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SUBSTANTIATION THE PARAMETERS OF THE PRIMARY PROCESSING IN INSTALLATION BASED OF RENEWABLE ENERGY

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Abstract

In this article there are described several mathematic analyses of load to energy installation during process of primary organic waste recycling. There is spoken about the positive influence to work effectiveness of biotechnological construction process of primary processing. Also, we can see some valuable information taken on the basis of the engineering research results for the construction of initial working out.

Key words: *organic waste materials, biomass, screw, knife, norms of loading, heat exchange, mixing quality, methane bacteria, biogas, biotechnology*

INTRODUCTION

For the last period, the appearance of the new generation of the constructions that work out organic waste materials gave an opportunity to work out the organic waste materials extremely [1.2.11].

But the content and shape of biomass that is loaded to them has not been fully studied yet. In the result, one should spend too much energy on anaerobic process in bioreactor and the necessity of research hastening is required [2, 3]. Also, in order to perfect the process of discharge of biogas that has energetic value, the content and features of biomass that is loaded to bio reactors depend on the primary work out in many ways [5.6].

Due to the research works of Dubroskiy found that, in working out the biomass with anaerobe depends on its deterioration, the speed of mixing loading, humidity and daily loading. And their changes badly influence on the development of methane bacteria. In working out the energy constructions that are reclaimed in anaerobic process, we can achieve good qualitative degree of energy and biologic fertilizers taken from them by creating necessary conditions for methane bacteria. And this is included in the work accomplished in the primary process. [4,5.6].

MATERIALS AND METHODS

In the researches carried out for anaerobic reclamation in energy constructions that reclaim organic wastes, Imomov *et al*.(2013), Imomov ans Kaymov (2012) ans Salimov amd Imomov (2017) paid attention to biomass reactor [5.6,9]; Eshonkulov [9]. paid attention to evaluating the biomass depth by layering; Rahmatov and Halilov cited by [6, 9]investigated pulsing mixing and its speed. But in Hoshimoto's researches on rendering the wastes from pig farms, Dubrovski (1988) complexly emphasized to the installations that get ecologic gas for fermentation of organic wastes to methane. Also, Gridnev and Kovalev (2014) gave their ideas and suggestions on reclamations before loading the biomass to bioreactors [2]. Shodiyev, who nowadays is carrying out his investigations, says that one can achieve optimal parameters when the amount of constructions loading is increased up to 6 times a day as cited by [6].

In most of the modern constructions that get biologic gas, the primary grinding is not accomplished wholly and there isn't take into consideration the speed in the process of primary reclamation. All of these prohibit the qualitative accomplishment of the biomass loaded to bioreactors. That is why, the suggested and specially designed mathematic model should take into consideration the grinding of changing biomass that is loaded to primary recycling construction and the speed of biomass in the process of humidity and grinding. In the given mathematic model, the size, the humidity of the wastes and the speed of the mass of organic waste in the process of primary reclamation of the regenerated energy construction and the amount of a daily loading of grinding construction are depicted.

In natural conditions, taking into consideration that the number of loadings in primary reclamation construction of biomass that is between 65-99 % moist of the manure of cattle shed is from 1 to 5 times as the size of manure is from 0.8 cm^2 up to 2 cm^2, we consider to carry out 8 experiments so that to decrease mistakes, using the method of "Method of carrying experiments" by Dospexov [3, 7, 8].

RESULTS AND DISCUSSIONS

During designing a mathematic model, the parameters of primary working out process in the construction of reclamation of the following organic waste data are based on the following, x – amount of moist [%], y – speed of liquid mass [m/sec], z – number of daily loading of the construction [day/times], U – grinding [cm^3] and a_0 – carried experiments. We have given the following regression equation on carrying out multi parameters experiments:

$$U = a_0 + ax + by + cz \quad \text{...............................(1)}$$

In determination of the coefficient of unknowns in the above given equation, we use the method of " the least squares" [5]:

$$\varphi(a_0, a, b, c) = \sum_{k=1}^{n} \left(U_k - \left(a_0 + ax_k + by_k + cz_k\right)\right)^2$$

............................(2)

