BRIEF PRESENTATION OF THE ORDER NO. 344/708/2004 OF THE MINISTRY OF ENVIRONMENT AND WATER MANAGEMENT AND THE MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT TO APPLY SEWAGE SLUDGE ON A STAGNIC PRELUVOSOL

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ABSTRACT

Within this paper there briefly presented the technical norms comprised in the Order for using sewage sludge and the evaluation criteria of soils in order to apply as fertilizer. There were studied the physical and chemical features of a stagnic preluvosol (stagnic luvisol) in order to asses the possibility to fertilize it by sewage sludge. The paper has an informative role for local farmers who can benefit by sewage sludge from Wastewater Treatment Plants of Craiova and Calafat.

INTRODUCTION

In agriculture, the food production process in close related to the soil, the agricultural production being influenced, first of all, by soil fertility, which means the ensemble of its morphological, physical, chemical and biologica features. The scarcity of chemical fertilizers, the increasing price of them and the increased demand of fertilizers for obtain constant and high yields conducted to the need of alternative materials that can be used as fertilizers. An alternative is to replace manure by sewage sludge from wastewater treatment plants.

MATERIAL AND METHOD

This is a documentary paper because the sewage sludge can be used in agriculture only after complying the legislative norms of EU Directive 86/278/CEE which was transfered in romanian legislation as Order no. 344/708/2004 of the Ministry of Environment and Water Management and the Ministry of Agriculture and Rural Development in order to comply with technical norms for environment protection, especially soil protection.

In this respect, the technical methodology of applying assumes the following steps :

1. The analysis of the residue left after wastewater treatment (sewage sludge) :

- for heavy metals – the Environment Agency (specialty laboratories) ;
- for nutrient content determination – the Bureau for Pedological and Agrochemical Studies Craiova (specialty laboratories).

On the basis of these two analysis bulletines there will be made the Special Agrochemical Study for sewage sludge application.

2. The documentation must be applicated to the Environment Agency for releasing the Application Permit.

3. Annually there are made analyses for soil monitoring after sewage sludge application.

Agrochemical properties of soils are a key factor in determining the degree of fertility, so their productive potential and also to develop measures to improve agrochemical and increasing fertility through the use of chemical and organic fertilizers. (Dodocioiu Ana Maria et al., 2013).

Sewage sludge applying in agriculture is a complex measure and, in order to avoid the appearition of unfavorable effects there must be accounted the physical, chemical and microbiological features of the sewage sludge as well as the soil properties, the plants capacity to use the nutrients from them and the danger of polluting the environment.

According to this legislative order, in order for sewage sludge to be used as fertilizers in agriculture there must be respected the maximal admissible limits on: heavy metals concentrations in soils where these materials are applied on, the heavy metals concentrations of the sewage sludge, the annual maximal quantities of heavy metals that can be applied on agricultural soils. The maximal admissible limmits for sewage sludge to be used as fertilizers in agriculture are given in the following tables:

Table 1.

The maximal admissible values of the heavy metals concentrations in soils where sewage sludge are applied (mg/kg of dry matter in a representative soil sample with a pH higher than 6.5)

Parameters	Limits
Cadmium	3
Copper	100
Nickel	50
Lead	50
Zinc	300
Mercury	1
Chrome	100

Table 2.

Maximal admissible concentrations of heavy metals from sewage sludge that are applied as fertilizers (mg/kg dry matter)

Parameter	Limits
Cadmium	10
Copper	500
Nickel	100
Lead	300
Zinc	2.000
Mercury	5
Chrome	500
Cobalt	50
Arsenic	10
SOC (sum of organogalogenatedcompunds)	500
APH (aromatic polycyclic hydrocarbures) – sum of the following substances: antracen, benzoantracen, benzofluoranten, benzoperilen, benzopiren, chrisen, fluorantren, indeno (1, 2, 3) piren, naphtaline, phenantren	5
PCB (polychloruratedbiphenols) – sum of compounds with numbers 28, 52, 101, 118, 138, 153, 180, according to Order of Water, Forests and Environment Protection Ministry nr. 756/1997 for aproving the Regulation on environment protection evaluation, published in Official Monitor of Romania, Part I, nr. 303 bis from 6 november 1997, with subsequent modifications.	0,8

Table 3.

The limit values for annual quantities of heavy metals that can be applied on agricultural soils on the basis of 10 years average (kg/ha/yr)

Parameter	Limit
Cadmium	0.15
Copper	12

Nickel	3
Lead	15
Zinc	30
Mercury	0.1
Chrome	12

There is forbidden the applying of sewage sludge when the concentration of one or more heavy metals from the soil overpasses the limit values written in table 1 and there must be taken measures in order for these limit values not to be overpassed as a result of sewage sludge applying.

On agricultural soils there can only be applied sewage sludge whose polluting elements contents do not overpass the limits written in table 2.

The maximal admissible quantities of heavy metals that can be applied on the soil on the surface unit and year are according with data from table 3.

There is forbidden the applying of sewage sludge or their delivery for applying on the following terrains:

- Lands designed for fruit trees plantation;
- Vegetable cultivation lands;
- Orchards, 10 months before harvesting or during harvesting.

The spreading of sewage sludge must be done only during periods when the acces on the land is normal and the incorporation of it into the soil can be done. Also, there must be accounted the following rules:

a). The nutritional needs of plants

b). Not to compromise the quality of soil and surface water.

c). The pH value from the soils where sewage sludge will be applied must be kept over 6.5.

The sewage sludge will not be applied on:

- Waterlogged lands;
- Frozen lands or covered by snow;
- Reclined lands exposed to erosion;
- Lands with the underground water under 1m depth at the date of applying.

