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Use of Sewage Sludge in Agriculture

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Abstract. For turning to a high degree of favorability of sludge from wastewater treatment plants, currently the reintroduction in the natural circuit of this waste is an urgent priority. Knowing precisely the composition of chemical and biological sludge from waste water in accordance with the law and the rules of their application, along with modern wastewater treatment appropriate technologies play a key role on environmental protection. Involvement by precise rules, the content of heavy metals in relation to the maximum permitted by law, translate in to particularly advantageous results in terms of environmental quality.

Keywords: sewage sludge, biochemical composition, fertilizer, environmental protection.

INTRODUCTION

In recent years, Romania is running several projects financed by the Structural and Cohesion Funds, regarding the modernization of urban wastewater treatment plants as required by EU directives.

Implementation of these projects raises many issues that have not yet been resolved. Use of sewage sludge in agriculture is a complex issue long discussed by stakeholders and to avoid the occurrence of adverse effects will be considered as physical, chemical and microbiological characteristics of sludge and soil properties, the ability of the plants to exploit nutrients from them and the danger of environmental pollution.

Analyses conducted to date in some treatment plants in the country, falls within the Romanian Order (344/2004) and EU Directive (86/278 EEC). Consequently, the use of sludge in agriculture is a realistic option, but requires a high degree of awareness among all stakeholders.

The concept of fertilizer in biological system (green) primarily requires the use of organic fertilization while limiting the mineral, conventional and use natural preservation and sustainable improvement of soil fertility (Olteanu, 2000).

The use of sludge resulting from municipal treatment plants in agriculture is considered the best option for EU environmental practices, but it is most vulnerable, being harder to insured having regard to the standards imposed by law and stakeholder pressure (Vaida , 2006).

One way to solve some of these shortcomings is the use of sludge as fertilizer for energy crops, an example being energy willow cultivated on flooded area, bringing significant economic benefits to agriculture and national economy (Bercu, 2011).

In order to protect and conserve natural resources, and thus the environment is necessary choosing the best methods, techniques, technologies and practices that reduce waste accumulation, through proper management of them.

MATERIALS AND METHODS

In this paper we proposed analysis of the main advantages and disadvantages of use in agriculture the sludge from wastewater, along with their chemical content and environmental impact.

Also, different values on the content of heavy metals and organic compounds in sewage sludge from different municipal treatment plants from region 4 SV Oltenia and potential measures to be used will be mentioned with the results.

There were analyzed sludge samples from four wastewater treatment plants in the counties of Gorj (Targu Jiu Motru) and Olt (Slatina Scornicesti), aiming at the classification of chemical compounds and organic allowable concentrations permitted by law.

Data were provided by the Environmental Protection Agency from and Gorj and Olt county.

We used the relevant legislation on wastewater and sludge treatment implemented by:

- Directive no. 86/278/CE on environmental protection, and in particular soil, when sewage sludge is used in agriculture;
- Joint Ministerial Order of. MMGA and MAPDR nr. 344/708/2004, approving technical norms of environmental protection and in particular the soil when sewage sludge is used in agriculture.

RESULTS AND DISCUSSION

Currently, an important issue, both for agriculture and population is the waste management and their integration into productive agricultural use. A complex problem posed by sewage, for the current practical, chemical and physical treatments, replace a number of harmful compounds with other less harmful but with implications still difficult to assess for our long-term health, while the sludge from treatment plants occupy increasing areas of land.

European standards, increasing interest in products made in conditions as less polluting and environmental resource management is a viable starting point for any activity.

By using sludge from wastewater is to be ensured to obtain increased yields, without affecting the quality index and lowering of plant resistance to diseases, pests and other natural factors.Such guidance is necessary to know the true state of supply of readily available soil nutrients and plant food consumption according to the annual planned production.

The quality of sludge is an important decision when you want to use it as fertilizer in agriculture.On the concentration of heavy metals and certain organic compounds, sludge samples taken from treatment plants must have sufficient quality, their values must be assigned to levels allowed by EU and Romanian legislation on the quality of sludge.

There are set by law the maximum permissible concentrations of heavy metals in soils on which sludge is applied, and maximum allowable concentrations of heavy metals in sludge destined for use in agriculture (Table 1).