Due to the method of "the least squares",we get private total numbers by a_0, a, b, c parameters in the second equation.

$$\frac{\partial u}{\partial a_0} = 2\sum_{k=1}^{n}\left(u_k - \left(a_0 + ax_k + by_k + cz_k\right)\right)\cdot(-1)$$

$$\frac{\partial u}{\partial a} = 2\sum_{k=1}^{n}\left(u_k - \left(a_0 + ax_k + by_k + cz_k\right)\right)\cdot(-x_k)$$

$$\frac{\partial u}{\partial b} = 2\sum_{k=1}^{n}\left(u_k - \left(a_0 + ax_k + by_k + cz_k\right)\right)\cdot(-y_k)$$

$$\frac{\partial u}{\partial c} = 2\sum_{k=1}^{n}\left(u_k - \left(a_0 + ax_k + by_k + cz_k\right)\right)\cdot(-z_k)$$

................................(3)

Due to sum of finding the extrimum of multi changing functions, equations in the 3rd equation of equalizing the taken sum to zero will be the following:

$$\begin{cases} \dfrac{\partial \varphi}{\partial a_0} = 0 \\ \dfrac{\partial \varphi}{\partial a} = 0 \\ \dfrac{\partial \varphi}{\partial b} = 0 \\ \dfrac{\partial \varphi}{\partial c} = 0 \end{cases} \quad \text{.........(4)}$$

We can compile the following system of equations from the above mentioned 4th equation:

$$\begin{cases} na_0 + a\sum_{k=1}^{n} x_k + b\sum_{k=1}^{n} y_k + c\sum_{k=1}^{n} z_k = \sum_{k=1}^{n} U_k \\ a_0\sum_{k=1}^{n} x_k + a\sum_{k=1}^{n} x_k^2 + b\sum_{k=1}^{n} x_k y_k + c\sum_{k=1}^{n} z_k x_k = \sum_{k=1}^{n} U_k x_k \\ a_0\sum_{k=1}^{n} y_k + a\sum_{k=1}^{n} x_k y_k + b\sum_{k=1}^{n} y_k^2 + c\sum_{k=1}^{n} z_k y_k = \sum_{k=1}^{n} U_k y_k \\ a_0\sum_{k=1}^{n} z_k + a\sum_{k=1}^{n} x_k z_k + b\sum_{k=1}^{n} y_k z_k + c\sum_{k=1}^{n} z_k^2 = \sum_{k=1}^{n} U_k z_k \end{cases}$$

...............(5)

where:

n – the number of experiments [times];
x – amount of moist [%];
y – speed of liquid mass [m/sec];
z – the number of daily loadings [day/times];
U –grinding [cm^3].

Relatively to the number of carried experiments, correlation connection due to the parameter changes are calculated due to the following Table 1 and here integrity is taken

as 1 in a million of cases in order to increase the degree of definiteness:
1–if we put the data given in the Table (5) in to the function given in the equation, it will be as the following:

$$\begin{cases} 8a_0 + 6,76a + 40b + 24c = 11,2 \\ 6,76a_0 + 5,743143a + 34,777143b + 20,931429c = 9,659429 \\ 40a_0 + 34,777143a + 230,857143b + 140,571429c = 62,171429 \\ 24a_0 + 20,931429a + 140,571429b + 85,714386c = 37,714286 \end{cases}$$

...........................(6)

So, from (6) equation we can see from the system of equations that we can get normal equation systems with 4 unknowns from it. When doing the system of these equations, we use the method of "Jordan House" [10,12,13]. The result is equal to the numbers that are ***coefficients*** are higher than 0 and lower than 1. We can see from the solution of the equations the following: *a_0=0.320554, a=0.247105, b=0.011710, c=0.270697* we put them in the system of equations (6) and check the results.

$$\begin{cases} 8.000000 \cdot 0.320554 + 6,760000 \cdot 0.247105 + 40.000000 \cdot 0.011710 + 24.000000 \cdot 0.270697 = 11,199990 \\ 6,760000 \cdot 0.320554 + 5,743143 \cdot 0.247105 + 34,777143 \cdot 0.011710 + 20,931429 \cdot 0.270697 = 9,659420 \\ 40.000000 \cdot 0.320554 + 34,777143 \cdot 0.247105 + 230,857143 \cdot 0.011710 + 140,571429 \cdot 0.270697 = 62,171367 \\ 24.000000 \cdot 0.320554 + 20,931429 \cdot 0.247105 + 140,571429 \cdot 0.011710 + 85,714386 \cdot 0.270697 = 37,714248 \end{cases}$$

