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AGRICULTURAL USE OF SLUDGE FROM SEWAGE PLANTS, CASE STUDY COMUNA BARU, HUNEDOARA COUNTY

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Abstract. *The necessity for the management of the sludge from sewage has emerged as a result of rehabilitation of existing wastewater treatment plants and investments in construction of new wastewater treatment plants. Therefore, a rapid increase in the volume of sludge produced is expected. From the perspective of the operators sludge is produced incessantly and without being stopped and the raw material varies both during the day and seasonally, with the weather and the attitude of industrial units towards discharging the wastewater into public sewerage. For now, the public display little concern regarding sewage sludge but perceptions and concerns can change easy due to lack of information and even an hostility to the use of sludge in agriculture which is still the best practical option in terms of the environment and that involves lowest capital and operating costs.This paper comes in support of the idea of using sludge from wastewater in agriculture, after carrying out experimental studies on both the composition and quality of the slurry to correspond the legislative provisions, namely the Order of the Ministry of Environment and Water and Ministry of Agriculture no. 344/2004 approving the technical norms on environmental protection and in particular of the soil when sewage sludge is used in agriculture.*

Key words: *sludge, wastewater treatment, fertilization, agricultural soils*

INTRODUCTION

Sewage sludge can only be used in agriculture provided that legal provisions, namely the Common Order of the Ministry of Environment and Water and Ministry of Agriculture No. 344/2004 for approving the technical norms on environmental protection and in particular of the soil when sewage sludge is used in agriculture.

Thus, according to this order, for sewage sludge to be used in agriculture it must be within the maximum admissible values on:

- Concentrations of heavy metals in soils in which sludge is applied,
- Concentrations of heavy metals in sludge,
- The maximum annual quantities of heavy metals which may be introduced in agricultural soils.

If sludge from municipal wastewater contains organic and/or inorganic toxic compounds that do not allow exploitation in agriculture, energetic recovery can be considered.

Limits allowed for sludge to be used in agriculture are shown in the table below:

Table 1

Limits permitted for the sludge to be used in agriculture

Element	**Limit**	**Measurement unit**
Lead	900	mg/kg DS
Cadmium	10	mg/kg DS
Chromium	100	mg/kg DS
Copper	800	mg/kg DS
Nickel	200	mg/kg DS
Mercury	8	mg/kg DS
Zinc	2500	mg/kg DS
PCB	0,2	ng/kg DS
PCDD	100	ng/kg DS

This means a continuous control of sludge and soil.

Sludge from wastewater treatment has a water content of 97%. By centrifugation or filtration water content can be reduced to 70-80%, for this reason, the dehydration process is a precondition for economic transport and possible storage / disposal.

The requirements for re-use in agriculture involve a drying level greater than 90%, in order to ensure that sludge is not fermentable and can be stored in silos before re-use.

If the quality of sludge from the treatment plant is not using agricultural price the treatment plant will have to find other ways of disposing of sludge.

All types of energetic recovery such as: co-incineration in cement, incineration or combustion in a fluidized bed requires a sufficient sludge calorific value. This means that the drying process is to take place in a separate or in combination with an incinerator.

Thus, prior to incineration, the reduction of the humidity of raw sludge and avoiding aerobic stabilization or anaerobic fermentation which decreases calorific value of the material to be incinerated are recommended.

Legislation on waste management provides for a reduction of the biodegradable waste disposed of in landfills. Therefore it will not be permitted the disposal of unstabilized sludge on hazardous waste landfills.

These sludge from wastewater treatment will be used in agriculture (given the predominantly organic composition), if not endanger soil quality and agricultural products resulting. In order to be used as fertilizer in agriculture, the sludge generated in the biological stage of wastewater treatment plants must meet the conditions set out in the Joint Order of EWM and MAPDR no. 344/708/2004 and obtain permit for use in agriculture.

MATERIAL AND METHODS

Sludge quality is an important factor to determine feasible options for sludge management, so Table 2 presents the results of laboratory analyzes conducted during July 2015-May 2016.