The buffer zone limits that must be respected when sewage sludges are applied are:

- Exposed buildings (hospitals, schools, churches) = 200 m;
- Houses = 100 m;
- Lakes and rivers = 20 m;
- Roads = 10 m;
- Domestic wells = 50 m
- Public wells = 50-100 m.

There can be used in agriculture only wastewater treated sewage sludge that was thermic, chemically and biologically treated, by long term stocking or by other processes (ecotoxicological studies are needed) that reduce the sanitary and fermentation risks that can appear after their application.

Within the study there must be written the complying conditions for producer and user of the sewage sludge in order to ensure the safety of environment protection.

The wastewater treatment plants must give, regularly to the user information on sewage sludge characteristics according with the following parameters: pH, moisture, calcination losses, total organic carbon, nitrogen, phosphorus, potassium, cadmium, chrome, copper, mercury, nickel, lead, zinc, on the basis of analyses emmited by competent authorities.

There must be accounted the criteria for soil evaluation in order to apply sewage sludge according with 344/708/2004 Order. According with this order, we have studied a stagnic preluvosol from the south eastern part of Craiova town in order to establish the possibility of its fertilization by sewage sludge from the Wastewater Station Craiova. The analyses have been made after ICPA Bucharest methodology.

RESULTS AND DISCUSSIONS

The present studies have shown that the sewage sludge and not composted or composted household residues contain high quantities of organic matter and nutrients (nitrogen, phosphorus, potassium, bivalent cations like Ca and Mg). this is why their applying on agricultural soil could conduct to the increasing of the soil organic matter, of its capacity of buffering and cation exchange. Yet, the specialty literature warns that, in parallel with beneficial effects, often, appearsnegative consequences that severely limits the uncontrolled applying on soil of these materials. The negative effects are due because of some chemical compounds that are found in high concentrations in these materials, overpassing the maximal admissible limits (heavy metals, etc.) as well of organic toxic compounds, soluble salts that can pollute the environment (Calciu Irina, PhD thesis, ICPA Bucharest).

The contamination with heavy metals (Pb, Cd, Cu, Zn) is done because of primary sources (phosphorus fertilizers from natural ore, amendments, household trash, pesticides) and secondary sources that are introduced into the soil, nonferrous industry and aerosols deposition (Mocanu R. et al., 2013).

The studied stagnic preluvosol is characterized by a low content of thick sand, around 6% and fine sand content of about 25-29%. The silt content is about 30% and the clay content increases on the soil profile reaching 49% in Bt horizon. This size composition gives to the soil middle to fine texture on the entire soil profile.

Table 4.

The main physical features of the stagnic preluvosol

Horizon, cm	Size analysis (%)				
	Thick sand (> 2 mm)	Fine sand (2-0.2 mm)	Silt (0.2-0.02 mm)	Clay (< 0,002 mm)	Texture
Ao 0-25	7.3	25.4	33.5	33.8	TP
AB 25-40	5.9	27.8	29.9	36.4	TT
Btw 40-95	6.1	26.2	28.4	49.3	AL
Bt 95-170	4.4	29.2	29.6	46.8	AL
C >170	5.2	22.5	31.2	42.1	TP

Table 5.

The main chemical features of the stagnic preluvosoil

Horizon (cm)	Humus (%)	Nt (%)	P (ppm)	K (ppm)	pH (H_2O)	Ah (me/ 100gsol)	SB (me/ 100gsol)	T me/ 100gsol)	V (%)
Ao 0-25	2.11	0.105	15	82	5.4	8.1	18.6	26.7	70
AB 25-40	0.85	0.042	8	69	5.5	7.9	19.8	27.7	71
Btw 40-95	0.70	0.035	14	66	5.7	7.0	22.4	29.4	76
Bt 95 - 170	0.42	0.021	12	60	6.2	6.4	24.5	30.9	79
C >170	0.26	0.013	11	51	6.8	4.2	30.2	34.4	87

The soil is low supplied by humus and nutrients. The humus content is about 2% in the first horizon and it decreases abruptly under 2% in the deeper horizons. The total nitrogen is average or low and the phosphorus and potassium supplying is low and very low. The soil reaction is moderate acid in the first horizons and low acid in deeper horizons, the pH value slightly increasing on the soil profile from 5.4 to 6.8.

Because the stagnic preluvosol is formed on even terrains, slightly ridged and gas a silty clayey texture is classified as low degree affected (after soil evaluation criteria comprised in the legislation) for which the scarification work is recommended. Also, it has to be determinate the heavy metals content of the soil which must be compared with the one of the sewage sludge from the wastewater treatment plant in order to avoid toxicity.

This soil type has moderate acid reaction in the first horizons till low acid in deeper horizons so, the affection degree is moderate. It is recommended that the fertilization by sewage sludge to be done after the correction of soil reaction by lime applying.

CONCLUSIONS

Accounting the criteria of soil evaluation in order to apply the sewage sludge written in legislation, the stagnic preluvosol comply with these conditions only after the correction of the acid reaction.

Farmers from Oltenia zone must be informed on the possibility of using the sewage sludge from the wastewater plants of Craiova and Calafat.

The effect of fertilization is influenced by the soil nutrient content, by the crops nutrient need and by the content of the soil in macro and micronutrients.

Researches carried out at national level have demonstrated that the sewage sludge has almost the same nutritional features as manure. It enhances the physical and chemical properties of the soil: structure, water keeping capacity, cationic exchange capacity, biological activity, humus, nitrogen, phosphorus, potassium, calcium and magnesium content increasing.

The applying of the sewage sludge as fertilizer determines a significant increase of organic carbon and macroelements content in the soil. In the same time, the fertilization by sewage sludge has nor brought any significant change of heavy metals and there was not a pollution danger of the soil (Dumitru M., 2005 ;Mihalache M., 2006; Ilie L., 2007).

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