So, the difference between them show the mistake in doing the system of equations:
We make a mathematic model of the primary working process of the energy construction of reclamation of organic waste by putting the results into the 1st equation.

$$\begin{cases} 11.200000 - 11.199990 = 0.000010 \\ 9.659429 - 9.659420 = 0.000009 \\ 62.171429 - 62.171367 = 0.000062 \\ 37.714286 - 37.714248 = 0.000038 \end{cases}$$

The mathematical model is:

$$U = 0.320554 + 0.247105 \cdot 6.76 + 0.011710 \cdot 40 + 0.270697 \cdot 24 = 8.956112$$

In checking the essence of a mathematic model, we use Fisher's stati
stics due to the parameters of primary working out process in the energy construction of reclamation of organic waste [3,8].

For that, we put the identified coefficients into the 1st equation (7) and make a equation. For each of the carried experiments we calculate U_t and the resulted are inserted in Table 2.

Formula (7):

$$U_t = 0.320554 + 0.247105x + 0.011710y + 0.270697z \text{ ....(7)}$$

Table 1. Correlation connection between the parameters of primary working out process of the organic waste in the energy construction of reclamation of organic waste

U	x	Y	Z	x^2	y^2	z^2
0.800000	0.750000	2.000000	1.000000	0.562500	4.000000	1.000000
0.971429	0.777143	2.857143	1.571429	0.603951	8.163265	2.469388
1.142857	0.804286	3.714286	2.142857	0.646876	13.795918	4.591837
1.314286	0.831429	4.571429	2.714286	0.691273	20.897959	7.367347
1.485714	0.858571	5.428571	3.285714	0.737145	29.469388	10.795918
1.657143	0.885714	6.285714	3.857143	0.784490	39.510204	14.877551
1.828571	0.912857	7.142857	4.428571	0.833308	51.020408	19.612245
2.000000	0.940000	8.000000	5.000000	0.883600	64.000000	25.000000
11.200000	**6.760000**	**40.000000**	**24.000000**	**5.743143**	**230.857143**	**85.714286**

Source: this table was designed based on the mathematic simulations of results the authors' investigations

Table 1. (continuous) Correlation connection between the parameters of primary working out process of the organic waste in the energy construction of reclamation of organic waste

xy	xz	yz	Xu	yU	zU
1.500000	0.750000	2.000000	0.600000	1.600000	0.800000
2.220408	1.221224	4.489796	0.754939	2.775510	1.526531
2.987347	1.723469	7.959184	0.919184	4.244898	2.448980
3.800816	2.256735	12.408163	1.092735	6.008163	3.567347
4.660816	2.821020	17.836735	1.275592	8.065306	4.881633
5.567347	3.416327	24.244898	1.467755	10.416327	6.391837
6.520408	4.042653	31.632653	1.669224	13.061224	8.097959
7.520000	4.700000	40.000000	1.880000	16.000000	10.000000
34.777143	**20.931429**	**140.571429**	**9.659429**	**62.171429**	**37.714286**

Source: this table was designed based on the mathematic simulations of results the authors' investigations

Table 2. Correlation connection for checking the essence of a mathematic model

№	U	x	y	Z	U_t	$U-U_t$	$(U-U_t)^2$	$(U-\bar{U})^2$
1	0.800000	0.750000	2.000000	1.000000	0.800000	0.000000	0.000000	0.360000
2	0.971429	0.777143	2.857143	1.571429	0.971428	0.000001	0.000000	0.183674
3	1.142857	0.804286	3.714286	2.142857	1.142856	0.000001	0.000000	0.066123
4	1.314286	0.831429	4.571429	2.714286	1.314285	0.000001	0.000000	0.007347
5	1.485714	0.858571	5.428571	3.285714	1.485713	0.000001	0.000000	0.007347
6	1.657143	0.885714	6.285714	3.857143	1.657141	0.000002	0.000000	0.066122
7	1.828571	0.912857	7.142857	4.428571	1.828569	0.000002	0.000000	0.183672
8	2.000000	0.940000	8.000000	5.000000	1.999998	0.000002	0.000000	0.359997
	11.20000	6.760000	40.00000	24.00000	11.19999	0.000010	10^{-12}	1.234281