Tab. 1

Maximum allowed contain of heavy metals in sludge from wastewater under EU and Romanian

Heavy metals	Limits allowed in soil mg / kg dry matter (pH>6,5)	Maximum allowable concentrations for sludge to be used in agriculture	Quantities can be added to the soil annually (limit values)
Lead	50	300	15
Cadmium	3	10	0,15
Chromium	100	500	12

Copper	100	500	12
Nickel	50	100	3
Mercury	1	5	0,1
Zinc	300	2000	30
Cobalt	-	50	-
Arsenic	-	10	-
PCB (polychlorinated biphenyl)	-	0,8	-
Polycyclic aromatic hydrocarbons (HAP)	-	5	-
Halogenated organic compounds (AOX)	-	500	-

In agriculture it can be used only sludge, which has been issued permit application by local environmental protection agency on the study of agrochemical specifically designed by the Agrochemical Soil Survey Office (OSPA) and approved by the Department for Agriculture and Rural Development.

The study should provide the conditions to be respected by the manufacturer and user of sludge to ensure environmental protection.

Manufacturers must provide for the user sludge, regularly, information on availability of sludge and sludge characteristics as general indicators (moisture, specific weight, pH, calorific value, etc.) and specific indicators (heavy metals, fertilizing substances, oils and fat, etc.).

The chemical composition of sludge resulting from the four wastewater treatment plants under study, namely the contents of heavy metals and some organic compounds, in rigorous experimental conditions applied, are presented in Table 2.

There has been collected several samples of sewage sludge resulting from wastewater treatment plants in the counties of Gorj and Olt (listed in Table 2) and were made sludge analysis as required by Romanian legislation (Order 344/2004).

The test results are indicative, but can be observed that sludge quality parameters meet legislative requirements on the use in agriculture.

Regarding the content of heavy metals in sludge samples collected, one problem arises from the treatment plant Scornicesti by the presence of high cadmium content.

In terms of organic compounds, in most cases has been recorded content overly large for polycyclic aromatic hydrocarbons compared to the maximum extent permitted by law.

Tab. 2

The chemical composition of sludge resulting from different treatment plants (mg / kg dry matter)

Treatment plant	Cu	Zn	Pb	Co	Ni	Hg	Cr	Cd	As	HAP	PCB
Treatment plant Târgu Jiu	127	553	79,8	<1	8,4	1,13	40,6	0,89	7,8	8,48	<0,001
Treatment plant Motru	53,6	313	50,7	5	24,4	0,41	30,9	<0,5	4,6	5,89	<0,001
Treatment plant Slatina	235	1370	157	7,2	43,2	0,347	46,3	0,5	<1	70,82	<0,001
Treatment plant Scorniceşti	197	1644	124	10,5	27,1	0,92	134	32,6	1,7	1,87	<0,001
Maximum permissible limit	500	2000	300	50	100	1200	500	10	10	5	0,8

Widely discussed and publicized, addressing all operators from water companies on the management of sewage sludge in a most fair way has attracted a number of projects, studies and comments.

Based on current legislation, with upgrading of the sewage plants, which include sludge treatment technology, we can speak of capitalization in agriculture, and that attracted a number of advantages and disadvantages (Table 3).

During 2003 - 2007 by County Environmental Protection Agencies, has been assessed the situation of sewage sludge in Romania, through questionnaires to all operators in the country (with a response rate of approx. 74%) regarding the sludge from the treatment plants that might be used in agriculture.

After analyzing and centralization of their data, it come out that from the total quantity of sludge generated, those used in agriculture ranged from 0.66% (in 2007) and 16.79% (2005) (Figure 1).

Tab. 3

Advanteges and disadvanteges of using sewdge sludge in agriculture

Advantage	Disadvantage
- the best option for recovery - most effective recovery of P in sludge (preserved phosphatic mineral reserves which are currently based on preparation of phosphoric fertilizers) - low investment costs - double benefit (operator, farmer) - is an old practice, simple and economic - replace conventional fertilizers, improving soil physical properties and organic. - provides fertilization of agricultural soils, a source of minerals for crops - recycles a number of chemical elements essential for plant growth - reduce the use of mineral fertilizers in agriculture.	- requires a very strict and complex monitoring of sludge and soils on which they have applied - involves advanced sludge treatment operation - very complicated logistics of storage and land application of sludge. - involves the introduction into the soil of certain types of pollutants, with potential risks to human and animal health. - existence of treatment plants with outdated technology, the vast majority of cities in Romania are missing or inoperative.

