

ECONOMICAL AND ECOLOGICAL CONSEQUENCES OF THE MANAGEMENT OF BIOLOGICAL WASTES ARISING IN THE INTENSIVE AGRICULTURAL LIVESTOCK PRODUCTION

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In the article the issues of economical and ecological consequences of the management of biological wastes arising in the intensive agricultural livestock production are described.

During the digestion of animals arise waste materials, which from the body are excreted in form of gases, sweat, excrement and urine. With reference to the necessity of their regular removal and purposeful use, respecting the principles of the environment protection, from the practical point of view the most important of them are the excrements and the urine of animals. These side products of the livestock production, often incorrectly called as waste, belong to the important nitrogenous fertilizers, which with their application into the soil effectively influence the production results of plants. We divide the stable organic fertilizers according to their origination into following categories:

- 1) manure – mixture of solid and liquid excrements and bedding material;
- 2) dung–water – mixture of urine with the ingredient of excrements and bedding;
- 3) seepage-water – liquid, which flows out from manure;
- 4) liquid manure – mixture of solid and liquid excrements containing different proportion of technical water, fodder residues and other foreign substances;
- 5) poultry excrement.

The stable manure is a mixture of excrements (excreted excrements and urine of animals), bedding (straw, sawdust, and chips), and water and fodder residues. In classic stables with tethering, typically is produced a stable manure without dung-water, which independently flows away from the stable into tanks. In newer technologies with free stabling it is usually the component of the stable manure. The production and quality of the stable manure is influenced by the quantity and composition of excrements and by the type and quantity of the used bedding as well. In classic

stables with outflow of the dung-water, in the stable manure is caught 40 % of the produced urine, in free stables the urine is a component of the stable manure. During the storage of the stable manure on dunghills there arise losses on the mass, organic substances and nutrients as well. The height of these losses in a relatively significant range is dependent upon the method of storage and treatment.

The seepage-water is released from the manure during its storage. Its quantity is dependent on the dry matter's content in the fresh stable manure, storage height and meteorological conditions. The outflow of the seepage-water is from 8 to 20 %, while it contains around 2 % of dry matter, 1 % of organic substances, 0,1 % N, 0,01 % P and 0,3 % K. Apart from the losses in the seepage-water, from the manure arises a loss during the maturation by chemical processes, which escape into the atmosphere.

The liquid manure of cattle and pigs is a good organic-mineral liquid fertilizer joining the properties of the stable manure and mineral fertilizers. It means that it is a bearer of organic substances and quickly releasing nutrients. The use of the liquid manure by direct application on the soil after its maturation is its most effective use. The minimal period of the liquid manure's maturation is 3 months.

The dung-water is the urine of farming animals diluted by water differently, flowing out of the stabling space with bedding. It is a good fertilizer which contains nitrogen and potassium. The target is to absorb the possible largest quantity of urine in the bedding. The quantity of urine, which flows away, is dependent upon the bedding's quantity.

The poultry excrement with its content of basic nutrients exceeds the excrements of other farming animals. It contains undigested parts of fodder, lining cells, residues of secretions, microorganisms of intestinal micro-flora and substances excreted with urine. The nitrogenous part consists of urine acid, ammonia, urea and other substances. Their content is app. 30 %. In case of poultry breeding on bedding, there arise poultry excrements enriched with substrates from the bedding. Above all lime, phosphorus and potassium belong to the mineral components of excrements. The poultry excrement contains almost 4x more potassium and 6x more phosphorus as the cattle manure [Agrobiomasa [Electronic recourse]. – Access mode: <http://www.agrobiomasa.sk/?s=1.1.3.2>, citation 2013-10-10].

In the present time the problems concerning the negative influence of the agriculture on the nature are still more topical. It is necessary to search the reasons in the technology, in the structure of agricultural production and in the benevolence during the use of natural resources.

