THE IMPACT OF THE COUNCIL DIRECTIVE 86/278/EEC ON THE TREATMENT AND USAGE OF SEWAGE SLUDGE IN LATVIA

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ABSTRACT

The article provides the results of the project - assessment of sludge treatment technologies used in world's practice and detection of the most optimal option as solution for waste water sludge treatment in Latvia taking in account generated sludge quantities, humidity, pollution type and their concentration. There were investigated sludge properties and detected the price of such treatment methods as sludge prolonged storage, composting, mesophilic anaerobic treatment and usage for energy plants growing. It was stated that composting is comparatively cheap and safe method, limiting hazardous pathogens if it is realized as open windrows during summer. To improve existing situation of sewage sludge treatment and use which is similar in all Baltic republics, and taking into account the climate conditions in Baltic, were elaborated recommendations for accomplishing the proposal of new EC Directive. It was recommended to include the biological tests and their results as obligatory requirement in the certification of sludge as fertilizer and accept as obligatory action sludge hygienic treatment before its usage for growing food products and selling for manual spreading. On the bases of the real situation in Latvia - to remove the sludge long-term storage method from the list of recommended treatment methods and introduce new recommendations for sludge usage as fertilizer in energy plant growing.

KEYWORDS

The sludge; treatment; technologies; the hazardous pathogens; limits of chemical organic pollution of sludge used in the agriculture, new EC Directive.

1 INTRODUCTION

The aim of the Directive 86/278/EEC of 12 of June 1986 was to regulate the use of sewage sludge in agriculture in a way to prevent harmful effects on soil, vegetation, animals and man. Latvia, as new EC member state, took into account all EC legislation demands and elaborated a set of National regulations on their bases. The main proposals of Directive 86/278/EEC were included by regulations of Latvian Cabinet of Ministers - Regulation No. 362 “Regulations on utilization, monitoring and control of sewage sludge and its compost” from 02.05.2006 [1].

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Regulation stated that sludge shall be treated before being used in agriculture, forestry or land reclamation and must undergone biological, chemical, heat treatment or long-term storage. The appropriate treatment methods listed for reduction of fermentability of sludge and the health hazards are - long term storage (at least 12 months), mesophilic anaerobic treatment, thermophilic anaerobic or aerobic digestion, composting, pasteurization, drying (T =100^{0}C) and lime treatment.

2 WASTE WATER TREATMENT SLUDGE PRODUCTION AND USAGE

The Table 1 includes official statistic data [2] and shows the produced sludge quantity (by dry mass) during last years in Latvia and types of their utilization. The long term storage, composting and mesophilic anaerobic treatment are the main methods, which had been used for sludge treatment according the stated requirements.

Table1. Quantity of produced, treated and utilised sludge in Latvia during 2007-2009 (tons of dry mass per year).

Year	*Produced*	*Treated*	*Untreated*	*Used in agriculture*	*Composted*	*Incinerated*	*Stored*	*Other*
2007	*23259*	*18191*	*5068*	*8131*	*2066*		*8586*	*205*
2008	*22486*	*18093*	*4392*	*5249*	*2784*	*1,93*	*10943*	*927*
2009	*22 684*	*17 242*	*5442*	*7259*	*3402*		*9074*	*2949*

Summarizing the information on sewage sludge generation and usage during last five years within the project “Elaboration of eco-effective standard documentation package for implementation of waste water sludge treatment technologies in Latvia“ had been concluded that about half of produced sludge (by dry mass) are stored and not used in spite of stated requirements – after tree years of storage non used sludge must be disposed in a landfill.

The main reason for that, as it was defined in the project, is the allowance of the regulation to implement as the treatment method the long - term storage which is cheap and simple technology. In the same time farmers are not interested to receive smelling and wet sludge (there is less evaporation of humidity as rainfall in Latvia) which is hard to use as fertilizer with common agricultural machines.

3 CONTENT OF SEWAGE SLUDGE AFTER DRYING AND TREATMENT

3.1 Content of sewage sludge after drying

According the provided measurements [3] the sludge after dewatering has high quality (estimated from the content of metals) and is chemically uncontaminated even in the largest industrial cities Riga - waste water treatment plant “Daugavgrīva” and Liepāja - “Liepājas ūdens” (see Table 2).

Table 2. Content of sewage sludge in the waste water plants “Daugavgrīva” and “Rīgas ūdens”.

