Technology of organic and organic-mineral fertilizers production from poultry manure

Vesselin Koutev, Dimitar Slavov, Pesho Bozadjiev*
Institute of Soil Science Nikola Poushkarov, Sofia, Bulgaria
**University of Chemical Technology and Metallurgy, Sofia, Bulgaria*
koutev@yahoo.com

Nutrients in organic fertilizers are presented as organic compounds and have a plant and animal origin. Commonly applied in practice are farmyard manure, poultry manure, peat, crop residues, composts etc. Organic fertilizers have lower nutrient content then mineral fertilizers but ratio of nutrient content is near to then optimal. Besides NPK they have calcium, magnesium, sulfur and many microelements as boron, molybdenum, copper, zinc, manganese, iron. We can combine the good parts of organic and inorganic fertilizers after mixing them. Thereby we will have an organic-mineral fertilizer with higher nutrients content and we can provide to the crops nutrients with specific ratios (1,2,3,4).

Last years the problem with waste from poultry production is arising dramatically because of the high concentrations of birds in small area, the intensive technology cycle of their growing, and the lack of effective technologies of wastes recycling. This is the reason for accumulation of millions of tons of poultry manure which are polluting the environment – water, soil and air.

Advantages of organic and organic-mineral fertilizers are enormous:

- expensive mineral fertilizers could be partly substituted
- balanced fertilization with NPK and micro fertilizers is provided
- nutrients are in favorable combination for plants, soil and micro flora
- biologically active substances and beneficial micro flora are amended in soil
- nutrients from organic compounds have a long-term effect – 2-3 years
- reutilization of animal wastes is reducing the environment pollution
- wastes recycling makes better the hygienic conditions of work and living for the people in farms and surrounding area

The recycling of poultry manure can go in 3 ways:

1. Utilization of well composted manure (for several years). This product is dryer and with lower nitrogen content and could be used immediately or with light drying. Expert data show that in Bulgaria we have about 8-10 millions tons and every year 1 million tons fresh poultry manure is stocked.
2. Second way of poultry manure recycling is the direct processing with or without mineral fertilizers and rapid composting. Deodorizing agents and microbial preparations could be applied for better results. Obtained biofertiliser must be dried, thus energy consumption is higher than in the first technology. This technology avoids long-term storing of manure and air pollution with greenhouse gases.
3. The most special way of poultry manure recycling is applied in cage breeding farms. The manure with high water content is mixed with lime and fodders phosphates and is used as food for animals and birds.

Technology line of all recycling types contains same elements - grinding, accelerated composting, mixing, granulating, drying, classification, packing. Till now the granulating was avoided in the technologies applied (Figure 1). The end product was in powder and was not suitable for distribution in the field. The granulated product is similar as mineral fertilizers and could use the same machines for speeding in field.

The poultry manure has not a defined content of nutrients that is why we will use manure with defined nutrients content. Mineral fertilizers have defined content. They are building part of organic-mineral fertilizers and we must take in account the antagonism and synergism between them and the antagonism and synergism between mineral fertilizers and poultry manure.

It is usual practice to mix manure with super phosphate (mono and double), Patentkali, ammonium phosphate, potassium chloride, precipitate, phosphorite, urea and etc. That is why we used same fertilizers for the organic-mineral fertilizers based on poultry manure (5,6).

Table 1. Initial nutrients content of applied fertilizers and poultry manure

№	Fertilisers	Nutrients content, %					
		N	P_2O_5	K_2O	CaO	MgO	S
1.	Poultry manure	3,0	2,0	2,0			
2.	Super phosphate (double)		46,0				
3.	Patentkali			30,0		10,0	17,0
4.	Potassium chloride			50,0			
5.	Ammonium phosphate	12,0	48,0				
6.	Precipitate		42,0				
7.	Ammonium sulfate	20,1					23,4
8.	Phosphorite (Tunisie)		30,0				
9.	Urea	46,4					
10.	Lime				54,0	2,5	

Urea and lime could be used in the final stage of granulating in case of antagonism between other components.
The mixed organic-mineral fertilizers were obtained in a granulating machine and the nutrient content is shown in Table 2.

