THE NEED OF TECHNICAL RULES CONCERNING ENVIRONMENT AND ESPECIALLY SOIL PROTECTION COMPLIANCE, WHEN SEWAGE SLUDGE IS USED IN AGRICULTURE

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Abstract: *Two dominant parameters are characterizing human society at the present stage of development: the rapid growth of world population, increasing food production requiring and advanced state of pollution and environmental damage, requiring increased attention to the quality of investment in kind. Agriculture has gradually become a complex task that is and will remain the safest and most appropriate means of food production for mankind, being real support of human biological existence, being an important source of raw materials for various industries producing of consumer goods. Imbalance between man and the environment, causes serious and irreversible ecological implications. Environmental problems have various aspects and with the development of society, need to be addressed with priority. One such problem is the residues from municipal wastewater treatment. There are multiple concerns for the elimination of these residues in the environment, without negative implications upon environment. The recycling of sludge through land acquired a major interest for many researchers, communities, local governments and not least for farmers. Wastewater treatment is by definition an activity in support of environmental protection, ensuring retention of pollutants in the form of sludge. To bring wastewater to the level of environmental activity it should be coupled with action for recovery / containment sludge from the process. For the specific case of sludge from wastewater treatment, their reintegration into the circuit is achievable in several ways, one of the most practical including application on agricultural land with the following advantages: recovery of large amounts of plant nutrients (humus, nitrogen, phosphorus, potassium, microelements etc.), decrease of mineral fertilizer quantities required to maintain high levels of agricultural production. Use of sewage sludge determines increase soil capacity to mineralize organic matter from wastewater and remediates physical, chemical and biological soil features. Expanding range of fertilizing resources through the use of other organic residues outside traditional scientific substances imposed knowledge of the chemical, microbiological and agronomic conditions of their use to avoid negative effects on the environment and consequently on soil resources Sewage sludge manufacturers must provide user with regular information on the availability of sludge and sludge characteristics according to the following indicators: pH, total organic carbon, dry matter, nitrogen, potassium, phosphorus, cadmium, cromium, copper, mercury, nickel, lead, zinc content.*

Key words: *sewage sludge, environment protection, soil, fertilizers*

INTRODUCTION

Imbalance between man and the environment causes serious and irreversible ecological implications of large economic implications damage particularly important. Environmental problems show various aspects with the development of society and need to be addressed with priority.

One such problem is the residues from municipal wastewater treatment. There are many concerns for the elimination of these residues in the environment, without negative implications. The recycling of sludge through land acquired a major interest for many researchers, communities, local governments and not least for farmers.

Organic waste materials derived mainly from urban activities are recognized as sources of environmental pollution and less as sources of nutrients with potentially beneficial effects on soil and crop production. Residual organic material with solid consistency from urban are varied and have a very complex composition which is determined by the source of sectors and activities: industry, sewage, street, households of citizens. Storage, recycling or use of such waste materials is one of the most difficult problems especially for large urban areas, but not unimportant either rural community. One of the possible solutions to eliminate those areas and give them a useful purpose is to introduce them as component technology tillage systems in different areas of agriculture, in terms of environmental protection and preservation costs reasonable.

J. Vegter (1993) shows that the main concern in soil protection is to maintain or restore its multifunctionality. The soil is considered multifunctional as long as the number of potential functions remain unaffected by human activities. Based on this principle, all human activities that have irreversible effects on soil, receive special attention as a restricting future land use for the existence of humans, plants and animals. One of the main objectives of the new science is **greening** the environment by human activities. By this term means using resources in a relatively new manner, the technical-economic systems model for the organization of ecological systems, the principle of closed cycles, involving recycling of resources. Promoting non-waste technologies or to start connecting with waste producing technology of recovery actions, is one way to avoid the ecological crisis and raw materials, saving about combining resources to protect the environment.

Wastewater treatment is by definition an activity in support of environmental protection, ensuring retention of pollutants in the form of sludge. To bring wastewater treatment to the level of environmental activity, it should be coupled with action for recovery / containment sludge from the process. For the specific case of sludge from wastewater treatment, their reintegration into the circuit in such matters is achievable in several ways including land application which is one of the most practical, with the following advantages: recovery of large amounts of plant nutrients (humus, nitrogen, phosphorus, potassium, microelements etc.), reduce the consumption of fertilizer required to maintain high levels of agricultural production, use organic substances mineralization capacity of soil.