Note: $\bar{U}$ – average value of the degree of grinding.
Source: this table was designed based on the mathematic simulations of results the authors' investigations

The average value of total growing dynamics of 8 experiments is equal to, 1.4 mm^3.

$$\overline{U} = \frac{U}{n} = \frac{11.2}{8} = 1.4mm^3$$

We calculate it by putting the necessary data in Table 2 into Fisher's equation (8):

$$F = \frac{\left(U_t - \overline{\mathrm{U}}\right)^2}{\left(U - U_t\right)^2} \cdot \frac{k_2}{k_1} \qquad (8)$$

where:
U – Degree of grinding [mm^3]
$\bar{U}$ – Average value of the degree of grinding 11.2/8=1.4 [mm^3]
U_t – Generalization of the results of all experiments [mm^3]
k_1 – The number of parameters that influence on the process [5,8,9]
k_2 – Value of average results of experiments $k_2=n-k_1-1=8-3-1=4$

$$F = \frac{1.234281}{10^{-12}} \cdot \frac{4}{3} \geq 3$$

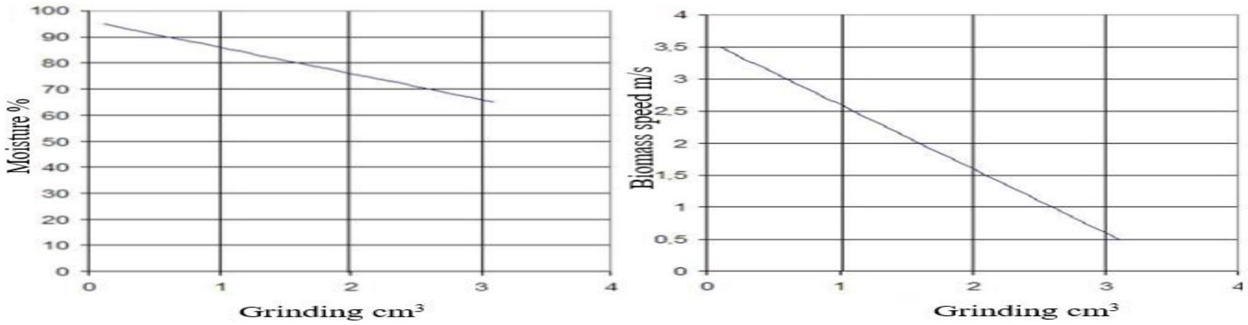

Fig. 1. Drawing of grinding with percent of Moisture and Biomass speed
Source: this figure was designed based on the mathematic simulations of results the authors' investigations

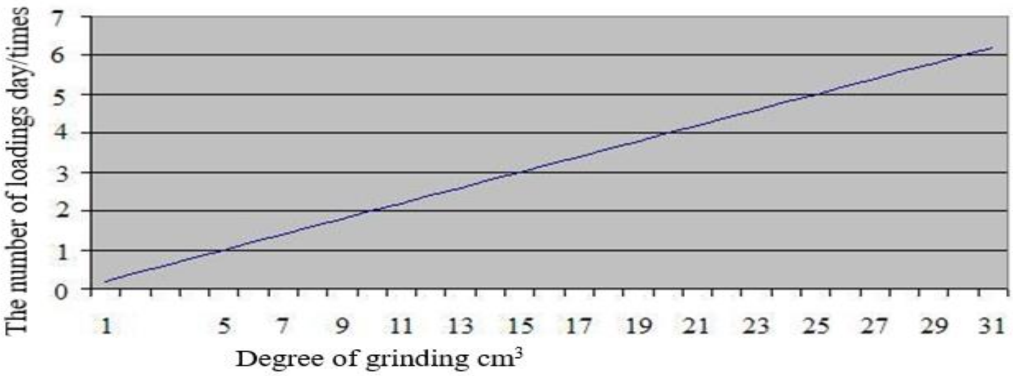

Fig. 2. Drawing of grinding with the number of loadings

Source: this figure was designed based on the mathematic simulations of results the authors' investigations

CONCLUSIONS

We can make the following conclusions out of a drawing compiled on the basis of a mathematic model:

-If biomass moist raises to 1 % , the degree of grinding increases to 0.247105 cm^3.

