ANAEROBIC PROCESS UPON THE UTILIZATION OF THE BIOLOGICAL SLUDGE IN A DOMESTIC WASTE DEPOSIT

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ABSTRACT: The anaerobic process existing into the biodegradation of the domestic waste can be accelerated by an addition of biological sludge, having the role of a process activator. An addition of 20 – 25% biological sludge determines the decrease of the biodegradation period with 32%. At the end of the process the ration C/N has values of 17,8 – 18,2%, values which can direct the utilization of the waste for punching.

KEYWORDS: anaerobic process, biological sludge, domestic waste, deposit.

1. INTRODUCTION

The economic development, all over the world, contributed to the growth of the production and consumption, which determined the increase of the industrial and domestic waste quantities. The environment pollution has become under these circumstances dependent of the inadequate administration of the waste, with implications in contaminating the environment factors [1]. At present, at an European level, the total quantity of domestic waste recovered, according to the OECD documentation can be quantitatively estimated between the limits of 30 – 40% from the city waste production. For the decrease of the pollution level two dominant directions are known: the utilization with industrial processes and punching or incineration [4].

Several European countries have started an intense action to reduce packing quantities or waste out of packing, a context where the utilization interest upon recycling are obvious [4,5].

The recovery and recycling degree cannot exclude the quantitative reduction of the waste, which follows the final evacuation way upon depositing. The determination of the composition and of the waste structure enforced as being necessary for the decisions orientation and for the best solution under the technical – economical aspect to set a technological process with a maximum efficiency in decreasing the pollution level of surrounding environment [3]. Therefore the ecological education of the population first, all takes into account the awareness of the fact that the recycling is a necessary activity and that the latter can not reach its goals without the active participation of each individual to the selective collect of recycling waste and in finding technological solutions able to lead to the fulfillment of a desiderata reported to the quality of the environment factors [2,3].

2. Materials and methods

To achieve the objective proposed with the research theme domestic waste has been used with a composition reported to the total mixture: paper and carton (17,11%), plastic packing (14,82%), textile (6,18%), metallic packing (9,19%), fermentable organic waste (52,3%).

The waste used with the research program has been made small pieces up to the dimensions varying within the limits: 2 mm – 5 mm (34,3%); 5 mm – 10 mm (35%), 10 mm – 15 mm (30,7%), the average humidity of the mixture had values between 50 –55 %, the ratio carbon/nitrogen is 31,2.

The chemical composition of the domestic waste was this one: carbon (31,97%), hydrogen (2,5%), oxygen (3,0%), nitrogen (10,5%), sulphur (1,0%), water (40,1%), mineral composition (11,5%).

The biological sludge which is the result of the treatment of the waste used waters upon the aerobic biochemical method has the following characteristic features: qualitative characteristic features: the main groups of micro – organisms which develop and are to be found within the formation process of the biological sludge were: fungus, actinomycetes, micro – organisms in the formations :bacteria, zooglealet, protozoa belonging to: flagellates, cilliates, metazoons, the fungus which dominated the composition of the biological sludge were from the species: Pennicillium, Rihzopus, Asperigillus and Mucor and the quantitative characteristic features: humidity: 95,3%, dry substances to 100+/-5 degree C: 4,7%, fixed waste at 800 degree C reported to the dry sludge: 45,5 %, bicarbonate alkalinity 1000 mg/l, pH: 6,5 – 8,5.

The pilot installation used for the depositing and biodegradation had the form of a cube, having the side of 1 m, laterally protected and its bottom by a PHDE sheet of 2 mm wide. The pilot installation was endowed with drainage tubes having a diameter of 65 mm, arranged in a stone layer having a granulation of 15/30 mm and a 20 cm thickness.

The goal of the research program was to set the factors with dominant influence in the process of anaerobic degradation, a process available in the central part and on the bottom of the pilot deposit, where the biological sludge was used, considered by composition a process accelerator.

