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COMPARATIVE STUDIES REGARDING THE NITROGEN COMPOUNDS IN WASTE WATERS FROM SMITHFIELD – PERIAM SWINE FARM, TIMIS COUNTY

STUDII COMPARATIVE PRIVIND COMPUSII AZOTULUI, DIN APELE REZIDUALE DE LA FERMA DE CRESTERE A PORCILOR SMITHFIELD – PERIAM, JUDETUL TIMIS

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The aim of presented study was to analyse and compare the nitrogen compounds in waste waters from a swine farm from the west of Romania and the environmental impact on the quality of surface water and groundwater. Water samples were taken from sites likely to be potentially sensitive to pollution, above, near and below the waste water discharge in the Mureş river and biopond units. Nitrogen concentrations from 652 mg/l at the pomp station 1 to 12.1 mg/l downstream 1 km after the discharge in the Mureş stream exceed the standard limits accepted for the surface waters. As regarding the ammonia concentrations are also very high, in the analysed samples for the old cleaning system, but lies under the admitted limits in the new system of wastewater cleaning. In conclusion, wastewater from Periam swine farm had a minor pollution impact for surface waters including for Mureş River, while in the new system some values for the nitrogen compounds lies over those obtained in the old system of wastewater cleaning.
Key words: nitrates, nitrites, ammonia, nitrogen, swine

Introduction

Livestock practice is the main contributor to environmental pollution of agricultural origin. Major efforts are required to evaluate the current situation of animal waste management with the aim to adopt the best environmental friendly technology for manure waste collection, storage, treatment and disposal. The recycling of pig slurry in agricultural soils is an alternative and valuable practice in countries with significant European pig production. From an agricultural perspective, the nitrogen content of the slurry needs to be determined to adopt ways of reducing its environmental impact. A major source of nitrates is farm animal wastes which contain large amounts of nitrogenous materials that may be converted into nitrates. The problem is more acute where farming is carried out

intensively. Nitrate is one of the most water soluble anions known. It is a widespread contaminant of ground and surface waters worldwide (Altman et al 1995). Fresh animal excreta does not contain N in the form of NO3. If manure is not aerated (e.g. by composting), NO3 will not be formed until after application to the soil.

Nitrites are formed in nature by the action of nitrifying bacteria as an intermediate stage in the formation of nitrates. Salts of nitrous acid (nitrites) are much more stable than the acid itself and are readily soluble in water with the exception of silver nitrite. A relevant aspect of pig farm units concerning the environmental impact is the ammonia emission from slurries, which is detrimental for animal (and sometimes also for human) welfare. Ammonia is released from intensive pig units and can affect ecosystems in various ways. Ammonia is the most common poison in the pig's environment. It may be toxic to some plants, either killing them outright or retarding their growth and development. Or, it may stimulate the growth and expansion of some plants by supplementing their nitrogen take-up (eutrophication), thereby eliminating more sensitive species. It is also an important component of acid rain (Portejoie et al., 2002). Nitrogen compounds in wastewater also have an impact on a river's oxygen resources. Sewage nitrogen can be broadly broken down into organic nitrogen compounds (such as proteins and urea) and ammonia. With time the organic nitrogen compounds are hydrolyzed to create additional ammonia. Autotrophic bacteria then assimilate the ammonia and create nitrite (NO2-) and nitrate (NO3-).

Materials and Methods

The experimental pig complex Smithfield -Periam has a size of thousand pigs and is considered to be one of the largest in Romania. Water samples were taken from sites likely to be potentially sensitive to pollution and samples for analyses were place in clean, six plastic containers and send to the laboratory immediately. The places were the water samples were taken are: the pumping station no.1; lagoon no.6, pumping station no.3; the discharge place of wastewater in Mureş River; 1 km downstream and 1 km upstream for surface water and from four boreholes for groundwater.

To avoid the concentration alteration, nitrates must be determinate in the day when samples were taken. The most suitable methods for the determination of nitrates and nitrites in surface and waste waters are colorimetric procedures using sodium salicylate for nitrates and 4-aminobenzenesulfonic acid (sulfanilic acid) and 1-naphthalenamine (l-naphthylamine) for nitrites. The colour intensity is read at spectrophotometer at a 410 mm length wave, using the vat of 1 cm optic path. The extinction value is read on the calibration plot obtaining the concentration in mg NO3/dm3. Ammonia retrieving from wastewater samples by distillation is made at pH =7.4 to can inhibit the hydrolysis of nitrogen compounds. Volumetric analysis or colorimetrically can make ammonia determination if the content is over 5 mg/dm3. Nitrogen from water is composed by organic nitrogen and mineral

nitrogen (ammonia, nitrates, nitrites). Nitrogen is mineralised with concentrated sulphuric acid and transformed in ammonium sulphate, which is distillate in a basic medium (Blicher-Mathiesen et al. 1999). As reagents were used: concentrated sulphuric acid (d = 1.84); sodium hydroxide 50%; accelerant compound consist of four shares potassium sulphate and one share copper sulphate; sulphuric acid 0.1 N; sodium hydroxide 0.1 N and methyl red 0.1.

Results and Discussion

According to the results shown in table 1 the higher quantity of nitrates was of 136.4 mg/l at pump station no.1 where manure come directly from the collectors placed at the shelters extremities. This quantity is over the value of 50 mg/l accepted for the surface waters by the standard quality.