If it concerns specially the **breeding of pigs**, it is possible to find a lot of commons to the industrial sources of pollution in relation to the environment protection. This concerns the similar occurrence of spot sources with high concentration of pollution. Here, the general principle is,

similarly like in the case of industrial sources, the principle of prevention, what in practice means the preferential orientation on the use of such technological procedures, which minimize the negative impact of solid and liquid wastes. In case of breeding of other farm animals, practically we don't meet with such spot pollution. Although the solving of wastes in livestock production requires a complex approach, nevertheless it is necessary to analyse the problem of spot pollution in the consequence of high breeding concentrations.

The differences in the production of liquid manure in dependence on the category of pigs are indicated in the table 2.

Approximately it is possible to calculate, that on 1000 kg of living mass of pigs, in the fattening are produced 120 – 130 litres of liquid manure daily.

From the viewpoint of the liquid manure's agrochemical characteristic it is necessary to emphasize that about the high fertilizer value decides the relation C: N, which is in the range 4-8:1. This ratio subsequently influences the:

Table 1 – The average composition of the fresh liquid manure in %

Indicator	Bedrna- Lopatník (1982)	Škarda (1982)	Bízík – Zápotočný – Malá (1998)	Stupka – Šprysl (1999)
Dry matter	8.3	6.4	5.4	6.5-7.5
Organic substances	6.7	4.8	4.3	6.0
C	2.9	2.1	N/A	N/A
Nt	0.61	0.49	N/A	0.63
N-NH ₄	0.36	0.29	0,4	0.44
P	0.14	0.11	0.22 (P ₂ O ₅)	0.15
K	0.18	0.17	0.2 (K ₂ O)	0.29
Ca	0.18	0.16	N/A	N/A
Mg	N/A	0.04	N/A	N/A
Na	N/A	0.03	N/A	N/A
pH	7.0	7.0	N/A	N/A
C:N	4.8	4.3:1	N/A	N/A
N:P:K	N/A	0.2:0.4:1	N/A	N/A

Note: source: <http://www.seps.sk/zp/etp/knihy/26/28.htm>; Bedrna, Z. – Lopatník, J.: Systems of fertilization and environment protection. Bratislava: Príroda.; Bízík, J. – Zápotočný, V. – Malá, Š.: Rational use of liquid manure. Naše pole; Stupka, R. – Šprysl, M.: Breeding of pigs. Praha: ČZU

Table 2 – Production of liquid manure in particular categories of pigs per piece and day

Category of pigs	Production in kg/piece and day	Dry matter in kg/piece and day
Sow (150 kg)	14.0	1.0
Sow feeding 9 piglets	24.0	1.7
Piglets (5–15 kg)	3.0	0.15
Piglets (15–30 kg)	4.1	0.25
Fattening pigs (30 – 115 kg)	8.5	0.50
Gilts	9.5	0.55
Boars	18.5	1.3

Note: source: Stupka, R. – Šprysl, M.: Breeding of pigs. Prag: ČZU

- Metabolism speed of organic substances in the soil;
- Speed of nitrogen release from organic bonds;
- Speed of the mineralization of soil organic mass;
- Resistance of organic substances to microbial decomposition;
- Use of the liquid manure’s energy for reproducing of microorganisms.

Since the liquid manure of pigs has a narrow ration C: N (relative opulence of nitrogen), if the balance of organic fertilization in the soil is not ensured it can come to:

- Intensive mineralization of the organic mass in the soil;
- Decrease of organic mass in the soil;
- Oversized, so called “luxurious” nutrition of plants with nitrogen;
- Contamination of over-ground and under-ground waters;
- Ammonisation or nitrification of ammonia.

For these reasons during the liquid manure’s application is necessary to ensure the stable balance of organic fertilization (application of plants with wide ratio C: N, as for example the ploughing of straw into the soil). The correctly produced and treated liquid manure represents a significant source of organic substances, nutrients, bacteria and substances of motivation character, which in case of correct application increase the soil fertility and represent a significant financial saving. The chemical analyses of liquid manure are made in large quantity during the investigation of metabolism. By analyses most frequently is determined the nitrogen, which on one side has large significance from the nutrition viewpoint of plants, but on the another side in large concentrations it disrupts the natural balance in more components of the environment. The table 3 presents an

overview about the average content of pure nutrients in liquid manure of pigs in dependence on the dry matter.

