FERTILISING AGRICULTURAL FIELDS WITH THE SLUDGE RESULTED FROM SEWAGE WATER TREATMENT STATIONS

UTILIZAREA NĂMOLURILOR DIN STAȚIILE DE EPURARE LA FERTILIZAREA TERENURILOR AGRICOLE

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Abstract: *The sludge resulted from urban sewage water treatment stations must be treated in order to be less harmful for the environment. The paper presents the chemical characteristics of the sludge resulted from urban and rural sewage water treatment stations. These chemical characteristics vary for both the fresh and the fermented sludge.*
This sludge can be used to fertilize the agricultural fields only after knowing the existent quantity of nitrogen, phosphorus and potassium in the soils.
The attempt to fertilize the agricultural fields with the sludge resulted from sewage water treatment stations is a component of the sustainable development of public health.

Rezumat: *Nămolurile provenite de la stațiile de epurare orăşeneşti trebuiesc fermentate pentru a fi mai puțin nocive şi pentru a nu fi dăunătoare mediului înconjurător. În lucrare sunt prezentate caracteristicile chimice ale nămolurilor rezultate din epurarea apelor reziduale orăşeneşti şi comunale. Aceste caracteristici chimice variază în cazul nămolului proaspăt şi a celui fermentat.*
Aceste nămoluri pot fi folosite la fertilizarea terenurilor agricole numai după ce se cunoaşte starea de asigurare a solurilor cu azot, fosfor şi potasiu. Încercarea de folosire a nămolurilor din stațiile de epurare orăşeneşti în agricultură se încadrează în conceptul de dezvoltare durabilă a salubrității publice.

***Key words*:** *sludge, sewage water treatment stations, agricultural fields, sustainable development, public health.*
Cuvinte cheie: *nămol, stații de epurare, terenuri agricole, dezvoltare durabilă, salubritate publică.*

INTODUCTION

The use of the sewage sludge for the fertilization of the agricultural lands is regulated through the Order 334/2004 on the environmental protection and especially on soil protection. This order:

- regulates the use of the sewage sludge in such a way as to prevent the hazardous effects on the soils, vegetation, animals and humans;
- establishes the limitative values for the heavy metals (cadmium, copper, nickel, lead, zinc, mercury) in the sludge and prohibits the use of the sludge in case the concentration of these metals in the soil exceeds the limitative value;
- establishes the obligation of treating the sludge before its use in agriculture;
- establishes the necessity of controlling the quality of the sludge and of the soils;
- obligates the users of the sludge to take into account the nutritional requirements of the plants so that the quality of the soils, of the surface and ground waters should not be destroyed;

Table 1

The quantity of the sewage sludge at the sewage water treatment stations

Year	No. of municipal stations	Wet sludge t/year	Dry sludge t/year	Used in agriculture t/year
2003	416	2,533,428.50	238,200.25	3,252.16
2004	416	3,428,943.64	357,057.04	5,330.40
2005	330	2,959,212.93	134,322.26	3,824.10

In order to comply with the requirements imposed by Order 334/2004, the quantity of the sewage sludge at the sewage water treatment stations must be registered.

MATERIALS AND METHOD

The municipal sewage sludge accounts for large quantities of wastes. They must be fermented in order to reduce the organic materials that they carry, making the sludge less harmful and easier to manipulate.

The purpose of its treatment is to alter its characteristics so that it stops harming the environment and be used for agricultural purposes, by maintaining its nutritive elements. At the same time, the reduction of its quantity is also targeted so that the storage surfaces could be as reduced as possible.

The sewage sludge contains initially 60-70 % of organic materials and 30-40 % of mineral materials. These percentages are reversed after the fermentation as follows: 40-50 % of organic materials and 50-60 % of mineral materials.

The fundamental characteristics of the sewage sludge are:

- the concentration in dry matter, which defines the treatment, transport and use conditions;
- the content in organic materials and in fertilizing elements, which must be known for the agricultural use;
- the content in toxic materials (organic pollutants, pathogenic organisms), which defines the possibilities and precautions of use.

The chemical characteristics of the sewage sludge vary according to the mineral, organic and animal origin of the substances they contain.

The analysis of the sewage sludge shows that it contains large quantities of organic materials and fertilizing elements (nitrogen, phosphorus, potassium) which justify its use for agricultural purposes. When the sludge is normal or homogenous and is discharged under normal agricultural practice, this use is not harmful for humans or for the environment.

The fertilizing value of the sludge comes from the nitrogen, potassium and phosphorus content. In general, the phosphorus and the nitrogen are found in sufficient quantities for the agricultural needs; usually the potassium is the one found in insufficient quantities. A ton of fermented and dewatered sludge contains a quantity of nitrogen equivalent to 60 kg of ammonium sulphate and a quantity of calcium equivalent to 150 kg of calcium carbonate.

