AGRICULTURAL RECOVERY OF MUNICIPAL WASTE WATER AND SEWAGE SLUDGE IN HUNGARY

Ferenc PETRÓCZKI
Department of Crop Production, University of West Hungary, Mosonmagyaróvár
petro@mtk.nyme.hu

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Abstract

The peoples of ancient civilizations already realized the importance of the organic matter content and -quality of the soil which has a considerable role on soil fertility, and they tried to return it. But the appearance of artificial fertilizers, the forced permanent yield increasing, the returning of the more and more decreasing proportion of biomass production of the soil, the increasing pesticide applications, the even less use of barnyard manure led to the organic matter content degradation of all genetical soil types in the second half of the XX. century. The agricultural crisis induced by the regime changing pointed to the untenabilty of the opposite extreme (minimized nutrient substitution, unprofessional technologies, disharmony between animal husbandry and plant production, etc.) with the even worse production indexes. The organic manuring has an overriding importance, because the soil gets not only nutrients with its help, but the soil structure improves and useful microbiological processes are induced. Therefore nowadays every possible way of organic manuring has vital importance on soil fertility preservation. Unfortunately for a long time we have been short of barnyard manure which is one of the most important kind of organic manures. As a result of the expanding public utilization of villages and towns increasing quantity of waste water and sewage sludge form. Their storage and placing - similarly to other kind of wastes, is getting even more difficult. The agricultural recovery offers an obvious solution. This article would like to help in the responsible execution of the recovery of the waste waters and sewage sludges in agriculture with the survey of the current Hungarian environmental legislations.

Keywords:waste water, sewage sludge, recovery, disposal, municipal liquid waste

1 Introduction

In consequence of water use both in the production and the consumption spheres waste water is produced. Its gathering, draining, treating have to be provided for, as well as the reusing possibilities of the sludge forming during the waste water treatment process or disposal to protect human health and the environmental elements.

The level of piped drinking water supply of the Hungarian population is the same as in Europe's other countries, but on the field of sewerage network and waste water cleaning Hungary is far below the European standards [1].

More than thousand is the number of the settlements, where the water conduit network has already been built, but the drainage and treatment of waste water has not been solved yet [2]. The quantity of drinking-water supplied for the Hungarian households was between 388-579 million m3/year in the last decade. 30 per cent of this quantity got into the sewerage so got some kind of treatment [3]. To close the widening price gap of public utilities the government made a decision on the National Waste Water Drainage and Treatment Realization Program ("A" Program) in 2002, which is in harmony with the legal regulations of the European Communities and the Hungarian geographical, geological and hydrogeological conditions. It specifies until 2015 the schedule of the drainage and treatment methods for settlements larger than 2000 IE (inhabitant equivalence) led by the public sewage system [4]. In connection with the regions which can not be supplied economically with public waste water drainage and treating utility the government decided on the Individual Waste Water Treatment National Realization Program ("B" program) in 2003 [5].

The "A" and the "B" Program will have to be completed in the near future with the municipal liquid waste program (the quantity of municipal liquid waste will be even less keeping up with the sewerage and waste water

treatment program). Concerning to this program there are regulations in the National Waste Management Plan [6]. The municipal liquid waste means the waste waters led in the public sewerage network and the waste waters which are not led in the waste water treatment plant. These waste waters come from the draining of waste water reservoirs of buildings suitable for human staying, from other local public utility settlement equipment and from economic (but not productional) and technological activity [7].

The treatment of waste waters and sewage sludges, to reduce their quantity, the repeated reuse of the treated waste water is a worldwide problem. The problem of their recovery and harmless disposal is in the centre of the experts' interests, because their quantity is increasing continuously in spite of the developing technologies and at the same time their reusing possibilities are narrowing.

2 Quantity and quality of sewage sludge

Waste water forms during the water-use. All discharged sewerage requires purification, because there are more or less organic and inorganic pollution in them and they change the physical, chemical and biological water characteristics.

The quantity of waste water originating from the households and social use changes cyclically depending on the parts of the day. It depends on the habits of the population and the number of commuters. 150 litre/inhabitant/day waste water quantity can be calculated per settlement, 14 hours can be taken into account for downflow. In those regions where the number of bathrooms per capita is less, the quantity of waste water is 100 litre/day and the time of downflow is 12 hours [8]. During the waste water treatment process three phases can be separated:

- I. phase or mechanical (the solid, filterable or precipitable contaminating materials are removed with machines and equipment);
- II. phase or biological (its goal is to remove the not precipitable colloids and the soluted organic matters from the mechanically purified sewerage through induced biological processes and with the aid of microoranisms);
- III. phase treatment (the salts originated from the secondary treatment, respectively the compounds containing nitrogen and phosphorus in the waste water are removed from the mechanically and biologically purified sewerage) [3][8][9].