Table 2. Organic-mineral fertilizers obtained with different ratios between poultry manure and mineral fertilizers and raw materials

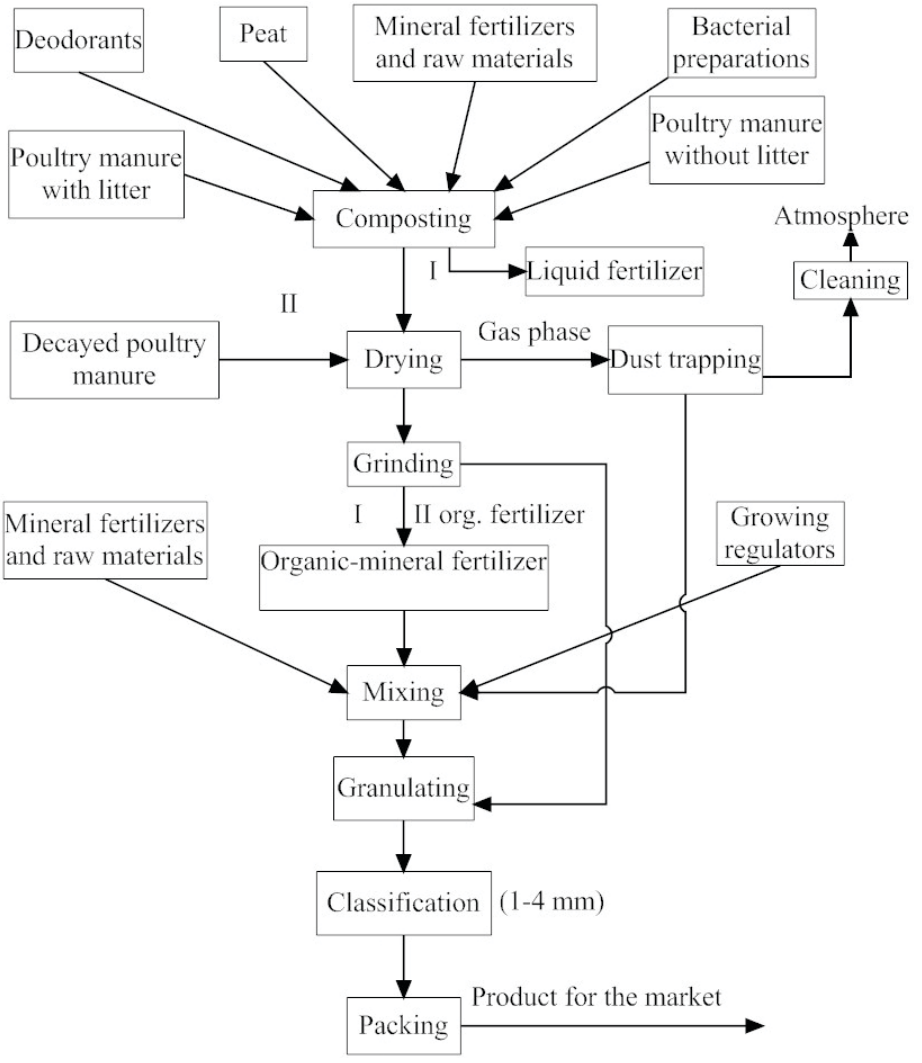
Poultry manure +	Ratios between poultry manure and mineral fertilizers and raw materials								
	3:1			1:1			1:3		
	Main nutrients content, %								
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Super phosphate (double)	0,00 2,25	11,5 1,5	0,0 1,5	0,0 1,5	23,0 1,0	0,0 1,0	0,0 0,75	34,5 0,5	0,0 0,5
Patentkali	0,0 2,25	0,0 1,5	7,5 1,5	0,0 1,5	0,0 1,0	15,0 1,0	0,0 0,75	0,0 0,5	22,5 0,5
Potassium chloride	0,0 2,25	0,0 1,5	12,5 1,5	0,0 1,5	0,0 1,0	25,0 1,0	0,0 0,75	0,0 0,5	37,5 0,5
Ammonium phosphate	3,0 2,25	12,0 1,5	0,0 1,5	6,0 1,5	24,0 1,0	0,0 1,0	9,0 0,75	36,0 0,5	0,0 0,5
Precipitate	0,00 2,25	10,5 1,5	0,0 1,5	0,0 1,5	21,0 1,0	0,0 1,0	0,0 0,75	31,5 0,5	0,0 0,5
Ammonium sulfate	5,25 2,25	0,0 1,5	0,0 1,5	10,5 1,5	0,0 1,0	0,0 1,0	15,25 0,75	0,0 0,5	0,0 0,5
Phosphorite (Tunisie)	0,0 2,25	7,5 1,5	0,0 1,5	0,0 1,5	15,0 1,0	0,0 1,0	0,0 0,75	22,5 0,5	0,0 0,5
Urea	11,5 2,25	0,0 1,5	0,0 1,5	23,0 1,5	0,0 1,0	0,0 1,0	34,5 0,75	0,0 0,5	0,0 0,5
Lime	0,0 2,25	0,0 1,5	0,0 1,5	0,0 1,5	0,0 1,0	0,0 1,0	0,0 0,75	0,0 0,5	0,0 0,5

