ECOLOGICAL ASPECTS OF SLUDGE DISPOSAL IN SLOVAKIA

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Abstract: *There are monitored " Great Boom" by building of new sewage systems in Slovakia in last years, especially in areas, where was low connection to the public sewage systems. There is coming great amount of finances for building a new sewage system in Slovakia. But at first we have to find the general idea how to build this system with the view of technical and economical relations. Quantitative production of sludge from urban waste water treatment as well as the issue of their contamination has been continuously monitored in Slovakia since 1998. Basic principles, together with the monitoring, have been derived from the concepts of management of sludge from municipal wastewater treatment plants. Controlled land application of sludge was stipulated as the principal method of handling sludge. This process has not only been selected for being relatively the cheapest way for the final disposal of sludge, but is assumed to be the most acceptable option in the Slovak conditions, as well.*

Keywords: *sludge treatment, sludge disposal, environment versus sludge, legislation in EU and Slovakia, sewage sludge applications.*

Sludge definition and characteristics.

Sludge is a disposal from urban waste water treatment. We define is as a disperse system, which consists from the suspended, colloid matters. The main part creates suspended matters with characteristics concentration 5-50 $g.l^{-1}$. The sludge consistence is liquid till greasy. Sludge creates from 1 till 2% of waste water volume and contains 50-80% of primary pollution. The sludge as waste product from various steps of waste water treatment is non stabile, it is the reason of the next sludge treatment, before it´s using as a lateral stuff.

One of the most important sludge character is hygienic aspect. Waste water treatment sludge is a waste product, which comes into being in the process of waste water treatment and so underlies under Waste Low. This act allowed to be each stuff, which has at least one dangerous property to the dangerous waste. The producer of this waste is obligatory disposal the sludge as a dangerous waste. Lot of sludge produced on the WWTP has one dangerous characteristic. It is infectivity. Infectivity is caused by pathogen microorganism. Their amount depends from the geographic, climate and demographic factors. The main source of pathogen microorganism is excrement of ill people or animals. Majority of these microorganisms is disposal by the treating process, but without perfect sludge hygienic inspection, the small amount stays still in the sludge. By the using of sludge in agriculture can expose these pathogenic germs healthy of living organisms. By the pathogenic organisms which occurs in the waste waters belong:

- viruses
- germs (Salmonella, Escherichia coli)
- protozoas
- lateral worms

Sludge often consist toxic chemical matters, which we can classify as a dangerous waste. There are some organic matters and heavy metals. The source of heavy metals is Cadmium, Chrome, Copper, Mercury, Lead and Zinc. We can find this matters into the industrial waste waters from the metal and leader industry, from the wet and dry deposition.

Table 1. Waste Water Sludge Composition

WW Sludge Composition

	Primary sludge % solid matters	**Activated Sludge** % solid matters
Organic matters	60 - 80	62 - 90
Carbon matters	25 - 35	38 - 47
Nitrogenous matters	3 - 4	3 - 9
Hydrogen matters	3 - 5	5 - 7
Cellulose	3,8	7
Fats	7 - 35	5 - 14
Albuminous	19 - 25	19 - 56
Lignin	5,8	1

Legislation on sewage sludge management at European level

The European Waste Catalogue classifies the sewage sludge as a waste. The current European standard for waste is Directive 2008/98/EC of 19 November on waste and repealing certain Directives, more commonly known as the Waste Framework Directive (WasteFD). The adoption of this Directive has repealed its predecessors:

- Directive 75/442/EEC, of 15 July on waste.
- Directive 91/156/EEC, of 18 March on waste.
- Directive 2006/12/EC, of 5 April on waste.

The European Community adopted in 1975 the Directive 75/442/EEC of 15 July on waste, thinking especially that the disparity of provisions in the MS could create competition distortions in a common market and pretending, at the same time, to protect human health and the environment by establishing a Community system for waste management. Three years later, with the same purpose was adopted Directive 78/319/EEC of 20 March concerning hazardous waste. Subsequently, it was adopted the Directive 91/156/EEC of 18 March amending Directive 75/442/EEC on waste. In this case, the Council of the European Communities considered necessary both ensure the removal and recovery of waste and take measures aimed to limit the production of waste.

In this line, Directive 91/156/EEC binds MS to promote the prevention, reduction, recovery and use of waste as a source of energy. A few months later, in order to adapt the provisions of Directive 91/156/EEC on waste, the Council adopted Directive 91/689/EEC of 12 December on hazardous waste. Hence, the Directive states that the "sludge from wastewater treatment facilities" and "untreated sewage sludge or unusable in agriculture" may be considered hazardous waste if they have any of the properties listed in Annex III of the Directive. As a result of the disparity between the MS legislation concerning the removal and recovery of waste, the Commission adopted the Directive 2006/12/EC of 5 April on waste. It defines the concept of waste and sets out a clear hierarchy for their management. One of the highlights is the importance that assigns to the recovery of waste in general and therefore, also to sewage sludge recovery. Given the difficulties for the implementation of Directive 2006/12 due inter alia to the lack of specificity in any of its terms, the Commission states that it was necessary to review such Directive in order to clarify key concepts. The result was the adoption of the Directive 2008/98/EC of 22 November on waste and repealing certain Directives (WasteFD).