-If the speed of biomass rises to 1 meters/ second, the degree of grinding also increases up to 0.011710 cm^3.

-If the number of daily loadings is decreased to 1, the degree of grinding rises to 0.270697 cm^3.

-The number of daily loadings influences relatively 9% more on the moist of biomass.

-So, the number of daily loadings due to the biomass speed influences on the degree of grinding 23 to times.

-Also, the raise of the amount of biomass moist (relatively to biomass speed) influences on the degree of grinding to 21 times.

-Due to checking the essence of a mathematic model by Fisher's statistics, its value is F>3 i.e. here we make a rather big value than the number of parameters. It reflexes the processes in a mathematic model correctly.

By creating necessary conditions for metan bacteria in working out of the energy construction of the reclamation of organic waste,i.e.the shape, content and feature changes of biomass loaded into bioreactor by primary working out of biomass economizes the energy and time spent for bioreactor process perceptibly. It also decreases the number of unsuccessful working process of bioreactors and gives an opportunity to control the biomass content.

REFERENCES

[1]Biryukov, A.B., Gnitièv, P., Drobyshevskaya, I.,2017, Analysis of technologies for the production of biogas from organic waste to replace natural gas // Bulletin of Donetsk National Technical University, 1 (7):25-30.

[2]Gridnev, P.I., Kovalev, A.A., 2014, On the prospects for the production of electricity based on the processing of manure in anaerobic conditions, 2014, Journal, Bulletin of the All-Russian Research Institute of Livestock Mechanization, 24-27.

[3]Dospexov, B.A., 2012, Methods of field experience (with the basics of statistical processing of results research, Book on Demand, 53-54.

[4]Dubrovskiy, V.S., Viestur, U.E., 1988, Metan fermentation of agricultural wastes, Riga "Zinatne", 15-17, 54-55.

[5]Imomov, S., Hwang Sang Gu, Usmonov, K., Shodiev, E., Kayumov, T., 2013, Alternative Organic Fuels / Ministry of Agriculture and Water Resources of the Republic of Uzbekistan. - Tashkent: Fan, 168 pp.

[6]Imomov, S.J., Kayumov, T.X., 2012, Qualitative organic fertilizer from the constructions of biologic gas, Uz. Agriculture. No. 10.

[7]Kantere, V.M., 1990, Theoretical foundations of microbiological production technology different, Moscow: Agropromizdat, 47-49. In: Bulkowska K. Optimization of anaerobic digestion of a mixture of Zea mays and Miscanthus sacchariflorus silages with various pig

manure dosages // Bioresource technology. V. 125. Pages 208-216.

[8]Nikitin, G.A., 1992, Biochemical basis of microbiological production, Publishing House Vishcha school, Kiev, 319 pp.

[9]Salimov, O., Imomov, S., 2017, Optimization of processes of a biogas plant by individual order // Irrigatsiya va melioratsiya, 2017, No. 2 (8):47-49.

[10]Shalabanov, A.K., 2008, Econometrix. An educational manual, Kazan, 173-175.

[11]Starov, V.N., Lazukin, V.F., Gurov, A.V., Vnukov, A.N., 1992, Prediction of reliability indices of technical systems. Moscow, “Vyshizdat”.

[12]Volkov, D.P., 1979, Reliability of building machines and equipment: studies. manual / D. P. Volkov, S. N. Nikolaev. - M., Higher. school, 1979.

[13]Zakharchenko, A.N., Rufai, I.A., 2005, Biogas production in agricultural production. // Reports of the TAA. issue 277. M: FGOU VPO RGAU - Moscow Agricultural Academy. CL Timiryazeva, 229-232.