Negative influences on the atmosphere

During the operation of any kind of stabling due to the decomposition of organic mass (residues of feeding, litters, excrements) arise materials, which can cause the pollution of atmosphere. These are mainly ammonia and smelling substances.

Table 3 – Average content of pure nutrients in the liquid manure

Percentage of dry matter	Percentage of pure nutrients			Totally kg of pure nutrients on 1 t of liquid manure		
	N	P	K	N	P	K
3	0.24	0.050	0.108	2.4	0.50	1.08
3.5	0.28	0.060	0.125	2.8	0.60	1.25
4	0.32	0.067	0.144	3.2	0.67	1.44
4.5	0.36	0.076	0.162	3.6	0.76	1.62
5	0.40	0.086	0.180	4.0	0.85	1.80
5.5	0.44	0.093	0.200	4.4	0.93	2.00
6	0.48	0.100	0.215	4.8	1.00	2.16
6.5	0.52	0.110	0.235	5.2	1.10	2.34
7	0.56	0.120	0.250	5.6	1.20	2.50
7.5	0.60	0.127	0.270	6.0	1.27	2.70

Note: source: Stupka, R. – Šprysl, M.: Breeding of pigs. Prag: ČZU

If the principles of proper operation are respected, the hydrogen sulphide and the carbon dioxide are on very low concentration level, which does not influence negatively the health status of the operation staff and animals. Despite of this, it is necessary to pay higher attention to the production of ammonia and smell in pig breeding as in the cattle breeding, where with respect to the character of breeding, the concentration and intensity of smell and in the same time the ammonia production does not occur so negatively.

The average emission of ammonia in case of pigs for fattening in average represents only 4.5 kg per piece and year. A lot of data in the professional literature show significant differences concerning ammonia production, because it' s production and emission into the surrounding

atmosphere significantly is influenced by the stabling system, ventilation, removal of excrements and by the methods of their storage and application.

The ammonia emission in kg per 1 cattle unit and per one pig according to various studies presents the following table 4.

Table 4 – Annual emission of ammonia in kg per cattle unit and per 1 piece of pig

Emission on	Janssen (1985)	Buijsman (1985)	Anon (1989)	Möller (1989)	Asman (1990)
Cattle unit.kg ⁻¹	20.7	17.5	19	39.4	30
piece.kg ⁻¹	4.8	4.0	4.4	9.1	6.9

The ammonia in larger concentrations has a direct influence on trees in the surrounding of stabling objects. It is transmitted by air to large distances, where it causes eutrophization and acidification of water and soil as well. This often appears also in changes in the ecology of plants and in the decrease of biological diversity of plants. The air from stabling objects, which contains ammonia, has an adverse influence primarily on coniferous trees up to distance of 50 metres from the objects.

Negative influences on the soil and water

One of the most frequent forms of nitrogen occurrence is the nitrogen in nitrate form. This form has only an imperceptible proportion in the liquid manure of pigs – in comparison to the ammoniacal form. The nitrogen in nitrate form is created indirectly, only after the fertilization with liquid manure and with its contact with the soil micro-flora. By mineralization processes the organic mass contained in the liquid manure is decomposed into ammonia, which subsequently partially by means of nitrification micro-flora is converted through the intermediate degree into nitrites (nitrification) and at the end into nitrates (nitration).

In contrary to the ammoniacal form of nitrogen in the soil, which is relatively stable and constant, the presence of the nitrate component significantly fluctuates in course of the year. The maximal quantities are in spring and in autumn; the minimums are in summer and winter. This is connected with more factors, as for example the seasonal climatic conditions (humidity, temperature), activity of the microbial component, vegetation degree of the covering of soil. Apart from it, the fixing of nitrogen in nitrate form onto the soil elements is more complicated and therefore it is released easier and penetrates into the over-ground and under-ground waters. In this

way is created a potential danger of contamination of waters with an influence on the health of higher organisms including human health. This danger is taken into consideration also in the legislation, beside others by approving the maximal quantities of individual nitrogen forms in the over-ground and under-ground water, and by the technical standard valid for the clean water.

