WASTE SLUDGE FROM MUNICIPAL WASTEWATER TREATMENT PLANTS AND ITS VALORIZACION IN AGRICULTURAL PRODUCTION

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ABSTRACT

The problem with the waste sludge is one of the most acute problems in modern life. Is an open question as to work with the waste sludge from treatment plants and how to eliminate the adverse environmental consequences of the same..

The proposed technological procedure for further processing of the resulting sludge from the aerobic and anaerobic wastewater treatment systems deliver concrete results for semi-pasteurized sludge, which is no longer a problem for environmental pollution and starting component for organic-mineral fertilizer. By combining the appropriate components is enabled full use and application for commercial use in agriculture.

Technological approach to getting a combined organic-mineral fertilizer is continuous approach which takes place in two stages. In the first stage pasteurized waste sludge, which gets microbiologically wholesome million, while the second phase is performed compositional pasteurized million pending combined organic-mineral fertilizer, according to legislation and standards for such type of products.

Economic viability of the proposed solution is based on investments in technological and technical procedure, which is incomparably more cost effective compared to other technological solutions and the effects of the product obtained in the exploitation and economic effects of its use.

Keywords: *Sewage sludge, Environment, pasteurization, organic-mineral fertilizer, economic effects.*

Introduction

Effects of technical and technological solution for sludge wastewater sludge is the solid-liquid system concentrated suspension where solid phase concentration after forced dehydration ranges from 20 - 25% SM (dry matter) with a composition of 53% organic matter and 47% inorganic materials and creates visible solid phase.

In the period from 2009-2012 worked on the project "Treatment and processing of municipal waste sludge from the treatment plant Vranishta" in Struga, Republic of Macedonia. Studies were performed in two stages.

In the first phase, the goal of the research is to obtain a microbiologically correct sludge material and as such be used for fertilizer, which is composed of an organic component that is increasingly lacking in worn-out soils, as a result of using purely inorganic fertilizers, and mineral part that would have contained the elements necessary for plant cultures. Important factor in the research is the new product does not change the composition of agricultural land.

In the second phase of the research is focusing on exploitation effects of new product combined organic-mineral fertilizer, which sent the effects on vegetable crops, soil impacts and economic viability of its use.

The purpose of this paper is to present the results of the second phase of the research. During the research, in addition to the Macedonian legislation for this area, used and norms of neighboring countries, especially for those segments for which there are no English rules [3; 12; 13; 15; 16].

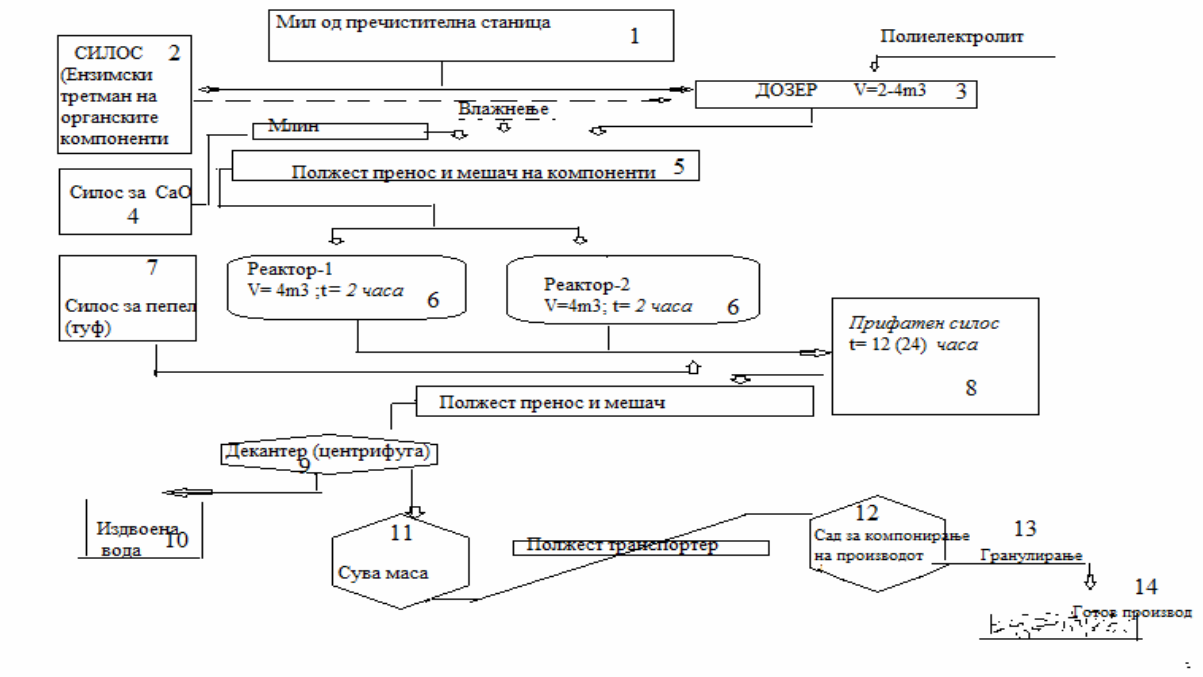
Getting combined fertilizer and its features

