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STUDY REGARDING THE USE OF SLUDGE AND EFLUENT FROM WASTE WATER PLANTS IN AGRICULTURE

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Abstract

In this paper was studied the possibility of use the sludge from wastewater treatment plant in agriculture. Under current legislation the sludge from treatment plants of Prahova county is divided into: sludge washing separator sludge from oil / water, sewage interception, sludge or emulsion desalination residues from stations of wastewater and drinking water treatment, refusals to grills / screens wastewater treatment plants, waste from desanding mixtures of fats and oils from separating fat from wastewater, sludge from industrial wastewater, sludge from municipal wastewater treatment solutions, sludge from regeneration of ion exchangers. In this study were determinate quality characteristics from the effluent and sludge: pH, BOD – total biological oxygen demand), BOD5, COD - chemical oxygen demand, SS - suspended solids. N - nitrogen, (TNK), P – phosphorus, specific resistance to filtration. This results show a possibility to use the sludge and effluent from wastewater treatment plant in agriculture according with national legislation. Testing time was about 12 weeks. It was calculated the risk factor of the process and has been studied the possibility of reducing the risk through appropriate measures.

***Key words**: sludge, effluent, quality, agriculture.*

INTRODUCTION

The use of sludge and wastewater in agriculture represents a permanent preoccupation because of the increasing need of water, nutrients and because of the environment protection norms imposed by the use of water and sludge (Management Plan, 2012). Sludge application on the soil needs protection of the soil according to the European legislation.
The directive 86/278/CCE establishes the framework of use in agriculture of the sludge from the wastewater treatment stations (Harris at al., 2005, Panaitescu at al. 2008) and this directive was transposed in Romania in the ministry order nr. 344/2004.
The application of the national legislation according to the European legislation prevents the appearance of harmful effects for the soil, encouraging the correct use of sludge in agriculture, establishing compulsory limit values for harmful components such as heavy metals (cadmium, copper, nickel, lead, zinc, mercury) in sludge and soil (table 1).
In this study have been determined the quality characteristics of the effluent from the municipal wastewater treatment stations and of the sludge corresponding to the treatment steps. The sludge has been deposited in sludge beds for their further use.

Table 1. Limit values of concentration for heavy metals in soil (mg/kg of dry matter)

Parameters	Limit values
Cadmium	20 – 40
Copper	1000 – 1750
Nickel	300 – 400
Lead	750 – 1200
Zinc	2500 – 4000
Mercury	16 – 25
Chromium	–

MATERIALS AND METHODS

The characteristics of the sludge that is to be used in agriculture have been chosen according to the applicable legislation (Directive 2000/60/EC/2000).
The pH was determined using the HANNA device, by direct measurement, the total solids

(TS) was measured with Standard Method EPA 2540B1 (table 2).

The limit values of heavy metals contained by the sludge and the methods used to determine them are presented in table 3.

Table 2. Physicochemical indicators and their methods of determination

Physico-chemical indicator	Determination method	Device
pH	Direct measurement	WTW
BOD	STAS 6560-82 and SR ISO 6060/96	VELP with BOD sensors
CCO	SR ISO 6060-96	DR 2800 spectrophotometer and Thermoreactor
SS	STAS 6953-81	DR 2800 spectrophotometer

Table 3. Limit values of the physicochemical indicators in sludge

Parameters	Analytical technique	Standard analytical methods	Limit values (mg/kg dry matter)
Cadmium	ICP-EOS	SR EN 11885-09	10
Copper	AAS	SR ISO 11047-99	500
Nickel	AAS	SR ISO 11047-99	100
Lead	AAS	SR ISO 11047-99	300
Zinc	AAS	SR ISO 11047-99	2000
Mercury	AAS with cold vapours	SR EN 1483-03	5
Chromium	AAS	SR ISO 11047-99	500
Cobalt	ICP-EOS	SR EN 11885-09	50
Arsen	ICP-EOS	SR EN 11885-09	10

Table 4. Value for water quality indicators

Value	Quality Indicator			
	SS mg/l	pH, pH units	BOD, mg/l	COD, mg/l
MAXIMUM LIMIT VALUE	60	6.5-8.5	25	125
Indicators value	58	7.0	18	118

Table 5. Value for sludge quality indicators

Indicators	Value
pH	7.0
Total suspended solids, %	3.21
Specific resistance to filtration, 10^{16} cm/g	1011

The water quality indicators and the analysis methods are presented in table 4.

The treated water samples were taken in accordance with SR ISO 5667-6:2009. The

physico-chemical indicators and the methods of determination are presented in table 3.
The sludge from the sludge beds has been injected in the soil in a testing area approved by the competent organisms. Initially, the sludge was applied instead of chemical fertilizer and for 12 weeks has been watched both the evolution of plants and the quality of the soil. The area where the sludge was applied had about 5000 m^2, the quantity of sludge applied being of about 12 tons.

RESUTS AND DISCUSSIONS

After taking samples of treated water and analysing them, their physicochemical characteristics were within the maximum limits imposed by legislation (table 4).
The effluent resulted from the wastewater treatment station has an acceptable quality for irrigations. So the water has been taken with the help of a mobile unit and transported for irrigations. For 12 weeks it has been used for the irrigation of the studied area.
The quality of the used sludge is presented in table 5.
After using the sludge and the wastewater, the carbon concentration in the soil increased to approximately 57%. The quantity of heavy metals did not overcome the maximum values. The values registered after 12 weeks were: lead-51.08%; copper-5%; zinc-1.81%; cadmium-11%; nikel-9.4%; manganese-2.1%.
The quantity of dry substance increased to the 2.4 t/ha, which shows a better value than the mature (unfertilized) soil of 1.1 t/ha.
The risk factor of the process was calculated and the possibility of reducing the risk was studied with adequate measure.
The risk factor associated and expressed in IU (importance units) was calculated as being 3 (*Panaitescu at all, 2013*).
The measures needed to reduce this risk are:
- the sanitation of the treatment sludge
- the mixing of the treatment sludge with supplements that can improve its quality, preferable within the composting process
- the usage of materials as substrates in the sludge composting process
- the avoidance of using volume agents so the soil will not be poor in organic carbon.

CONCLUSIONS

The usage of the sludge obtained from the wastewater treatment plant in agriculture can be a solution for the soil fertilization and for reducing the impact to the environment by reducing the quantity of existing sludge.
Using the injection in the soil and irrigating with the effluent from the wastewater treatment plant on an experimental area foe 12 weeks has shown an increase of the organic carbon concentration in the soil to almost 57%.
The heavy metals concentration was kept under control because the effluent and the sludge have had acceptable values of these pollutants.
The quantity of dry substance has been increased within the experiment with 2.4 t/ha, unlike of the unfertilized soil with 1.1 t/ha.
The risk factor associated with the use of sludge and of the effluent in agriculture was been calculated to be 3 IU. To keep under control the risks associated with this soil fertilization solution, there have been proposed measures for the sanitation of the sludge, adding additives, using the composting process, avoidance of the use of volume agents and the usage of substrates for the composting process.

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