Remark: Upper number is the nutrient content coming from mineral fertilizer. Down number is the nutrient content coming from poultry manure. Total content is the sum between them.

It is well seen that we obtain a good combination between poultry manure and compatible mineral fertilizers. The products represent an interest for the agriculture practice, but the ratios between nutrients are not equilibrated. Usually one of the elements is predominant. For obtaining organic-mineral fertilizers with equilibrium between nutrients suitable for different crops we have two possibilities:

a) Poultry manure is mixed with combination of fertilizers calculated in advance
b) Industrial complex mineral fertilizer with needed proportions of nutrients is mixed with poultry manure

Figure 1. Block-scheme of the technological line for production of organic and organic-mineral fertilizers



In table 3 is presented the complex fertilizers mixing with poultry manure with ratios N:P:K=1:1:0 (23-23-0) and N:P:K=1:1:1 (16-16-16).

Ratios between nutrients remain nearly the same in particular in case of organic-mineral fertilizers with 50% and 25% content of poultry manure.

Table 3. Organic-mineral fertilizers obtained at different ratios of poultry manure and double and triple complex mineral fertilizers

Poultry manure +	Ratio between poultry manure and the complex fertilizer								
	3:1			1:1			1:3		
	Main nutrients content, %								
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Double complex fertilizer 1:1:0 (23-23-0)	5,75 2,25	5,75 1,5	0 1,5	11,5 1,5	11,5 1,0	0 1,0	17,25 0,75	17,25 0,5	0 0,5
Triple complex fertilizer 1:1:1 (16-16-16)	4,0 2,25	4,0 1,5	4,0 1,5	8,0 1,5	8,0 1,0	8,0 1,0	12,0 0,75	12,0 0,5	12,0 0,5

Remark: Upper number is the nutrient content coming from complex mineral fertilizer. Down number is the nutrient content coming fr

It is seen that the standard installation for production of mixed mineral fertilizers (in powder or granulated) can be used (after additional operations including) and for the production of organic-mineral fertilizers. In this way the functionality and the range of produced fertilizers will increase.

The pilot installation testing must be in a poultry farm or nearby because of the easy access to the raw material.*om poultry manure. Total content is the sum between them.*

Conclusions

Selection of initial fertilizers and raw materials for production of organo-mineral fertilizers is done.

Mixtures of poultry manure and compatible mineral fertilizers with different content of macronutrients are made.

Principle block-scheme of the technological line for production of organic and organic-mineral fertilizers is created.

Application of the technology could resolve the environmental problems in the vicinity of poultry farms – soil, water, air pollution

References

Karshev I. – 1986, Guide of mineral fertilizers, Eds. Tehnika, Sofia.
Chekalov K.I. - 1958. Production and application of organic and organic mineral fertilizers, Eds. Selhozizdat
Vasileva, V.A., N. Filipova, 1984.- Guide of organic fertilizers, Rosselhozizdat.
Authorship certificate – PRB № 33400 (Method for production of complex fertilisers).
Ivanova R. – 2006, PhD Thesis, UCTM.
Ivanova R., D. Bojinova, I. Gruncharov, R. Velkova. 2005. Nonacid methods of rock phosphates processing and utilization of phosphorus. Chapter in book: Crops: Growth, Quality and Biotehnology, In: Pris R (ed),WEL Publisher, Helsinki, Finland, p. 149-167.