (mg/kg DS)	SS in agriculture (mg/kg DS)	Limit value in soil (mg/kg			SS in agriculture (mg/kg TS)	soil* (mg/kg DS)	sewage sludge** (mg/kg DS)	SS in agriculture (mg/kg TS)	soil (mg/kg DS)		SS in agriculture (mg/kg DS)	SS in agriculture (mg/kg DS) (since 2021)	soil (mg/kg DS)	sewage sludge (mg/kg DS)	SS in agriculture (mg/kg TS)	soil (mg/kg DS)
			clay	loam /silt	sand					Sand	Clay/ loam						
Cadmium (Cd)	3	20	1,5	1	0,4	2	3-4	10,0	5,00	1	1,5	20	5	2	15/30	2/15	0,4
Copper (Cu)	50	1000	60	40	20	900	30-60	800	500	50	80	1000	500	132	750/1500	132/750	40
Nickel (Ni)	50	300	70	50	15	80	50-100	200	100	50	60	300	70	80	200/400	80/200	30
Lead (Pb)	100	750	100	70	40	150	75-200	500	250	50	80	750	150	130	250/500	130/250	40
Zink (Zn)	300	2500	200	150	60	4000	250-350	2500	1500	160	260	2500	1500	220	1750/3500	220/1750	100
Mercury (Hg)	1,5	16	1	0,5	1	1	2-3	10,0	5,00	0,6	1	8	1	2,1	7,5/15	2,1/7,5	0,3
Chrome (Cr)	100	1000	100	60	30										500/1000	90/500	60
Arsenic (As)						40									10/20	2,0/10	

*limit value depends on soil granulometry

**if this limit value is exceeded, sludge is considered as hazardous waste