Technological procedure begins by defining the composition of the waste sludge [15,16].Sewage sludge, also defined composition, is subject to the following technological procedures (attached chart):

Treatment with quicklime (CaO),

- Treatment with ash electrical filters
- - Composer parameters for the final product - combined fertilizer
- - Granules
- - Drying and
- - Packing.

Technological scheme for the treatment and processing of the resulting sludge from treatment of urban polluted water stations



EXPERIMENTAL SECTION

Research exploitation effects, the quantities and the effect of fertilizers on crops and soil as a basic medium for their cultivation, use multiple methods such as: field trials, vegetation trials (trials in pots), chemical analysis of soil chemical analysis plant and visual diagnostics [11]. Polish experience is basic and most objective method for the study of theoretical and practical problems in agriculture. Polish experience planning begins with setting a specific task that needs to resolve a problem in agricultural production. You should also know that the setting of the Polish experience, all factors should be the same except for the factor being investigated. Polish trials can be annual, biannual and perennial that the setting of the Polish experience, all factors should be the same except for the factor being investigated.. The annual surveys do not provide reliable results. They serve for outgoing information for studying a problem.To obtain accurate results, the same field trials must be asked for at least three years.

Realizing the significance and importance, and the fact that the results obtained from the exact field trials can be transferred and applied in the wider agricultural practice, represent a fundamental part in the second phase of our research. The main task of this research is to investigate the quality, quantity and effect examined fertilizers on yields of cultivated crops, and also its impact on soil as an unrivaled environment for agricultural production for a period of 5 consecutive years of the same locations.

RESULTS AND DISCUSSION

Impact of the resulting compost on the soil and on crops огледни fields

Function research effects resulting fertilizer in 2010 were set exact field trials of two locality experimental field of Scientific Tobacco Institute - Prilep and in the village. Добрушево - Bitola, with four variants: control variation (ungarbage), garbage variant with 10 t, garbage variant with 20 t and garbage variant with 30 t complex fertilizer obtained by technical-technological procedure of waste sludge standard tobacco variety P-23. To investigate the effect of fertilizer on the soil before setting up the experiment and after the vegetation period, taken as average soil samples from two locations. The results obtained are presented in Tabela.1

Table 1: Results of tests on soil treated with different amounts of fertilizer combined

Locality: proving ground NITP														
variants	Humus		Total nitrogen		pH				mg/100 g				physical clay %	
					H_2O	KCl	H_2O	KCl	$P_2 0_5$		K_2O			
	пред веге	по веге	пред веге	по веге	пред веге	пред веге.	по веге	по веге	пред веге.	по веге	пред веге	по веге	пред веге.	по веге
Ѳ	1,36	1,30	0,068	0,063	6,76	5,56	6,58	5,66	22,11	22.1	X	18.8	26,7	28,50
10 t	1,36	1,43	0,068	0.056	6,76	5,56	6,81	6,18	22,11	22.7	X	13.9	26,7	30,60
20 t	1,36	1,68	0,068	0,083	6,76	5,56	7,06	6,52	22,11	23.3	X	15.3	26,7	34,70
30 t	1,36	1,73	0,068	0,086	6,76	5,56	7,19	6,53	22,11	26,6	X	18,1	26,7	35,50
Locality: village. Добрушево														
Ѳ	1,37	1,30	0,069	0,061	7,08	5,93	7,05	5,91	4,74	5,7	16,25	15,3	26,7	28,20
10 t	1,37	1,30	0,069	0,063	7,08	5,92	7,13	6,91	4,74	4,7	16,25	16,4	26,7	30,70
20 t	1,37	1,53	0,069	0,071	7,08	6,04	7,18	6,97	4,74	6,1	16,25	14,9	26,7	29,60
30 t	1,37	1,58	0,069	0,075	7,08	5,96	7,26	6,88	4,74	4,9	16,25	15,6	26,7	31,00