Table 1
Values of nitrogen compounds in wastewaters – in the old cleaning system (2006)

Indicator	Values/ Sample place						Admitted values/ Quality standard
	PS1	DB6	PS3	Dg Mr	Dn Mr	Up Mr	
Nitrates (NO_3 -) mg/l max	136.4	127.3	123.2	178.4	**39.9**	21.4	**50**
Nitrites (NO_2-) mg/l max	5.3	4.1	3.6	1.30	**0.35**	0.3	**0.5**
Ammonia (NH_4+) mg/l max	525	391	298	4.1	**0.4**	0.2	**0.5**
Nitrogen (N) mg/l max	652	543	367	50.1	**12.1**	7.3	**10**

In the sample took at lagoon no.6 the quantity of nitrates was lower, of 127.3 mg/l which means that the value is over the standard of surface waters. At pump station no.3, is ascertain that the nitrates quantity was of 123.2 mg/l, which means that a major part of the nitrates decrease after the manure was store in the lagoons. The nitrate quantity ascertains at the place of wastewater discharge in the Mureş River was of 178.4 mg/l, lies over the standard for the surface waters. One km downstream after discharge in Mureş stream the nitrates concentartion of 39.9 mg/l. and in the water sample took one km upstream the place of wastewater discharge in the Mureş River of 21.4 mg/l, lie above the standard for the surface waters.

The nitrites concentration of 3.6 mg/l, is outrunning the standard limits accepted for all the surface waters classes at pump station three. The highest nitrites concentration was determined in the water sample took in pump station one, with a value of 5.3 mg/l being also over the all accepted standard limits accepted for surface waters approved by the National Council of Waters Resources.

Water samples took one km upstream and downstream, lies above the standard for the surface waters. In the sample took at the discharge of waste water in the Mureş River, nitrites concentration was of 1.3 mg/l, lies over the standard for the surface waters. As table above shows the nitrogen concentration is extremely high in the samples of wastewaters. Values decreasing from pump station one with 652 mg/l, to drying bed six – 543 mg/l and pump station three – 367 mg/l. Obviously all nitrogen concentrations exceed the standard limit accepted for the surface waters. Nitrogen concentrations decrease, from pump station three (367 mg/l) to only 50.1 mg/l, at the discharge in Mureş River. One km downstream nitrogen concentration was 12.1 mg/l and 7.3 mg/l one km upstream the Mureş River. Even these concentrations decreased are still more over the standard accepted for the surface waters.

In accordance with data table, ammonia concentration is also very high for the first three analyzed water samples. Value for the sample took at pump station one was of 525 mg/l and decrease till 298 mg/l in the sample took at pump station three. These values obviously lies over the standard accepted for the surface waters. Drying beds and pump stations reduce the ammonia concentration in waste waters, since at the discharging of waste water in Mureş River the ammonia concentration is 4.1 mg/l. One km downstream ammonia concentration decrease to 0.4 mg/l and one km upstream, ammonia concentration of 0.2 mg/l lies under the limit accepted for the surface waters.

In the new system of wastewater cleaning in Smithfield group with huge storage tanks and boreholes for pollution control, were registered the following data.

Table 2

Values for nitrogen compounds in the new system of cleaning in Periam farm of Smithfield group

Indicator	Values/ Sample	Values/ Quality standard
	2008	
Nitrates (NO3-)mg/l max	37,1	50
Nitrites (NO2-)mg/l max	0,02	0,5
Ammonia (NH4+) mg/l max	0,38	0,5
Nitrogen (N) mg/l max	15	10

As regarding the concentration of nitrates, the value for the analysed sample of 37.1 mg/l is under the standard limit for underground waters of 50 mg/l. In the new system of wastewater cleaning, value for nitrites in the borehole of 0.02 mg/l is under the standard value of 0.5 mg/l and lowest compare with the values found in the old system of waste water for nitrites. The ammonia value found in the borehole sample of 0.38 mg/l is situated under the limit admitted for underground water of 0.5 mg/l. But the nitrogen concentration with a value of 15 mg/l is over 10 mg/l, the maximum value which is provided in the Law 458/2002 changed and completed by the Law 311/2004. Manure slurry from concentrated pork production operations can be injected directly into the soil at the root zone. This practice preserves the valuable crop nutrients in manure, virtually eliminates odor and runoff potential and places the nutrients where crops can use them (Addy et al. 2002). Hog manure is very valuable in restoring soil productivity and will bring soil back to a higher level of productivity than it had before because of the organic nutrient content. Ammonium nitrogen content in the groundwater from different holes was low and did not vary considerably. The nitrite and nitrate presence can be caused both by their migration, and by nitrification and nitrate reduction in the ground. Nitrate reduction could have taken place due to a good supply of oxidizable organic matters (Diez et al 2003). Simultaneous presence of nitrites and ammonium nitrogen in the ground water demonstrates water pollution and makes the water undrinkable.

Conclusions

1. Maximum concentration of nitrates was registered in the water sample took at the pump station one, of 136.4 mg/l in the old system of wastewater cleaning.

2. The wastewaters nitrites concentration is variable in different places samples were taken, values among 5.3 at PS1 in the old system and 0.02 mg/l in the new cleaning system.

3. Producers have to understand how manure impacts air and water quality and reduce the amount of material entering in the underground waters.

4. Protection of our water resources from contamination must be a high priority of the pork industry.

7. Repeated application of pig slurry to agricultural soils may result in an accumulation of salts and a risk of aquifer pollution due to nitrate leaching and salinisation.

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