Taking into account the novel definition of waste proposed by the WasteFD, if sewage sludge is properly managed would be considered as a useful product instead a waste. Moreover, WasteFD updates the hierarchy in waste management and redefines the concept of recovery. Except prevention and elimination, all other operations are considered as recovery ones. In the case of sewage sludge, it is evident that recycling and other types of recovery are the points of interest. According the Directive, these operations must be favored by the MS through the adoption of National Plans of Waste Management.

Directive 1986/278/EEC, of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture The Directive 1986/278/EEC seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals and people. To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. The Directive specifies rules for the sampling and analysis of sludge and soils. It sets out requirements for the keeping of detailed records of the quantities of sludge produced, the quantities used in agriculture, the composition and properties of the sludge, the type of treatment and the sites where the sludge is used. Limit values for concentrations of heavy metals in sewage sludge intended for agricultural use and in sludge-treated soils are provided. The European Commission is currently assessing whether this Directive should be reviewed – and if so, the extent of this review.

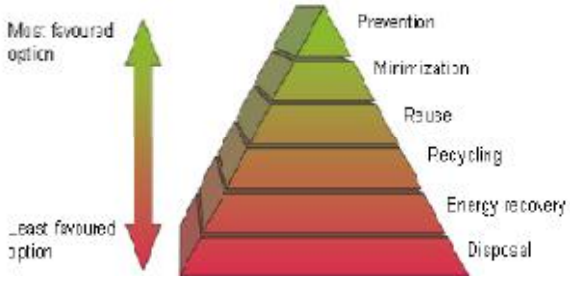

Fig. 1. Hierarchy of sludge management (Directive 2008/98/EC)

Legislation on sewage sludge management at State level , sludge disposal in Slovakia.

Today are in Slovakia valid two Acts according to the sewage sludge management.

- . Act no. 231/2000 Coll., of the Waste

- Act no. 188/2000 Coll. on application of waste water sludge into soil.

There are the methods of controlled application of sludge into soil are used:

- Direct application of sludge into soil as of the Act no.188/2003 Coll. on application of waste water sludge into soil
- Application as of the Act no. 136/2000 Coll. in wording of Act no.555/2004 Coll. on fertilizers, for example, as compost or soil-growing medium. In this case the product is subject to certification.

Overview of sludge production from urban wastewater treatment for wastewater treatment plant and carried out handling them in the time period of 2001 – 2009, as shown in Figure 2.

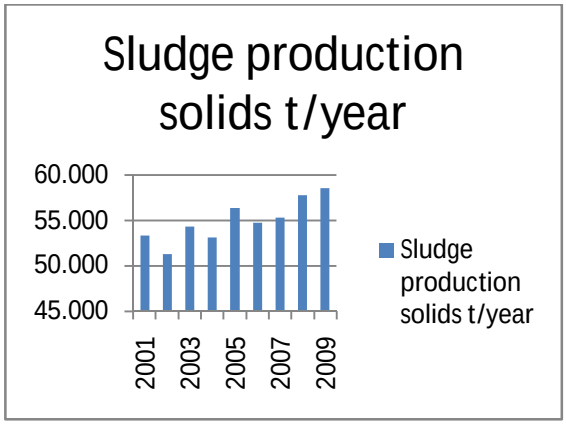

Fig. 2 Sewage sludge production in Slovakia

Pressure sewage

In the context of increasing requirements for wastewater treatment - the implementation of Council Directive 91/271 EEC on Urban Waste Water, the increase of sludge production by about 20-40% is to be expected in the near future. It is mainly the addition of sludge from small sewage treatment plants without significant involvement of industrial waste water, so a certain degree of contamination of sludge can be expected, which corresponds to the requirements of the process, limiting its application to the soil. [3]

Methods of sewage sludge disposal and hygienic inspection

The most using process of sewage sludge disposal in Slovakia is application into the soil. The controlled application must be done according to the valid legislation (Act no.188/2003 Coll. and Act no. 136/2000 Coll.).