Based on the results obtained from tests on soil samples taken before vegetation and vegetation after a positive trend can be observed values of the examined parameters. The high percentage of organic matter in manure influenced the increase in the amount of organic matter in the soil, and the tendency of increase is correlated with the increase in the amount of fertilizer (variant with 10T to variant with 30 t / ha). We do not see a significant change in soil reaction, and content readily available phosphorus and potassium increases slightly with increasing the amount of fertilizer. Mark is the percentage of physical clay, The experienced field of Tobacco Institute has increased from 2.1% in garbage variant with 10 t / ha to 7.0% in garbage variant with 30 t / ha, and the site in the village . Добрушево increase ranges from 2.5% to 2.8% in the control variant. This property will be given special attention in the following years of research, because it has a strong influence on the physical properties of soil.

Table 2. Content of heavy metals in soil (mg / kg)

proving ground	Variants	Cu mg/kg	Pb mg/kg	Zn mg/kg	Mn mg/kg	Cr mg/kg	Fe mg/ kg	Cd mg/kg	Ni mg/kg
Tobbako Institut	Ѳ	42,9	7,5	68,3	439,4	1,2	7655,8	0,5	25,8
	10 t	37,2	7,3	40,2	504,6	1,3	10722,1	0,3	10,9
	20 t	49,0	7,1	43,0	517,1	1,5	12764,4	0,3	10,8
	30 t	45,0	9,3	47,3	510,7	1,3	14021,4	0,3	13,5
Dobrusevo	Ѳ	52,2	8,4	48,4	461,6	2,9	12559,8	0,3	13,2
	10 t	55,2	10,6	53,9	483,1	3,0	24719,4	0,3	16,4
	20 t	77,6	11,4	54,2	491,5	2,9	15648,9	0,3	17,6
	30 t	72,9	11,3	86,9	484,5	2,8	16474,2	0,3	17,2

When these studies were taken into account the fact that the combined fertilizer produced from waste water contains a certain amount of trace elements. In the first phase, technical and technological procedure these elements are put in the immobilized state and are completely inaccessible to plants. This was confirmed by the results of laboratory investigations of soil and plant material taken from the set field trials. The results analyses are presented in Tables 2 and 3. According to the results it can be concluded that the concentration of metals in soil and plant material in both studied localities are below the limits, therefore it can be concluded that they are not contaminated with heavy metals and that the used fertilizer has no influence on the content of these metals in soil and produced tobacco raw material.

Table 3. Content of heavy metals in plant material - tobacco (mg / kg)

	Cu mg/kg		Pb mg/kg		Zn mg/kg		Mn mg/kg		Cr mg/kg		Fe mg/ kg		Cd mg/kg		Ni mg/kg	
Plant material	И	Д	И	Д	И	Д	И	Д	И	Д	И	Д	И	Д	И	Д
Ѳ /1	9,0	3.8	1.1	2.5	1.5	17.2	48.8	53	8.8	8.3	398.2	148.3	0.3	< 0,2	5.7	5.3
Ѳ /2	8.5	3.95	1.2	3.5	1.5	18.3	73.9	88.0	8.8	4.3	110.5	88.95	0.3	< 0,2	6.2	5.2
Ѳ /3	4.0	6.65	0.8	3.5	1.7	16.2	82.6	73.2	11.0	4.8	68.5	88.9	0.5	< 0,2	4.3	4.85
10 t – first harvest	13.0	6.75	2.1	10.5	3.2	17.1	55.7	67.6	2.1	6.5	47.0	234.9	0.4	< 0,2	0.8	5.65
10 t – second harvest	10.5	4.9	2.7	9	4.7	12.9	62.0	91	5.2	6.5	52.8	60	0.4	< 0,2	2.5	6.25
10 t – third harvest	6.0	4.85	0.8	9	1.6	15.6	40.3	89.5	2.4	8.2	45.8	48.3	0.3	< 0,2	4.9	5.5
20 t / first harvest	14.5	4.8	0.9	8.5	1.8	14.4	46.2	70.4	7.4	11.4	126.6	351.2	0.2	< 0,2	3.3	8.15
20 t / second harvest	14.5	4.4	1.2	4	2.1	13.2	67.3	90.9	5.4	6.0	70.9	151.15	0.3	< 0,2	3.9	4.1
20 t / third harvest	7.0	5.55	1.1	3.5	2.0	26.8	53.1	76.9	6.3	6.9	54.7	114.15	0.5	< 0,2	4.7	4.1
30 t /– first harvest	6.0	5.3	4.5	5.5	3.3	24	35.2	73.0	7.7	5.9	90.5	253.6	0.4	< 0,2	5.0	5.35
30 t / second harvest	10.5	5.8	2.3	3	3.3	16.4	71.7	77.9	4.8	7.3	36.6	72	0.2	< 0,2	4.2	5.95
30 t / third harvest	9.0	5.8	2.0	4	1.8	15.9	58.0	67.5	6.0	6.4	37.0	73.4	0.3	< 0,2	4.6	4.7