On the basis of mentioned negative influences of substances contained in the liquid manure, respectively processes which arise from them, it is necessary to implement certain precautions in order to prevent the damaging of environment. These precautions are included in many legal standards of more ministries, which limit the use of liquid manure in the zones of hygienic protection.

Technological procedures of the use of liquid manure

The liquid manure with its origin and composition is designated for fertilization. It fecundates the soil and increases its productivity. The practice knows a lot of processing and treatment methods of the liquid manure. The processing of the liquid manure should be implemented with a method, which solves satisfactorily the following three spheres of problems:

- Use of the liquid manure as a fertilizer;
- Hygienic viewpoint of the liquid manure's application;
- No damaging of the environment.

The procedures of the liquid manure's treatment and processing can be divided into two large groups:

- Processing of liquid manure without preceding treatment;
- Processing of liquid manure after preceding treatment.

The processing of liquid manure without preceding treatment can be implemented with many methods. In the world are applied the following ones:

- 1) Use as fertilizer by direct application onto the agricultural soil;
- 2) Biological reclamation. It is a technology by which is possible to reclaim voluminous industrial wastes. In this way effectively are used the liquid manure's balance surpluses;
- 3) Direct application of liquid manure on poplar plantations. The method enables to use effectively the liquid manure's surpluses, to save the storage capacity of tanks and to achieve high quality organic manure, which can be used as manure. The surplus liquid manure is poured out into shallow lagoons, around which poplars are planted. In the lagoon comes to mineralization of the liquid manure's organic mass, to evaporation of water from liquid manure under the formation of the solid fraction, to high growth of the wooden mass and to effective absorbing of nitrites and nitrates by the root systems of trees. But this system requires a vast area and large distance from dwellings (smell);

4) Production and use of champignon substrate from liquid manure. It is a very effective technology, which can increase the production of champignons. The champignon substrate consists of the liquid manure of pigs, straw, solid component of liquid manure, poultry excrements and gypsum as well;

5) Anaerobic formic digestion of the liquid manure with biogas production;

6) Use of the liquid manure as a fodder. The excrements of pigs represent a significant reserve of cheap nutrients applicable for ruminants. This concerns primarily the N-materials, which are well available. The process of such metabolism itself can be implemented by more methods (drying, chemical treatment, mechanical modification etc.). The disadvantage of this method for the utilization of the liquid manure are the possibilities of health risks, possible recycling of harmful substances and heavy metals and significant investment, energetic and operational demandingness;

7) Composting of the liquid manure;

8) Production of manure from liquid manure and straw. This method is considered as not convenient because it eliminates the advantages and main plusses of stabling without bedding and by the production of manure outside the stabling objects increases the costs for its production;

The processing of liquid manure after preceding treatment is implemented in two forms:

9) Anaerobic purifying processing of the liquid manure;

10) Separation of the liquid manure into solid and liquid part.

In conditions of Central Europe are used primarily the methods 1), 5), 7), 9) and 10) as well.

Direct application

It is a direct utilization of the liquid manure for fertilization purposes, which in our country is considered for the best processed, by operation verified and economically most effective way of pig liquid manure utilization for fertilization of agricultural crops and long-lasting grass vegetations.

For the effective implementation of this system are decisive the following factors:

- Quality of the liquid manure;
- Manipulation technique;
- Application technique;
- Storage capacities;
- Work quality of the attendance staff;
- Homogenization of liquid manure.

The extolling of liquid manure to the field without its previous processing is the most frequent methods of the liquid manure's utilization. In this context the liquid manure often, also by agricultural subjects, is considered for a necessary wrong, side product arising during the pig meat production, which has no significant practical use. Generally dominates the opinion, that this is the

cheapest liquidation method of this biological waste. Since, the liquid manure before its application in the field is not processed at all; it is not possible to talk about its real processing in closer sense. However, before the application during its storage in collecting tanks for 4-5 months it comes to certain changes in its composition, primarily to liquidation of various weed seeds and pathogenic germs, which can be found in the freshly produced liquid manure. Therefore we can consider this method for one way of its utilization, however in a wider sense.

In case of this system it is necessary to respect the following precautions:

1. To produce high quality liquid manure with a dry matter of 6.8 %. It is necessary to limit the thinning of liquid manure with technological water, the volume of which should not exceed 25 % of the produced liquid manure's volume.