Table 2

Chemical characteristics of sewage sludge, in % of the total of the solid mass in dry state

Substances contained by the sludge	Fresh sludge	Fermented sludge
Organic (volatile) substances	60-80	45-60
Total mineral substances	20-40	40-55
Non-soluble ash	17-35	35-40
Nitrogen (N)	2.4-3.5	3-3.3
Sodium nitrate	1-3.5	1.4
Phosphorus (P_2O_5)	1-3.5	0.5-3.7
Potassium (K_2O)	0.2-0.5	0.4
Silica (SiO_2)	-	15-16
Iron (Fe_2O_3)	3-2	5.4
Cellulose and other substances	10-13	10-13
Fat and oils	7-35	3-17
Proteins	22-28	16-21
Lignin	5.8-8.5	5.15-5.60

The nutritive substances are found in the soil as a result of the degradation processes of the minerals in the parental material with the exception of the nitrogen which is fixed in the nitrogen-fixing microorganisms found in the soil's air.

The substances in the soil appear permanently from the soil material, but are also lost either due to the plants consumption or to percolation, which means that the state of soils supply varies a lot in time and space.

The nitrogen has an important role in the plants' growth and development. The total content of nitrogen in the soils in Romania ranges between 0.02 – 0.35 % of which 90 % is found in organic compounds and 10 % in mineral compounds.

The mineral nitrogen in the soil can be found in the following forms:

- The unaltered ammonium, fixed in the clayey minerals in the soil;
- The ammonium in the soil solution (<10 ppm);
- The nitrates and nitrites in the soil solution (20-60 ppm), which represent the main source of nitrogen in the soil;

As far as the state of supply of the soils in Romania with nitrogen is concerned, we can talk about a nitrogen deficit, namely the soils can provide 50 % of the necessary nitrogen while the rest of 50 % must be provided by fertilizers.

The phosphorus is needed for the photosynthesis and in the metabolism, rushing the plants' development. The total content of phosphorus of the soils in Romania is of 0.04 - 0.074 % of which 50 % in organic compounds and 50 % in mineral ones.

The mineral phosphorus in the soil exists in three forms:

-The native phosphorus included in the crystalline network of minerals, that plants cannot access;

-The Phosphorus retained in the colloidal complex, alterable;

-The Phosphorus in the soil solution, directly accessible.

Potassium is an essential nutritive element in the plants' life, having a predominantly catalytic role. The total content of potassium of the soils in Romania is of 0.5- 2 % and can be found in the following forms:

-The potassium in the crystalline network of the primary and secondary minerals;

-The potassium adsorbed on the surface of the colloids;

-The soluble potassium on the surface of the soil.

In general, soils have a satisfying state of supply for a medium level of crops, but on some soil types some potassium deficits may be observed.

In order to establish the level of supply of the soil with nitrogen, phosphorus and potassium assimilable by the plants, we must take into account these elements found in a mobile state in a solution of lactate acetate of ammonium. The degree of nitrogen, phosphorus and potassium supply is analyzed taking into account the values presented in table 3.

Table 3.

Degree of supply of the soils with assimilable nitrogen, phosphorus and potassium

Degree of supply	$N(NO_3)$	Mobile P	Mobile K
Extremely low	≤ 0.5	≤ 4	≤ 40
Very low	0.6-1.0	4-8	41-65
Low	1.1-2.0	9-18	66-130
Medium	2.1-3.0	19-36	131-200
High	3.1-6.0	37-72	201-300
Very high	≥ 6.1	≥ 72	≥ 301

RESULTS AND DISCUSSION

Sewage sludge may be stored in holes, former sand or brick quarries provided that they do not produce an unpleasant smell or they do not pollute the wastewaters.

Another solution would be the dispersion of the rough sludge as well as the fermented and dewatered one on the agricultural lands. Still, before starting to use the sludge for agricultural purposes, it is important to test it for the toxic substances for the plants.

Nitrogen (N), phosphorus in the form of P_2O_5 and potassium in the form of K_2O have a fertilizing action. Besides these elements, the sludge also provides the soil with other organic substances.

The fertilizing value of the sewage sludge varies according to its treatment process.

The fresh non-fermented sludge contains numerous pathogenic organisms, which means that it must be used only for the fodder cultures. The land must be ploughed immediately after the dispersion. The fermented sludge contains less nitrogen than the fresh one, but the bacteria content is lower.

If the fermented and the fresh sludge are composted, sludge with higher fertilizing qualities will be obtained.

CONCLUSIONS

The concept of sustainable development of the public health leads to the use of the municipal sewage sludge for the fertilization of the agricultural lands.

As a result, instead of becoming a pollutant for the environment, the sludge contributes to the completion of the deficit of nutritive elements in the soil.

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