I - Tobacco Institut Д – Добрушево

Effects resulting fertilizer on crops breeding fields

The effect of used fertilizer in Polish conditions had a positive impact on growth tobacco plants and thus on the yield and quality of tobacco produced (Table 4). An increase of the yield to 10.46%, the average price down to 20.74%, and the gross money income from unit area up to 33.37%.

Table 4: Effect of used fertilizer in Polish conditions on growth tobacco plants

Locality: proving ground NITP							
N^0	Variant	yield	%	Price	%	Income	%
1	Ѳ	2878	100,00	135,5	100,00	389969	100,00
2	10 t	3069	106.64	142,4	105.09	437026	112.07
3	20 t	3105	107.89	140,2	103.47	435321	111.63
4	30 t	3179	110.46	163,6	120.74	520084	133.37
Locality: village. Dobrusevo							
1	Ѳ	3136	100,00	131,8	100,00	413325	100,00
2	10 t	3110	99.17	127,7	96.89	397147	96.09
3	20 t	3236	103.19	157,5	119.50	509670	123.31
4	30 t	3283	104.69	157,9	119.80	518386	125.42

However, it should be noted that this initial tests that are based on annual surveys. Draw exact conclusions need Polish trials continue and in the next 3-4 years, which is clearly defined in the methodology of this project.

Evaluation of the product

Average annual agricultural needs of the Republic. Macedonia amounted to approx 50,990 tons. Of that amount about 30% belong to the barn and 70% mineral fertilizer [14]. Annual manure production amounts to approx 15,807 tons. Given that in Macedonia there are no facilities for the production of mineral fertilizers, the total required quantity accounted import.

Enormously large amount of fertilizers used in agriculture and forcing agricultural production lead to greater depletion of agricultural land with organic component. On the other hand is under the production of manure which is the basis for the recovery of the organic part in the composition of agricultural land.

The combined organic-mineral fertilizer, the product of our research is an excellent combination to replace both types of fertilizers, Cow and mineral. By using this fertilizer to satisfy the needs of nutritive components in the soil, but when it comes to the impoverishment of the same. Practically, the resulting product is not only acting as fertilizer in food plants, but also complements the structure of the soil with organic matter necessary.
On the basis of the technological procedure [15] designed and developed technological line for the treatment of sewage sludge and its confectioning combined organic-mineral fertilizer. The capacity of the line is planned for the quantity of waste sludge from the treatment plant Vranishta near Struga and is dimensioned for about 2500 t / year of finished product.

Advantage of this product is that is based on domestic raw materials. His production will reduce imports. In the beginning the reduction of imports would be symbolic (about 5% in terms of

total imported mineral fertilizer), but with increased production using pasteurized sludge from other treatment plants, import dependence will be further reduced.

Against planned estimates for technological process to finished product, the expected cost of the material cost per unit of quantity of product to be about 100 - 150 $ / t. Unlike our achieved price of mineral fertilizers in the world market price ranges from 240-280 $ / t.

Seeing all aspects can be concluded that the product obtained organic-mineral fertilizer has advantages over other types of fertilizers.

CONCLUSIONS

Investigated the treatment of sewage sludge from treatment plants achieved their goals-getting microbiological straight sludge that can be disposed of in such a condition without any danger to the environment.

Treated sludge contains components that have their value in use for agriculture.

With the proposed technology obtained is the product of organic-mineral fertilizer containing organic and mineral components, which would meet the needs for fodder crops and thereby to prevent soil depletion.

The resulting product is based mainly on domestic raw materials and its involvement in the normal application reduces imports of mineral fertilizers, although, beginning symbolically (approx 5%), but with the increase in production would increase and the percentage which would reduce imports.

Relatively cheap cost of equipment and production costs (material costs of production are predicted in the range of 100-150 $ / t of finished product) make the product competitive in the market.

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