2. To store the produced liquid manure minimally for 3–4 months. But the optimal time of its storage is 6 months, which enables not to extol the liquid manure in winter period and to apply the liquid manure 2 × annually, i.e. in period March -April and October - November. The storage of liquid manure can be implemented in various collecting tanks. The most frequent are steel circular tanks with a capacity of 17 – 2847 m³, concrete tanks or either partially or fully in earth embedded cesspits. In case of sufficiently long storage period and maturation of the liquid manure it comes to removal of the infectious potential of the liquid manure (coliform bacteria, salmonellas etc.), deactivation of harmful substances with inhibition effects on plants (hippuric acid, uric acid, benzoic acid etc.) and to the loss of germinability of weed seeds as well. It is possible to speed up these processes by aeration of the stored liquid manure. In some countries (e.g. Germany) with the aim of effective destruction of germs in the liquid manure is applied a special treatment (electrically dosed Cu ions into the liquid manure), the final effect of which is the improvement of homogenization and fluidity of the liquid manure and the decrease of the production of harmful gases.

3. Prior to extol the liquid manure to the field it is necessary to implement a high quality homogenization in the whole content of the tank by various types of stirrers (the liquid manure of pigs separates in such a way that the solid component decreases) and subsequently to re-pump the liquid manure into applicators by means of various pumps.

4. In course of fertilization with liquid manure we limit the application by means of spraying onto the field surface. During this work there occurs smell, escape of ammoniac nitrogen, high pressure etc. Therefore, it is suitable to use such application technique which enables to put the liquid manure below the earth surface, with application below leaves on the earth surface or with application below leaves during the vegetation with partial putting the liquid manure into the earth between the rows.

Separation

The separation of the produced liquid manure into solid and liquid part represents an economically interesting alternative of the liquid manure's treatment in comparison to the direct extol to the field. This method of the liquid manure's processing in condition of the Slovak agriculture is still not appreciated. Apart from the larger possibilities of the utilisation of the separated liquid manure in comparison to non-separated one, the liquid manure's separation has an economical contribution to the saving of storing capacities for liquid manure as a consequence of the reduced quantity of the more problematic liquid part in comparison to the non-separated liquid manure.

These processing methods are recommended to companies producing strongly thinned liquid manure (low content of dry matter), whose utilization in raw status cause of the large volume is not effective, and also everywhere, where the liquid proportion of the liquid manure can be used for irrigation.

In case of these methods the solid substances contained in the liquid manure are separated from the liquid substances, during which there arises a solid and a liquid component.

By separation of the raw liquid manure it comes to its dividing into two parts:

- Liquid part with a small content of dry matter;
- Firm, solid part, which can be stored without problems.

The separated parts of liquid manure besides physical properties have also a different composition of nutrients, which is presented in the table 5.

Table 5 – Division of nutrients in percentages during the liquid manure's separation

Nutrient	Solid part	Liquid part
N	30 %	70 %
P	35 %	65 %
K	25 %	75 %

Note: source: Černý, M.: Processing of the liquid manure of farm animals by separation

As it can be seen, the liquid part contains more nutrients. The liquid part in comparison to non-separated liquid manure has such advantage, that no sedimentation occurs in it. Before the application of non-separated liquid manure it is necessary to homogenize the settled liquid manure, what is connected with additional investment and operation costs – consumption of energies, respectively of fuels for the operation of homogenizing facilities. Due to the storage of the liquid manure's liquid part noticeably is decreasing the negative impact on the atmosphere – smell creation. By the separation of liquid manure's parts is achieved their larger stability. During the

storage and application the losses of nitrogen are lower. The lower concentration of nutrients in the liquid part in comparison to non-separated liquid manure enables higher doses of liquid part on unit of area. The higher homogeneity of the separated liquid manure's liquid part in comparison to non-separated liquid manure enables the better and more simple application on the earth, reduces the risk of clogging, respectively the mechanical damaging of the application technique. By the application of the liquid part is reduced the risk that the lands fertilized by liquid manure will be overrun by weeds cause of the significantly reduced quantity of weed seeds contained in it, in comparison to non-separated liquid manure. The liquid part of the liquid manure segregated by separation represents smaller volume by 15 -30 % in comparison to non-processed liquid manure. For an agricultural company it means lower need for storage capacities of the liquid manure and lower number of extols of matured liquid manure to the field, what results on one side in reduced investment costs for the construction of tanks and on the another side in lower operation costs in form of depreciations of investments and fuel consumption of transport means.