The research program was performed on the grounds of documents of rotative central type, II order with 4 variables and 31 experiences. The independent variables, which could orientate and define the anaerobic process of degradation, are shown in table no.1.

Table 1.

Values for the independent variables (x)

Denomination of the independent parameters	X – Codified					
	-2	-1	0	1	2	Dx
	Real values					
Biodegradable organic waste (%)	40	45	50	55	60	5
Biological sludge (%)	1,0	2,0	3,0	4,0	5,0	1
Time (days)	72	144	216	288	360	72
Humidity (%)	45	50	55	60	65	5

The analytic characteristic was performed using the standard methods in force, for the average samples collected by means of a prospecting hole from a height higher 10 cm from the aeration surface.

3. RESULTS AND DISCUSSIONS

The dependent variables necessary to determine the influence of the technological process parameters shown in table 1, on the anaerobic degradation process within the collecting area of the average tests under 10 cm from the surface of the pilot installation (which contained all its height, where the aeration could not practically be determined) are shown in table no 2, under the form of regression equations derived from the general equation no 1:

$$y = b_0 + b_i x_i + b_{ij} x_i x_j + b_{ii} x_i^2, \quad [1]$$

To set the possible correlations for the independent technological variables and the resulting dependent variables of the research process the graphic method was chosen (the resultant of the equations shown in table no. 2 and figures 1-4).

Table 2.

Regression equations for the dependent parameters

Denomination of dependent parameters (y_i) [%]	Characteristic equation
Y1 – organic nitrogen	$17+1,13x_1+0,82x_2+0,15x_3+0,22x_4+1,22\ x_1x_2-0,15x_2^2$
Y2 – total nitrogen	$19+1,22x_1+1,34x_2+0,15x_3-0,72\ x_4+0,94x_1x_2+1,13x_2^2$
Y3 – fixed waste at 100 +/-5˚C	$29-0,56x_1-0,43x_2+0,12x_3+0,15x_4+1,22x_1x_2+0,22x_2x_3+0,76x_2^2$
Y4 – fixed waste at 800˚C	$7,8+1,38x_1-0,46x_2+0,12x_3-0,42\ x_4-0,79x_1x_2+0,28x_2x_3$
Y5 –organic carbon	$800+1,31x_1+0,86x_2+0,15x_3-0,12x_4-0,93x_1x_2-0,72x_2x_3-,51x_2^2$
Y6 –carbon dioxide	$46,2-1,14x_1+1,12x_2+0,13x_3-0,96x_1x_2+0,13x_1^2-1,13\ x_2^2$
Y7 – volume	$7-0,22x_1+1,74x_2+0,56x_3-0,24x_4-1,02x_1x_2+0,23x_2x_3-1,15x_1^2+1,22x_2^2$

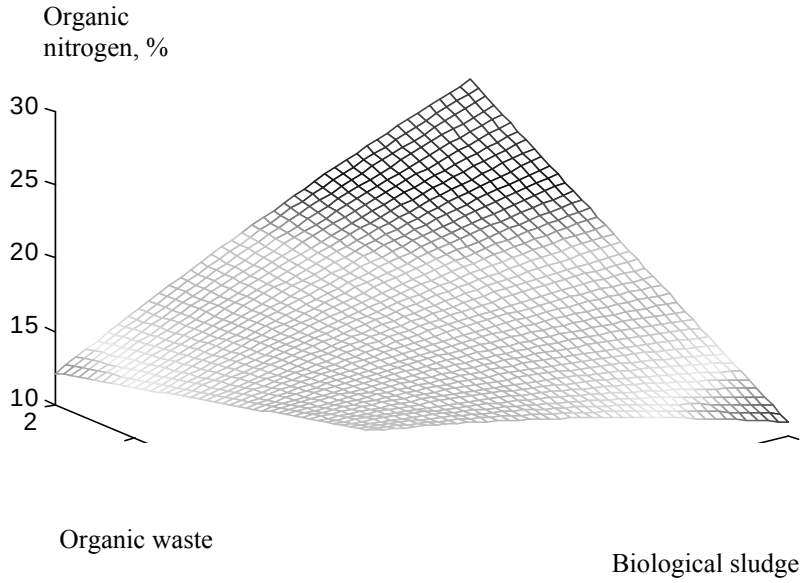

Fig. no.1. The variation of organic nitrogen depending on the organic waste quantity and biological sludge quantity, when duration and humidity are in the central area (50 %)