Parameter, concentratin	**Detected concentration in sludge from “Daugavgrīva”**	**Detected concentration in sludge from “Liepājas ūdens”**	**Limits stated by** **Regulation for highest class of sludge** **(I class)**	**Limit value for allowance to use the sludge in agriculture, forestry or sanitary land filling**
Cd, mg/kg	<0,1	1.97	≤ 2,0	10
Hg, mg/kg	0,24	1,84	≤ 3,0	10
Cr, mg/kg		95,97	≤ 100	600
Pb, mg/kg		64,13	≤ 150	500
Zn, mg/kg		739,75	≤ 800	2500
Ni, mg/kg		22,93	≤ 50	200
Cu, mg/kg		155,75	≤ 400	800
Phenol, mg/kg			Not regulated	Not regulated
4-Nonylphenol	32,3	0,83		
4-Nonylphenol monoethoxylate	8.58	2.19		
4-t-Octylphenol	0.537	0.024		
Pesticides, mg/kg			Not regulated	Not regulated
2,4-DDD	0.041	0.020		
4,4'-DDD	0.040	0,034		
4,4'-DDE	0.042	0.021		
∑4 DDT isomers	0.082	0.055		
∑6 DDT isomers	0.123	0.075		

Organic Tin, mg/kg			Not regulated	Not regulated
Didutyltin	0.160	0.059		
Dioctyltin	0.034	0.021		
Monobutyltin	0.120	0.054		
Tetrabutyltin	<0.006	<0.003		
Tributyltin	0.028	0.018		

3.2 Mesophilic anaerobic treatment of sludge

Provided measurements [4] of pathogenic bacteria amount in sludge from six Latvian sewage biological treatment plants shows that - the treatment of sludge using the mesophilic anaerobic digestion method did not fully provide sufficient reduction in bacterial pathogen amount (see *Figure 1*). Concentration of Escherichia coli and Enterococci (cfu g-1) in sludge treated in mesophilic regime decreased after 6 months of storage by 1.9 log10 and 3.4 log 10 thus corresponding to the desired level.

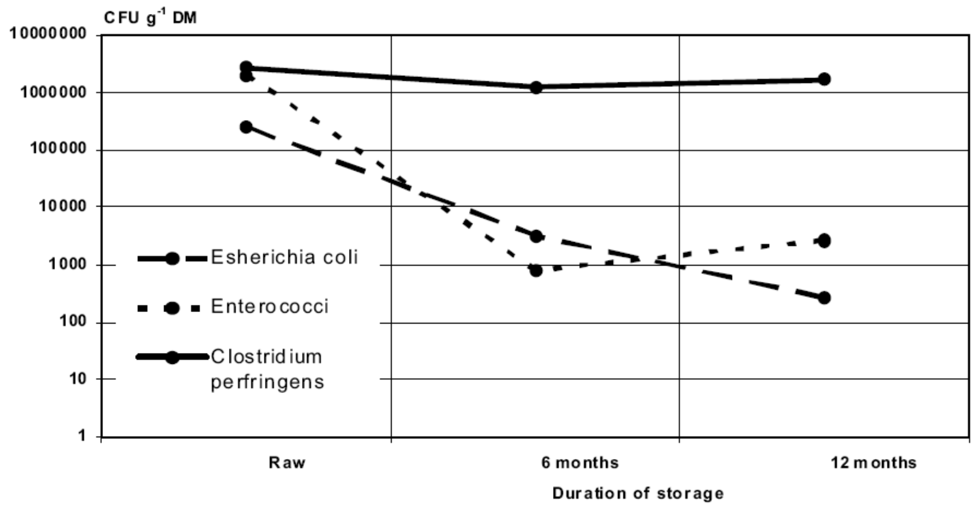

Figure 1. Change in pathogenic bacteria amounts in sludge treated by mesophilic digestion during storage [4].

In untreated sludge, such a decrease was reached (2.1 log10 and 2.4 log10) after 12 months of storage (see *Figure 2*). The presence of Salmonella spp. was not found in sewage sludge treated in mesophilic regime after 6 months of storage, and after 12 months of storage in untreated sludge. Amounts of Clostridium perfringens (cfu g-1) did not naturally change during both six and 12 months of storage.

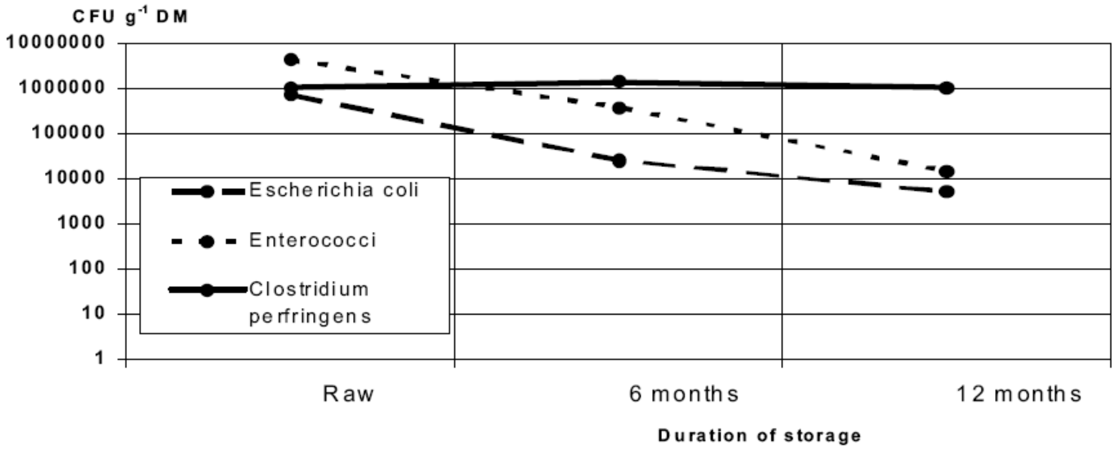

Figure 2. Change in pathogenic bacteria amounts in untreated dewatered sludge during storage [4].