The firm part is suitable for individual composting on free areas without ingredients of other materials; it does not flow away and does not smell. The high content of dry matter, in average from 25 up to 35 %, i.e. approximately as in case of humid sawdust particle, enables its trouble-free storage. The higher proportion of organic mass in comparison to non-separated liquid manure increases the proportion of humus in the earth. During the transport and manipulation with the firm part is not required any special outfit with agricultural technique. The composted firm part has better possibilities of realization outside the agricultural company as the non-processed liquid manure.

The separation itself, during which the components of liquid manure are separated, can be:

- One-stage – single separation of firm fraction from the liquid one, while both components are final products. It is the most frequently used method of separation.

- Two-stage – used for the achievement of 40 – 50 % dry mater firm component and for the processing of the firm component by multi-stage procedures (ultra-filtration, nitrification etc.) in order to achieve pure water.

- Thermophilic – enabling to achieve the dry matter of firm part above 60 % without the necessity of its further modification. Liquid component (condensate) is used like as a toss, or is recycled.

In case of various types of separation according to the dry matter content are chosen various methods of separation of the firm part:

- Sedimentation – energetically not demanding and effective separation method enabling to catch up to 80 – 85 % of firm substances. The sediment contains 8 – 11 % of dry matter and it can be pumped.

- Filtering – sieves, filters etc.
- Spinning – rotation sieves, spinning separators etc.
- Pressing – hydraulic presses, vibration presses and others.

However, in case of the liquid manure's separation it is necessary to emphasize, that the mechanical separation facilities have high consumption of energy. During the finalization of processing by drying finishing or granulation, the costs increase even more.

Sewage water treatment plant

The essence of this technology is the processing of the liquid manure's liquid proportion after the mechanical separation of firm parts by biological activation.

During purification the organic substances of the liquid part oxidize by aeration, partially are converted into biomass (which further is processed eventually liquidated) and the waste water usually after a technological cleaning process in several stages is charged out into the water sources.

For the main deficiencies of the liquid manure's cleaning methods can be considered the liquidation of essential parts of organic substances and nutrients contained in the liquid manure, the insufficient purification of the waste water charged out into the water sources and their subsequent eutrophication, and the high operational demandingness of these facilities.

The processing of liquid manure in the objects of sewage water treatment plants represents the use of highly specialized technologies. These have a high purchasing price with a subsequent large height of depreciations. Therefore only economically strong and sufficiently large breeding farms can afford such investments, where there are preconditions, that the high number of animals enables to reduce the costs for one unit of the final product to such rate that they are from the viewpoint of costs and prices competitive.

Biogas

The anaerobic fermentation means the use of a biologic-chemical process of decomposition of organic substances for biogas production. Here are used the groups of acid producing and formic bacteria. The whole process depends upon the:

- Composition and quality of the liquid manure;
- Anaerobic conditions of the environment;
- Temperature of fermentation and used tribe of microorganisms.

The result of the anaerobic decomposition process of the liquid manure is:

- Biogas, utilizable as an energetically rich fuel;
- Rotted sludge usable for fertilization;

– Sludge water, which before charging out into water sources can be purified by biological activation, and its quantity is app. 50 % of the liquid manure's input quantity.

The quantity of produced gas is shown in the table 6.

Table 6 – The daily volume of biogas in dependence from the category of pigs

Category of animals	dry matter of excretes and urine (kg/day)	Excretes totally (kg/day)	Biogas quantity (m ³ / day)
Boars (250 kg)	1,3	18,5	0,3
Sows (170 kg)	1,0	14	0,3
Fattening pigs (70 kg)	0,5	8,5	0,2

Note: source: Stupka, R. – Šprysl, M.: Breeding of pigs. Prag: ČZU

The actual calorific value of the gas produced in this way depends on its proportion of methane. This is in the range from 55 to 70 %. With the increasing proportion increases the calorific value as well. This is lower as in case of the natural gas (natural gas 29 – 42 MJ/m³, biogas 19.7 – 28.6 MJ/m³).