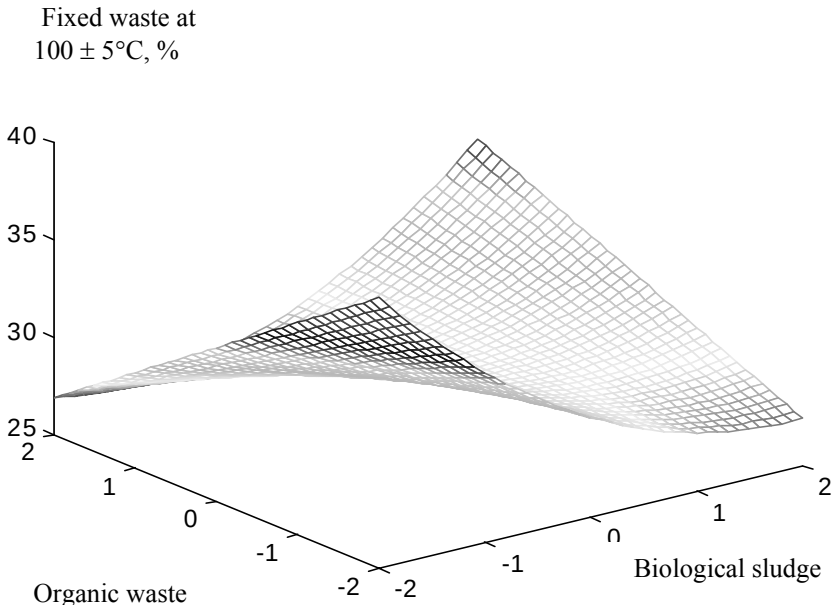

Fig. no. 2. The variation of the fixed waste at 100±5 °C, depending on organic waste quantity and biological sludge quantity, when period and humidity are in the central area (216 days, 55 %)

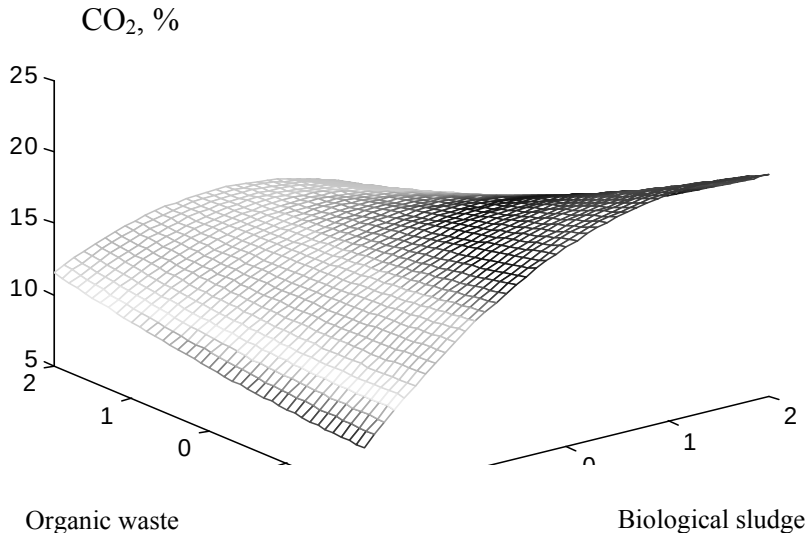

Fig. no. 3. The variation of the carbon dioxide depending on organic waste quantity and biological sludge quantity, when period and humidity are in the central area (216 days, 55 %)