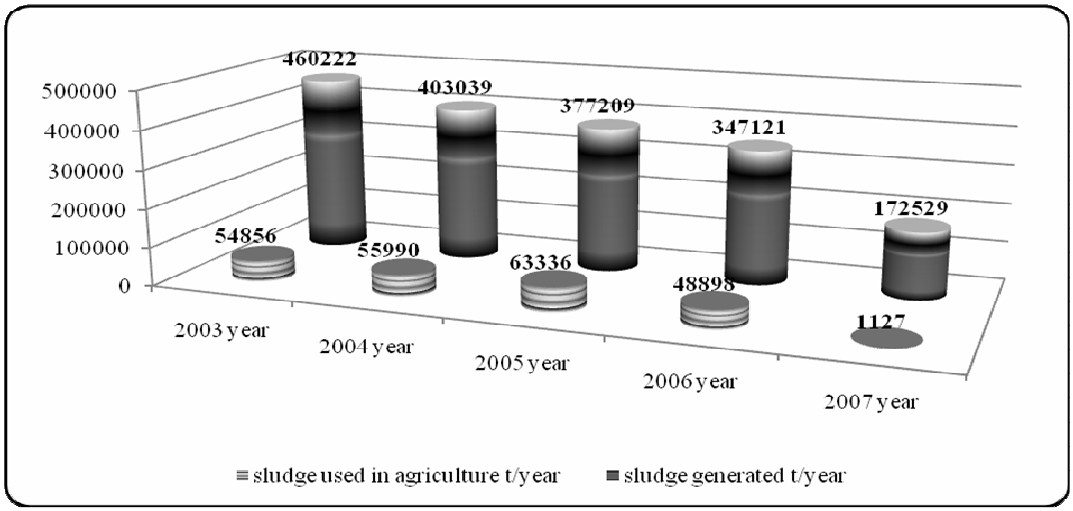

Fig. 1.The current situation of sewage sludge in Romania (source MMP)

Although the legislation established maximum limits for sludge of heavy metals (copper, zinc, lead, cobalt, nickel, mercury, chromium, cadmium) and organic compounds (AOX, PAH, PCB), there is no reference to the content pathogens in sludge, which is a factor that may influence largely restrictions on the use of sludge on agricultural land.

Because of its nutrient content and organic matter, sludge and mineral fertilizers can substitute and improve the physical properties of soil.

However, the presence of heavy metals, certain organic compounds and pathogens, limit its use in agriculture.

Also, the sludge may contain a number of pathogens (Salmonella, Koch bacillus, Escherichia coli, etc.), eggs and dangerous helmits.

For this they required a series of measures to destroy them by: anaerobic fermentation, pasteurization at 80 – 9000 C, liming, composting, thus ensuring uncontaminated sludge used as fertilizer in agriculture.

CONCLUSIONS

In the four treatment plants studied the sludge presented a properly quality, the parameters being analyzed over the limits allowed by Directive 86/278 EEC on the quality of sludge, except in very few cases. It requires upgrading wastewater treatment and sludge treatment more complex.

The analysis of advantages and disadvantages it can be clearly observed the double benefit of stakeholders (farmers and big water companies), but with a sustained effort and on a long-term.Under the financial aspect, the sludge resulting from waste sludge treatment is the most effective solution in terms of cost, as a source of nitrogen, phosphorus and organic substances and is therefore greatly advantageous if applied on agricultural land.

Spreading sludge on land is most often the most economical in terms of storage, providing a cheap source of nutrients.

It is necessary to raise community awareness about the benefits of reuse sewage sludge. In doing so, sludge can be further integrated in the waste hierarchy, rather than being stored in sludge deposits.

The changes identified in the future sludge management should aim to improve quality (microbiological, chemical, biological and physical) before recycling of sludge to eliminate profitable reuse impact on public health

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