The volume of sewage sludges isolated during the waste water treatment process are approximately 0,5-1 per cent of the waste waters [10][11]. Recognizing the importance of environment protection it is obvious that the problem of sewage sludge and waste water disposal and recovery have to be solved, moreover the drastic increase in the proportion of disposal joining the recovery of sewage sludge is necessary [6].

As a waste from the waste water treatment in Hungary 220-230 thousand tons/year sewage sludge originates in dry weight forms. 65-70 per cent of this quantity get into the landfill sites or rubbish dumps, 25-30 per cent is recovered by the agriculture, the fate of a few per cent is unknown. This part has potencially multiple risk on environment than the disposal carried out in regulated, controlled conditions [4].

Examining the consistence of sewage sludges they are liquid, mud- like substances. They can be originated from productional (industrial, agricultural, service industrial) and municipal (communal) processes [12][13].

Examining their quality Turovszkij [11] determined that the raw sludge has 92-95 per cent moisture content, its solid phase contains 60-75 per cent organic substances. The live sludge has 96,5-98 per cent moisture content and its solid phase contains 70- 75 per cent organic substances. The dry matter content of the so called wet sludges (raw- and digested sludges with liquid consistence) is mostly between 2-12 per cent, their element compound can fluctuate between wide ranges.

Wet sludges with plant-macronutrients contain some nitrogen and phosphorus which come to only a few per cent of the dry matter; their potassium content is relatively poor. Their average N-, P-, K-content is approximately 5 per cent of the dry matter [1].

Whereas the substances removable with decantation during the waste water treatment concentrate in the sewage sludge, therefore besides the useful substances harmful, toxic compounds and microorganisms also can be found there [13]. Their quantity can be dangerous if too much productional waste water of the badly or not well treated kind mixes into the municipal waste waters. These are extremely dangerous, due to their adsorption and accumulation they may have chronic effects even at low concentration [14].

Several examinations prove that there can be a lot of nutrients in sewage sludges which are easily uptakeable by plants. In sewage sludge besides pathogenic microorganisms (streptococcus- and clostridium species, salmonellas, protozoas and other pathogen organisms) live useful bacteria groups in considerable number which are essential

for the sustainability and improvement of soil fertility and the decomposition of wastes and at the same time they function as antagonists of pathogenic organisms [13].

Legally and in wide range applied solutions for the problems of waste water and sewage sludge placing are: incineration, disposal in landfills or recovery in areas to be recultivated, tree plantation, other plantation, arable land, etc. [15][16]. There are also some other kinds of disposing possibilities (in earthworm- breeding, as fodder, in water systems and in industry) but these methods can have only local importance because of their obvious limits [13]. Earlier the sea dumping and sludge recovery in existent forest were allowed, but nowadays these methods are prohibited by international and Hungarian regulations [17][18].

On the basis of these facts it is easy to understand, that 50-75 per cent of the 7,7 million tons (dry weight) of sewage sludge originating in the Member States get to some kind of landfills and 25-35 per cent of the amount is placed in agricultural land [17]. In the USA and Canada, despite the increasing costs, agricultural utilization has become the major method of sludge disposal [19][20].

3 The legal background of agricultural waste water use

On the basis of Act XLIII of 2000 on Waste Management and Act LIII of 1995 on The General Rules of Environmental Protection the government rules the terms of agricultural use of waste waters and sewage sludges with the following decrees which may be approximated with the legal instruments of the European Communities [21]:

The aim of 33/2000. (III. 17.) Government decree is in connection with the activities concerning to the underground water quality. Its goal is to avoid the load of the underground water, to prevent the pollution of underground water and geological formation, to reduce and terminate the damage and the pollution occured above the limit value, to make rules for the sake of them and to strive for the application of the best available technology [22].

The goal of the 49/2001. (IV. 3.) Government decree is to protect our surface and underground waters from nitrate pollution of agricultural origin and to decrease the existing nitrate pollution. It is may be approximated with the Council Directive 91/676/EEC [23].

The 50/2001. (IV. 3.) Government decree controlls among others the conditions of using water from sewarage and treated water and treated sludge, their location, distribution to agricultural area so as their harmful effects on the soil, surface and underground waters, on human beings, plants and animals can be avoided. This decree is may be approximated with the Council Directive 86/278/EEC [24], which goal is to protect the fertile soil first of all [25].