Expanding range of resources through the use of fertilizers and other organic residues outside traditional, imposed scientific substantiation of the chemical conditions, microbiological and agronomic use them to avoid negative effects on the environment and consequently on soil resources.

MATERIAL AND METHOD

The legal framework for the use of sewage sludge in agriculture in Romania

- Joint Order of the Ministry of Environment and Water and the Ministry of Agriculture and Rural Development no. 344/708/2004 approving technical standards for environmental protection mainly soil, when sludge coming from wastewater is used in agriculture.
- Ministry of Agriculture nr.49/2004 approving technical standards on environmental protection and in particular the soil, when sewage sludge is used in agriculture.

Legislation on the use of sewage sludge in agriculture in the EU

The main EU legislation governing the management of sewage sludge when it comes to their use in agriculture are:

- Directive 86/28 EEC of 12 June 1986. The appearance of this law was necessary because Directive 75/442 EEC of the European Council does not cover the use of sewage sludge on the farm, but refers only to waste.
- Directive 78/319 EEC of 20 March 1978 related to hazardous waste and sewage sludge is applied to the extent that they contain or are contaminated with substances listed in the Annex to this Directive;
- Directive 91/676 EEC on preventing pollution of soil and groundwater with nitrates, establishes control over the spread sludge in areas with trends nitrogen eutrophisation and pollution by indicating maximum doses of nitrogen.

RESULTS AND DISCUSSIONS

Environmental and technical standards in particular of the soil, when sewage sludge is used in agriculture aimed at unlocking the agrochemical potential of sludge, preventing and reducing harmful effects on soil, water, vegetation, animals and human, in order to ensure the use correct this sludge.

Sludge from wastewater treatment plants in cities can be used in agriculture only if it complies with the technical rules set by law. To protect soils, which are to manage these sewage sludge, will be considered the maximum permissible concentrations of heavy metals in soil. So, sludge are applied on soils that can only fit in the maximum allowable heavy metal.

Table 1

Maximum allowable concentrations of heavy metals in sludge for use in agriculture (mg · kg^{-1} dry matter)

Parameters	Maximum admitance level (mg·kg^{-1}d.m.)
Cadmium	3
Copper	100
Nickel	50
Lead	50
Zinc	300
Mercury	1
Chromium	100

Soil pH higher than 6,5

The use of sludge where the concentration of one or more heavy metals in the soil exceeds the limit values is forbidden.

For environmental protection in generally and soil in particular, for the use of sewage sludge in agriculture, this must necessarily be within the maximum permissible limits for heavy metals and other parameters.

Table 2

Maximum allowable concentrations of heavy metals in sludge for use in agriculture (mg · kg^{-1} dry matter)

Parameter	Maximum admitance level (mg·kg^{-1}d.m.)
Cadmium	10
Copper	500
Nickel	100
Lead	300
Zinc	2.000
Mercury	5
Chromium	500
Cobalt	50
Arsenic	10
AOX (chlorinated organic compounds)	500
PAH (polycyclic aromatic hydrocarbons)	5
PCB (polychlorinated biphenyls)	0,8

Agricultural lands can only apply sludge polluting elements whose content does not exceed the limits listed above.

Maximum allowable quantities of heavy metals that can be applied to the soil per unit area per year does not exceed the limit values.

Table 3

Limit values for the annual quantities of heavy metals which may be introduced into agricultural land based on an average of 10 years (kg / ha / year)

Parameters	Maximum admitance level (mg·kg^{-1}d.m.)
Cadmiu	0,15
Cupru	12
Nichel	3
Plumb	15
Zinc	30
Mercur	0,1
Crom	12

For other pollutants that are not available in Tables 1,2,3 restrictions and use of sludge will be set by the territorial environmental protection authorities, based on recommendations from central authorities based on studies conducted by the National Institute of Research and Development for Environmental Protection and Research Institute for Soil Science and Agrochemistry, for each wastewater treatment plant based on analyzes of soil and mud.