Hygienic inspection is the technological process of sludge treatment, which is used in the case, when the sludge properties are not fulfilled the request of valid Slovak legislation. The main part of waste, microorganisms and viruses proceed after treatment into the sludge. By hygienic inspection improved the hygienic and sanitary properties of the sludge. We can use for it various methods as a pasteurisation, aerobical, thermophilic stabilisation, chemical methods-with using CaO, by gamma radiation or irradiation and incineration

Pasteurisation

Pasteurisation is a process, when the sludge is heated during relative short time on a temperature 70°C. Process of pasteurisation was established in Switzerland. The goal of it is elimination of germs and viruses especially of salmonella. Pasteurisation no replaced process of sludge stabilisation. It has to be combined with some other process of stabilisation. The process of pasteurisation is high effective by killing of various types of viruses especially on entherogerms and salmonella. It is no effective by thermo tolerant types of life forms as a certain types of viruses and spores.

Irradiation

There are only marginal experiences of irradiation of sewage sludge in the Europe. By the irradiation are most reduced salmonella and entherogerms. By the operational point of view is interesting, that the irradiated sludge has better

dewatering properties as a no irradiated sludge.

Aerobical thermophilic stabilisation

Aerobical thermophilic stabilisation was developed for the sewage sludge stabilisation. High level of aeration reinitiate by biological processes in such intensity, that the warmth generated by the process keeps the temperatures needed for the disinfection. We know two concepts of aerobical thermophilic stabilisation:

- aeration by clear oxygen
- aeration by air oxygen

By the using of clear oxygen, are the average temperatures about 60-80°C. The disinfection effect will be comparable with the pasteurisation and we can reach also better results then by pasteurisation.

When is the process supplied with oxygen from the air, the reached temperature is 40-60°C. In this temperature interval is the process of disinfection reduced and there is needed longer time for deactivation of pathogens. To find the optimal relation between aeration and temperature is not easy.

Composting

Composting is a process, which is depending on aerobical reduction of organic matter by thermophilic germs. Sludge is mixing with filling mass, what served to the increase of porosity for better aeration, for reduction of content of humidity and improve of relationship between C:N. There are often combined all three functions in one product. For example: straw, wood peel or household waste. There can be used also no degradable material as a plastic. It was developed many types of composting processes, so is really difficult to define average data for requested disinfection effect. Generally we can speak about two basic processes:

- Composting in composting lagoon
- Composting in bioreactor

By composting in composting lagoon is the sewage sludge in a role of filling mass. For requested sanitary effect is necessary to achieve the critical temperature for requested time distance. For elimination of salmonella in summer period is the critical time established on 6-7 weeks.

Lime treatment

Lime is often added into the swage sludge before dewatering. That caused increase of pH level, it can reached value from 9-13 in dependency of lime supply and sludge characteristics. Vegetative germ cells (coliform germs or salmonella) are fast reduced to nothing by value of pH from 9 till 10. According to Strauch and Berg, pH level has to be higher than 11,5 for reaching of requested efficiency. By these ph values will be destroyed most of viruses. Destruction of the viruses is not effected directly by ph effect, but by unlocking of free ammonia by pH level around 12. Complete destruction can be reached by adding of quicklime into the dewatered sludge. At this moment the temperature increase till 70-80 °C and all pathogens died very fast. The ain destruction factor is temperature.

Incineration

Incineration is one of the most effective process of sewage sludge treatment and sanitation. By the still growing amount of sludge it is a perspective solution for sludge disposal. But the process of sewage sludge incineration is not easy to realise in really conditions. The dewatered sludge contents about 75% of water. The complication is also high value of heavy metals in sludge. It can cause creation of vapours by higher incineration temperatures. One of the perspective methods of sewage sludge incineration was founded fluid layer. The fluid layer create thermal homogeneous environment, which

is reach on oxygen with strong abrasive influence on the sludge elements. The thermic degradation has a lot of advantages. At first it is volume reduction about 87%. The ash from the incinerated sludge is inorganic and mostly is it sterile matter. So we can use it in building industry. The heavy metals are strong bounded on sorbate and so they are not washed up. The gas emissions are deep under allowed limits. Also the process of thermic degradation is friendly to the environment. By the treatment on WWTP we can skip the sludge treatment from the technology of waste water treatment and replace it with thermic sludge degradation.

Conclusions

Wastewater treatment involves the generation of large volumes of sludge and other waste which management in an economical and environmental acceptable way has become a matter of increasing importance during the last few years. While the technologies and processes to reduce sludge generation are being widely studied, contributions relative to economic aspects are much more limited. However, when WWTPs operators face to the implementation of these technologies, not only technical aspects must be considered but also influence on environment regarded. Technical solution, economical aspect and environment friendly, that are the three highlights, which have to bee in balance. We can see, that is possible to use various methods for sludge disposal. But our goal is to choose the best alternative from the technical, environmental and last and but not least economical point of view. Each WWTP has its own sludge treatment and also specific condition for sewage sludge disposal and hygienic inspection. We have to find the optimal solution for the people and for the environment.

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