3.3 Composting of sludge

The sludge composting in waste water treatment plants "Daugavgrīva "and "Liepājas ūdens" had been introduced during last years. Dewatered sludge from methane tank ("Daugavgrīva") or directly after drying ("Liepājas ūdens") was mixed with the filling material (peat, grain waste, woodchips, straw, leaves, etc.) in ratio 1:1.3 . For compost production large windrows were piled (width at the base - 3,4 m , height ~ 1,5 m). Material was periodically mixed to ensure sufficient oxygen content, as well to regulate temperature and humidity in the windrow. Sludge compost ripening time was ~ 1.5 - 3 months. The quality of sludge compost is approved by certificate containing data on heavy metals and agrochemical parameters. Table 3 presents the average data on sewage sludge composts prepared by Ltd. "Eko Terra" on the bases of digested and dryed sludge from "Daugavgrīva" and "Liepājas ūdens" using sludge directly after drying.

Table 3. Parameters of sludge compost prepared in Ltd. "Eko Terra" and "Liepājas ūdens".

Parameters	**Sludge compost from "Eko Terra"**		**Sludge compost from "Liepājas ūdens"**	
Heavy metals	**Lowest value**	**Highest value**	**Lowest value**	**Highest value**
Cd, mg/kg	1.1	2.5	1,1	1,5
Hg, mg/kg	1.3	1.7	0,77	1,26
Cr, mg/kg	49	80	54,6	75,6
Pb, mg/kg	24	130	37,7	54,3
Zn, mg/kg	515	820	392	508

Ni, mg/kg	15	40	12,4	15,4
Cu, mg/kg	148	260	78,1	110
Agrochemical parameters	**Lowest value**	**Highest value**	**Lowest value**	**Highest value**
Reaction of media (pHKCl)	6,42	7,14	5,68	7,77
Content of organic matter in dry mass (%)	37,1	45,0	51,9	66,3
Content of nitrogen in dry mass (g/kg)	13,0	29,0	19,9	27,0
Content of phosphorous in dry mass (g/kg)	8,0	19,0	9,44	16,5
Dry mass (%)	30,3	50,0	33,6	45,7

That means - composting process substantially reduces the content of heavy metals by mixing sludge mass with filling material; reduces the humidity of mass and improves the relation C:N:P.

There is not official demand stated by law to detect pathogens content in the sludge compost. Provided investigations by the scientists of the Institute of Microbiology [5] stated that the number of *Salmonella* and *Staphylococcus aureus* decreased during composting and are depending on composting conditions in the windrow. The most significant factor to produce the high quality compost is a season of the year, when the composting process was started [6].

4 ECONOMICS OF SLUDGE TREATMENT TECHNOLOGIES

To promote implementation of waste water sludge technologies in practice in order to ensure the formation of full water treatment cycle within country and to prevent created pollution by irrelevant storage and disposal of waste water sludge during the project were compared not only chemical and biological parameters of sludge after different treatment methods but reconcile the economical data of the implementation of revised treatment methods, too.

It was estimated that disposal of sludge containing not less than 15% of dry mass will cost 200 EUR per ton of dry mass. The production of sludge compost in open windrows according the revised conditions - ratio of sludge (15% of dry mass) to organic matter 1:1.3 will cost 250 EUR per ton of dry mass, but production of methane gas in closed reactors – 380 EUR per ton of dry matter. Those values are similar to reported in [7] and gives the answer to the question - why the main method of sludge usage is spreading of the sludge after one year storage on the fields (cost of method 160-210 EUR per ton of dry matter). Taking in account that Latvian law is not limiting the pathogen content for sludge used as fertilizer and till now biogas production is weakly supported by co-financing from power production, the selection of the treatment method is provided according financial possibilities of waste water treatment plants. Any water company problems either technological or financial, first of all are addressed to the expense of the management of sludge. During last years wastewater treatment sludge processing and management costs of water development projects in agglomerations above 2000pe in current financial planning period are identified as ineligible costs, so such measures are not included in the projects.

5 CONCLUSIONS

To improve existing situation which is similar in all Baltic republics [8] and taking in account the climate conditions in Baltic, Waste Management Association of Latvia elaborated some recommendations for accomplishing the proposal of new EC Directive:

- To include the biological tests and their results as obligatory condition in the certification of sludge as fertilizer;
- To remove the sludge prolonged storage from the list of recommended treatment methods;
- To accept as obligatory sludge hygienic treatment before its usage for growing food products and selling for manual spreading;
- To introduce new recommendations for sludge usage as fertilizer in energy plant growing.

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