Table 2

Quality parameters of sludge from the treatment plant Baru-Mare

No.	Parameter	Limit	Date	11.15	12.15	01.16	02.16	03.16	04.16
			M.U	Determined values					
0	1	2	3	4	5	6	7	8	9
1	pH		pH Unit	6,77	7,08	6,88	6,93	6,84	7,01
2	Moisture		%	81,5	78,05	58,7	80,98	82,8	99
3	Loss on ignition		%	63,73	60,7	57,6	58,77	61,8	65,15
4	Total nitrogen		mg/Kg DS	1,98	1,64	1,79	4,32	905,95	924
5	Total phosphorus		mg/Kg DS	7267	12117	6136	9226	10373	17464
6	Potassium		mg/Kg DS	9910	7904	3494	2691	3864	480
7	Arsenic	10	mg/Kg DS	9,8	9,44	1,76	5,7	5,1	1,91
8	BTXEN	10	mg/Kg DS	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
9	Cadmium		mg/Kg DS	3,23	2,69	1,2	4,55	3,04	0,42
10	Total cyanide		mg/Kg DS	<0,1	<0,1	<0,1	<0,1	<0,1	1,14
11	Cobalt	50	mg/Kg DS	15,9	11,5	5,8	17,2	8,36	0,99
12	Total chromium	500	mg/Kg DS	66	459	67,2	177	252	9,46
13	Copper	500	mg/Kg DS	272	378	159	420	250	48,2
14	Mercury	5	mg/Kg DS	0,85	1,48	0,56	0,83	0,9	0,14
15	Nickel	100	mg/Kg DS	59,8	95,7	95	98	65,2	6,74
16	PCB	0,8	mg/Kg DS	<0,01	0,12	0,51	0,58	0,44	0,71
17	Lead	300	mg/Kg DS	70,8	78,5	39,8	135	66,7	11,7
18	Sulphates		mg/Kg DS	1243	938,9	570	483	668,5	1638
19	Zinc	2000	mg/Kg DS	866	1398	52,3	131,7	108,3	167
20	Total PAH	5	mg/Kg DS	4,29	4,66	4,4	2,26	3,08	1,35

We aimed to establish a system of fertilizing sand depleted of nutrients in vegetation pots system that included the following samples:

- P1 - 100% mineral material (sand in the floodplain of the River Stream)
- P2 - 75% and 25% mineral material organic material
- P3 - 50% and 50% mineral material organic material
- P4 - 25% and 75% mineral material organic material
- P5 - 100% organic material

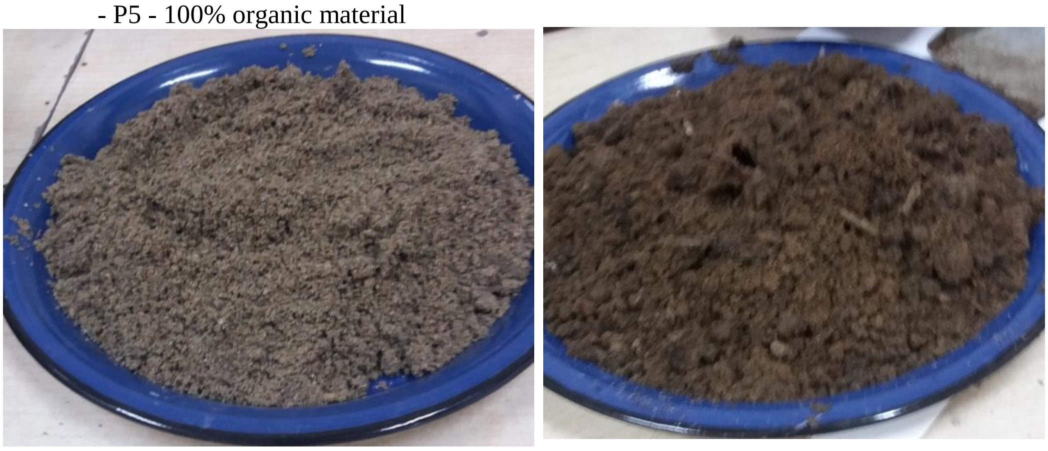
Figure 1. The materials before mixing (sand – left, sludge - right)

The amount of mixture from vegetation pots is 220 g. The mixing itself was done manually in a larger pot, depending on the required quantities.

The organic material consists of sludge from sewage from Baru, whose characteristics have been shown in Table 2.

RESULTS AND DISSCUTIONS

Fertilization is a major technological lever to conserve or restore soil fertility through the permanent renewal of the natural background of organic chemicals needed for plant growth and development.

The seeds used were oat and wheat, 10 growing seeds in each pot.

During the 30 days of the experiment it was observed that the number of growing plants depends on the amount of compost in each pot. It has been followed the period of emergence in each pot, the number of plants and the plant length.