The method of the biogas use itself is given by local conditions. It is used for:

- Heat production;
- Electric energy production;
- Production of fuels.

Although this method of pig liquid manure's processing from the viewpoint of ecology is considered by experts for a perspective method of the third millennium, it is not possible to talk about its effectiveness. Its expansion is hindered by more factors:

- High investment and operational costs;
- Complexity of the waste-free operation;
- Personnel demandingness;
- High volume of sludge water;
- High losses of organic mass during operation (49 % of the original quantity);
- High losses N, P and K (74-86 %).

Incorporation of the liquid manure into the compost

The use of technologies based on the use of enzymatic preparations represents highly ecological procedures, since gases don't arise here, primarily ammonia, whose production here in comparison to the customary operation is limited by 70 %.

The total consumption of excrements is being reduced as well, because the excrements are processed together with the bedding and their total quantity represents 10 – 20 % of excrements from a usual operation. The reduction of the manure in case of mentioned technologies is one of the most significant factors. The processing of produced excrements with the bedding consists in their binding onto the bedding mass, their subsequent decomposition and after the evaporation of water together with the bedding material qualitative change to friable, dry and not smelling fertilizer. The fertilizer created in this way has a high quality, with high fertilizer value (see chapter 4.8), from the hygienic point of view the storage and application is trouble-free. The bedding also liquidates the smelling components of excrements, whereby significantly limits the smell in stabling objects and in their surroundings. By the exploitation of this system also falls away the contamination possibility of under-ground waters, because the correctly implemented bedding binds and processes all solid and liquid excrements.

The proportion of pure nutrients in the fermentation of bedding created in compost shows the following table 7.

Table 7 – Proportion of pure nutrients in the bedding substrate in %

Nutrient	N	P	K	Mg	Ca
Proportion in %	1.3	1.26	0.73	0.202	0.67

If there are sufficient suitable substrates, as for example residues of straws, turf, wooden chips etc., it is possible to process the liquid manure with these substrates by direct composting.

The process takes place in open spaces with occasional mixing of the composted material. The liquid manure with the addition of various materials represents a source of nutrients and energy for microorganisms and in the same time it enriches the own compost with nutrients including microelements. Large advantage of this method is:

- Reduction of smell during the application of compost in the surrounding of city agglomerations;
- Controlled fermentation course;
- Shortening of the maturation period;
- Higher binding of basic nutrients under the minimization of their floating into underground waters;

– Acquisition of organic substances from the non-agricultural sphere and their incorporation into the circulation of materials into the agriculture during their effective utilization.

Specific method of the processing of deep bedding is its composting directly in pens of stabling objects by use of enzymatic preparations (e.g. EnviStim, Ecofluid or Bio-Algeen G-40).

The bedding is created from a 40 – 70 cm high layer of a close-cropped straw or sawdust particles, into which the microbial preparation EnviStim is added.

On the properly working bedding is possible to breed up to five fattening cycles of piglets. In the bedding takes places a thermal reaction, which warms it up to 26 – 36 °C, while during this reaction all excrements are decomposed. The advantage of the system is also the minimal demandingness on the stabling object, which facilitates the situation of breeders, who have no investment sources for the construction of new stables. The bedding requires its maintenance consisting in the spreading of excrements on the whole surface, since the pigs usually put their excrements to one place only. It is spread 1 – 2 × weekly. The most important activity is the aeration - ploughing, since the oxygen is needful for the correct course of reaction. The EnviStim preparation is applied during each ploughing by simple scattering on the bedding's surface. If the bedding's temperature is reduced and it's humidity is increased, the reaction ends and it is necessary to replace the bedding. The use of this system usually burdens the economy of pig breeding by a sum app. 0.06 EUR per 1 kg of pig meat. But the production could be made more effective by the realization of the final substrate – compost in the market.

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