There are some technological directives to keep the prescriptions of these legal rules and to help the practical realization from the planning until the recovery:

- The number 9003/1983. is a common statement on the Rules on Waste Water Disposal. It was published by the Ministry of Agriculture (MÉM), the Ministry of Health (EÜM) and the National Bureau of Water (OVH). It contains organizational, operational and supervisory guidelines on the works which were founded for the disposal and the recovery [26];

- The MI-10-420-83 is a technological directive. It contains planning and implementing requirements on the innocuous placing of sewage sludge in agriculture [27];

- The goal of the MI-08-1735-1990 sectoral technological directive from the Ministry of Agriculture to summarize the conditions, requirements, rules and limit values on the land and forest application of waste waters and sewage sludges [28].

All these legal rules define in details the conditions of applying waste water and sewage sludge in agriculture taking into account the pedological, the public- and animal health, plant and other interests. Study the suitability, the areal requirements, the duration, the volume of waste water application in detail and rule the control examinations. With their help the recovery of waste water and sewage sludge can be ensured for a long time in agriculture.

4 Criteria of the agricultural application

From the point of view of agricultural utilization and treatment the sludges are municipal liquid wastes and the sludges which come into being during the municipal waste water treatment process and the waste waters originating from other waste water treatment plants with similar compounds [24].

Between the disposal and the recovery of sludges distinction has to be made. The first one is aimed at averting the environment pollution, while the latter one's purpose is to utilize economically the valuable organic substances, the plant nutrients in the interests of soil fertility [29].

The sludges have simultaneous harmful and beneficial effects on the soil. The sewage sludges improve the physical soil properties, the soil fertility, ensure better cultivability and better aquiferous capacity of the soil [30]. The fact that they contain nitrogen, phosphorus and potassium in complex form supports their agricultural use [31]. Their toxic pollutant, pathogenic microorganism and highly harmful salt (Na-salts, some hidrocarbonates, sulphates) content is a disadvantage, but keeping the required technologies and legal provisions their effects can be prevented [1][10].

During the sludge application on arable land their water- and nutrient content can be used up [32]. The effect of their application is favourable on the physical, chemical, biological soil properties, water, nutrients, microbes get into the soil so the soil life go through a considerable changing [33].

The water deficiency, soil compaction, etc. reducing effects of the sewage sludge can be ensured for a long time with the periodic repeating of the treatments [15]. But the effect of sludge on soil pH has to be considered. As the examinations of Sanders et al. [34] showed, the solubility of heavy metals in sludges grows as the pH falls.

It is a general principle, that the given area has to be used so that after the usage a possibility should remain to the further provision of the complex function of the soil, there has to be a possibility to restore the functions [35].

At the same time the decomposing, mobilizing, transforming, blunting, etc. role of the soil have to be used to meet the demands of increasing volume of plant production and environment protection. In practice it can be carried out with conscious and controlled recovery of wastes and secondary products and their harmless recycling into the natural substance cycle [1].

5 Results and discussion

The quantity of sewage sludge will increase as a result of the treatment of municipal liquid waste in connection with the progress of National Waste Water Drainage and Treatment Program. If the sludge quality comply with the requirements, the agriculture will be able to recover the great part of its expanding quantity. In the interest of the realization of the great proportion of agricultural recovery of sewage sludge, the pollutant-content of the industrial plant's waste water led by the public sewage system has to examine regularly to ensure the properly efficient operation of pre- purifiers. Their admittance into the public sewarage will have to be restricted if the operation of pre-purifiers are unsuitable.

The limit values determined by legal instuments need further investigations and improvement to avoid the soil pollutions. Several research proves, that different plants react differently to the sewage sludge treatments in given conditions. Therefore the application of limit value systems on certain plants, crop rotations and soil types could be effective.

To prove the constant quality of sludges intended to agricultural use, their pre-treatment (stabilization, digestion, etc.) is necessary. From the possible pre-treatment methods the composting can be recommended first of all. In right composting execution, besides small nutrient loss, several favourable chemical, physical, biological effect are induced from botanical and pedological point of view. These properties solve most of the problems of the agricultural recovery of sludges which are connected to public-health and environment-protection.

Of course to create a composting facility is not a cheap investment. Therefore the creation and the development of costuctive works, their financial background which is necessary for the realization of pre-treatment have to be calculated and ensured nationwidely.

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