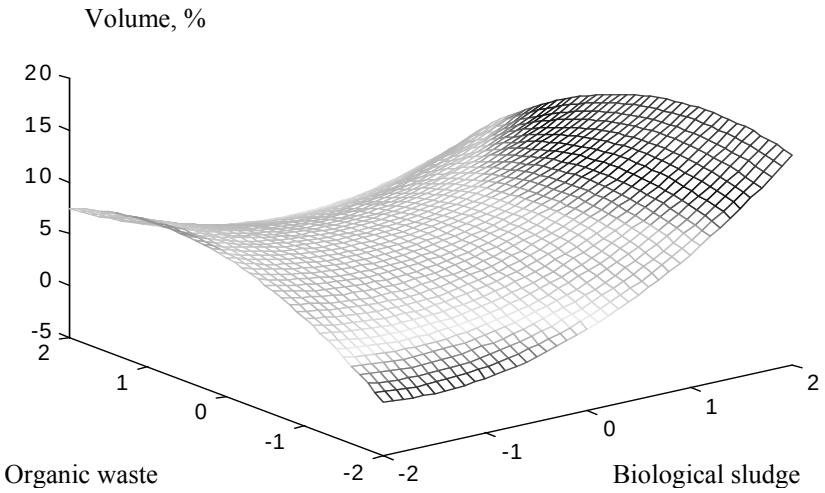

Fig. no. 4. The variation of the volume depending on organic waste quantity and biological sludge quantity, when period and humidity are in the central area (216 days, 55 %)

The total nitrogen content of which the organic nitrogen is directly influenced by the organic waste content and by the biological sludge addition represent values which can confirm the existence of the biodegradation process (figures 1,2). But the biodegradation process knows a minimum existence corresponding to the reduced values of organic waste and biological sludge, in codified values with the –1, -2 area.

When the biological sludge was evidently increases the composition of the biological sludge influenced the whole system analyzed. The fixed waste at 100 degrees C and 800 degrees C presented values under research conditions of 12,7%, situation when the biological sludge dose varied under the limits of 2,5 – 3,0%.

The determination of the ratio C/N was achieved for the conditions when the active independent variables were: the organic composition and the biological sludge addition. The ratio C/N has variations according to the anaerobic process performed, and in the end the values have the limits between 17,8 – 18,2 appreciated in comparison with the values given by the experience in this field, as being a corresponding mixture for utilizations in agro – technical industry, situation also confirmed by the values determined for the chemical characteristics of the main components with nutritional values for the vegetal class. Under the same conditions of humidity for the domestic waste, the gas content determined for CO_2 and the volume of the system decreases together with the consumption of the organic components (figures 3, 4).

The values determined for the chemical characteristics of the main components with nutritional value for the vegetal class are shown in table no. 3.

Table 3

The values determined for the chemical characteristics of the main components

	Chemical composition (%) reported to the dry material				
	N	P_2O	K_2O	$CaCO_3$	pH
Average tests for: October – March period	1,07	1,00	0,65	6,02	6,6
Average tests for: April – September period.	1,44	1,83	0,88	8,9	6,9

4. CONCLUSIONS

The results of the research program performed allowed the following conclusions:

- the anaerobic process of biochemical destruction dominant under the conditions of the pilot installation of depositing the domestic waste can be accelerated if the biological sludge is used, coming from the treatment stations of the waste waters, the addition with considerable results being of 2 –3%, assessed for the whole mixture;
- the process of anaerobic degradation in the presence of the biological sludge determined the obtaining of a material, punched type, with nutritional properties for the vegetal class, having the following characteristic features: ratio C/N of 17,8-18,2% and a variable chemical composition depending on the punching period (winter, summer), as table 3 indicates, the nitrogen content varying from 1,07% to 1,44 %, P_2O from 1,00% to 1,83%, K_2O from 0,65% to 0,88%, $CaCO_3$ from 6,02% to 8,9% and pH from 6,6 to 6,9.;
- the selective collect of the domestic waste, as preliminary operation of the depositing process is recommended.

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