In agriculture can be used only treated sludge, which has been issued permit application by the local environmental protection agency based on the agrochemical study developed by Agrochemical Soil Survey Office (OSPA) and approved by the Department for Agriculture and Rural Development. This study must provide the conditions for the producers and users of sludge to ensure environmental protection.

Application of sewage sludge on agricultural land is restricted by soil suitability. Land suitability assessment criteria in this case are related to several factors (topography, land slope,

texture, permeability, soil drainage, surface erosion hazard, flood, usable water capacity, depth of groundwater, edaphic volume, pH , cation exchange capacity and loading heavy metal).

In this context, it is important to remember situations that prohibit the use of sludge or delivery for use on:

- Land used for grazing;
- Land for cultivation of fruit trees
- Land for vegetable culture
- Land for fruit crops, 10 months before harvest and during harvest

The use of sludge should take into account the following rules:

- Spreading of sludge is only possible in periods in which normal access to land and incorporating sludge into the soil immediately after application are permited;

- To take into account the nutritional needs of plants;

- Do not compromise the quality of soil and surface water;

- The pH of soils that are to be applied sewage sludge must be maintained at values above 6.5

The manufacturer\'s obligations respectively of sewage sludge users refer to these conditions (aspects):

- to announce territorial authority environmental and mud users about potential pollutants existing in mud;

- to identify sludge users and areas that meet the conditions necessary agricultural use of sludge;

- to contact the user and to evaluate the possibility of using sludge;

- to provide sludge transport and spreading;

- to announce Environmental territorial authority if the initial conditions are changed, if the land change, or if the user subsequently refuse mud;

- choose solution for sludge disposal (incineration, storage) if failure to obtain authorization spreading;

- to keep up date records of: the amount of sludge produced and the quantities of sludge supplied to agriculture, the composition and characteristics of the sludge, the type of treatment carried out, the names and addresses recipients of sludge and sludge utilization sites

- to communicate the request to the competent authorities, information from registers

- to make special control, agrochemical research and monitoring soil on which sludge was applied.

The manufacturer is responsible for quality, quantity, transportation, spreading sludge on farmland, as well as its effects on human health and the environment after use. In sludge use areas are organized monitoring system of environmental factors (soil, water, plants), in addition to the national system.

Users of sewage sludge must notify the competent authorities and manufacturer of mud on crop rotation, to achieve incorporation of sludge into the soil in the same day to announce applied sludge and sludge maker if he changed his mind regarding the use of sludge.

In applying these technical rules are involving both the central competent authority (Ministry of Environment and Water Management, National Environmental Protection Agency, Ministry of Agriculture and Rural Development, Research Institute for Soil Science and Agrochemistry, Soil and Agrochemical Studies Office,) and the competent authorities at local level (Territorial Authority Environmental Protection, Agricultural Land Authority, Agricultural Consulting Agencies).

To obtain the allowance for application on agricultural land, sludge producer must submit competent territorial authority, at least one month before spreading period, data on:

- The amount of sludge generated and supplied for use in agriculture;
- Composition and properties of the sludge;
- The type of treatment carried out on sludge;
- Identification of sludge users;
- agricultural area location;
- data that is to be applied sludge;
- type of culture.

CONCLUSIONS

Sludge application on agricultural land has the advantage of being the least expensive method of neutralization and recycling of these organic wastes, while being consistent with the general concept of ecological recycling and neutralization.

So steps that can be taken in accordance with the legislation, are:

- prevention - through the application of "clean technologies" in activities that generate waste;
- reducing quantities - by applying best practices in each area of activity generating the waste;
- exploitation - through reuse, material recycling (composting / use in agriculture);
- disposal - by incineration (with energy recovery) and controlled storage.

Knowledge and compliance with these technical rules, ensure the proper use of fertilizer potential of sewage sludge in agriculture, and also a complete reintegration into the natural cycles of these organic wastes, fully respecting environmental provisions.

To maintain quality in terms of soil chemistry, is required: to enhance organic matter, to manage nutrients and pests efficiently, to prevent soil compaction and to diversify cropping systems .

ACKNOWLEDGEMENTS

This work was published during the project “Postdoctoral school of agriculture and veterinary medicine", posdru/89/1.5/S/62371, co-financed by the European Social Fund through the Sectorial Operational Programme for the Human Resources Development 2007-2013.

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