Figure 2. Planting the seeds of wheat and oats, 10 in each pot

In Figure 3 (a, b, and c) are presented images of plants during germination, maturity and before harvesting. During germination can be observed as plants begin to grow up, depending on the proportions of material from the vessels. During the period of maturity and before harvesting is best seen their development, the plants having all the necessary conditions for growth. The results of the plant growth are shown in Tables 3 and 4.

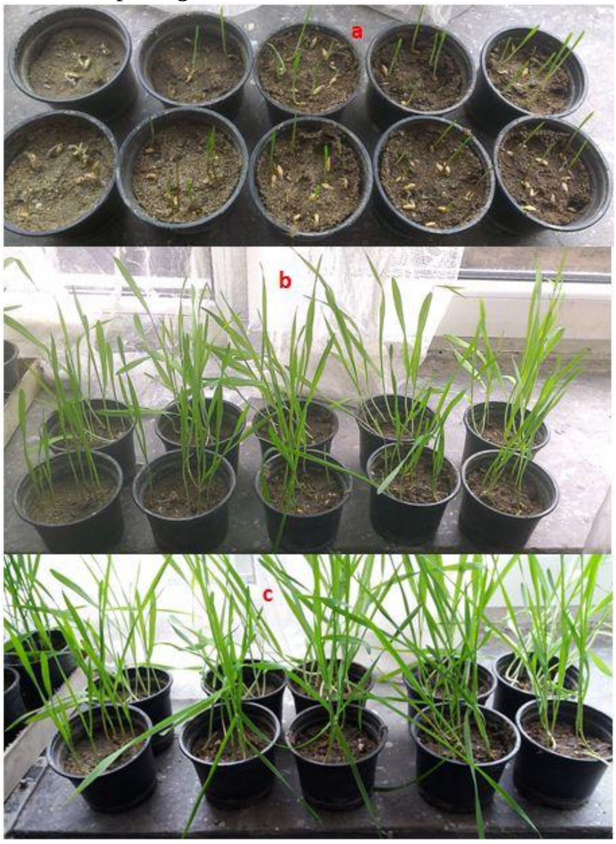

Figure 3. Images of plants in various vegetation stages

Table 3

Development of wheat

Wheat	P1	P2	P3	P4	P5
Day 5	Growth 50% of all	Growth 80% of all	Growth 50% of all	Growth 80% of all	Growth 60% of all
Day 12	Growth 50% of all	Growth 80% of all	Growth 50% of all	Growth 90% of all	Growth 70% of all
Day 19	Growth 70% of all	Growth 90% of all	Growth 70% of all	Growth 100% of all	Growth 100% of all
Day 30	Growth 70% of all	Growth 90% of all	Growth 70% of all	Growth 100% of all	Growth 90% of all

Table 4

Development of oats

Oat	P1	P2	P3	P4	P5
Day 5	Growth 50% of all	Growth 70% of all	Growth 80% of all	Growth 70% of all	Growth 80% of all
Day 12	Growth 50% of all	Growth 80% of all	Growth 80% of all	Growth 80% of all	Growth 80% of all
Day 19	Growth 70% of all	Growth 90% of all	Growth 90% of all	Growth 70% of all	Growth 90% of all
Day 30	Growth 70% of all	Growth 90% of all	Growth 100% of all	Growth 70% of all	Growth 90% of all

CONCLUSIONS

Following tests in laboratory and chemical analyzes performed in this phase of research can highlight the following:

- Sludge may be successfully used in the fertilizing of sand, thus avoiding the use of chemical fertilizers;
- For wheat growth is observed that the optimal mixture has been P4 (25% mineral material and 75% organic material);
- Oats shows that plants have developed best to the mixture P3; (50% mineral material and 50% organic material)
- Most plants grew best in pots where organic material was added;
- There were cases where the plants have developed during germination, but later due to adverse conditions or lack of essential elements in the soil, they dried.

The sludge can be used in agriculture, provided it does not contain elements such as heavy metals, which are then absorbed by plants and consumed by animals and humans.

It can be used for rehabilitation of degraded land, deposited in a layer of 0.5 m where the land is rehabilitated for use for agricultural purposes. It can also be used as material for loan planting trees or trees.

It can be used for rapid revegetation of dumps. It can be used in cities for parks and green spaces, planting flowers and beautifying the area and packaged and sold as soil for potted flowers.

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