

**ADSORPTION PROPERTIES OF SORBENTS IN PIG SLURRY
FROM THE MICROBIOLOGICAL POINT OF VIEW****Zuzana Pačajová, J. Venglovský, Marija Vučemilo, Alenka Tofant****Summary**

Adsorption properties of two natural sorbents, zeolite and bentonite, were investigated by observation of microbiological and physical-chemical parameters in pig slurry. After 28 days experimental period a marked decrease in the numbers of mesophilic and psychrophilic microorganisms was detected while coliform and fecal coliform microorganisms decreased to zero. Both sorbents contributed to better sedimentation of suspended particles and decreased odour. Results point to the possible utilization of sorbents in the initial stages of pig excrement treatment.

Key words: pig slurry, zeolite, bentonite, microbiological parameters

Introduction

An increased stress on the improvement of the living environment is characteristic of the recent period. It is difficult to determine exactly the relationship between the existing agricultural practice and environmental pollution (Pokorný, 1994; Strauch, 1980, 1992). Intensification in animal production occurring under present conditions is accompanied by the development of new animal hygiene - epizootiological relationships (Vasiľ, 1994) which changes the conventional view of majority of diseases caused by viruses, bacteria and mycotoxins (Vasiľ, 1996, Makóová et. al., 1998) and at the same time results in production of large quantities of side products which can cause considerable economical problems. One of the possibilities of prevention of unfavourable impact of excrements on the quality of the

Zuzana Pačajová, J. Venglovský, Research Institute of Veterinary Medicine, Košice, Slovak Republic; Marija Vučemilo, Alenka Tofant, Faculty of Veterinary Medicine, Univerzity of Zagreb, Croatia.

environment and decrease of hygiene risks is the construction of water treatment plants.

The treatment plants used for processing wastewaters from animal farms apply technologies starting with separation of liquid and solid fractions of slurry on vibrating screens or press belts. The liquid fraction is treated biologically, using frequently the aerobic processes, and the effluent is discharged into the recipient. The solid fraction is transported to field heaps or dumps and subsequently used for manuring the agriculture crops. However, the problem of processing and utilization of animal excrements has not yet been solved to complete satisfaction (Venglovský et al., 1992; Ondrašovič, et al., 1996; Juriš et al., 1994).

The questions of the use of zeolites in order to reduce the ecological risks have been studied also by Kovanda et al., 1997, Králová et al., 1994.

Our study was aimed at obtaining additional information which could help to resolve the problems encountered in wastewater treatment plants and also the problems which arise within ecological manipulation with farm animal wastes. In this connexion we tested the microbiological and physical-chemical properties of natural zeolite and bentonite.

Materials and methods

The aim of the present study was to determine the possibilities of utilization of natural zeolite and bentonite in the treatment of pig slurry from large capacity pig farm in Košická Polianka.

Zeolites are crystalline hydrated aluminosilicates containing cations of alkaline metals and metals of alkaline earths. Bentonites are natural aluminosilicates. The essential component of bentonites is mintmorillonite having crystals of the smallest size of all clay materials (Dvořák, 1989).

Zeolite (powder, from Nižný Hrabovec) and bentonite (powder, from Jelšový Potok) were added to slurry in the amount of 250 g per 5 l. The mixture obtained was mixed for 10 min and stored at laboratory temperature. Slurry unamended with zeolite or bentonite served as a control. The temperature of the slurry during the storage ranged from 18 to 19 °C. Samples for microbiological and physical-chemical examination were taken from mixtures with zeolite and bentonite and from the control after 30 min, 2 and 24 h and 7, 14 and 28 days of storage.

Analyses were carried out according to STN 83 0531 (1978) and Štěpánek (1982). They included determination of total number of

psychrophilic, mesophilic, coliform and fecal coliform microorganisms and salmonellae. Incubation was carried out on meat-peptone agar, Endo agar and XLD agar (Imuna, Šarišské Michaľany) at 20 °C, 37 °C and 43 °C during 24 to 72 h. After dilution of the sample, 0.1 ml aliquots were transferred to the solid nutrient media. Colony forming coliform and fecal coliform germs and salmonellae were counted after 24-48 h and psychrophilic microorganisms after 72 h. Similar procedure for determination of the number of microorganisms was used after 2 and 24 h and after 7, 14 and 28 days.

Results

The influence of an addition of zeolite and bentonite on the number of selected groups of microorganisms was observed and the results are summarised in Tables 1 and 2. The results indicated that the plate counts in the control mixture were in the range $8.8 \cdot 10^6$ - $9.1 \cdot 10^9$. The most marked decrease in the plate counts in mixtures with zeolite or bentonite was observed after 28 days of storage (99.9% per cent of effectiveness).

Table 1. - MICROBIOLOGICAL ANALYSIS OF PIG SLURRY AMMENDED WITH ZEOLITE (Z) AND THE EFFECTIVENESS IN % IN COMPARISON WITH THE CONTROL (K)

Zeolite	Mesophilic MPA	Psychrophilic MPA	Coliform EA	Fecal coliform EA
Control	$4,9 \cdot 10^8$	$9,1 \cdot 10^9$	$7,0 \cdot 10^7$	$8,6 \cdot 10^6$
After 30 min.	$9,8 \cdot 10^7$	$3,4 \cdot 10^8$	$3,3 \cdot 10^6$	$7,3 \cdot 10^5$
% effect.	80,0	96,3	95,3	91,5
After 2 h	$9,6 \cdot 10^7$	$9,1 \cdot 10^7$	$5,6 \cdot 10^6$	$4,3 \cdot 10^4$
% effect.	80	99	99,2	99,5
After 24 h	$9,6 \cdot 10^7$	$3,6 \cdot 10^7$	$9,2 \cdot 10^5$	$4,2 \cdot 10^4$
% effect.	80,0	99,6	98,6	99,5
After 7 days	$4,6 \cdot 10^7$	$9,9 \cdot 10^6$	$3,7 \cdot 10^5$	$3,4 \cdot 10^4$
% effect.	90,6	99,8	99,5	99,6
After 14 days	$3,3 \cdot 10^6$	$9,3 \cdot 10^6$	-	-
% effect.	99,3	99,8	-	-
After 28 days	$7,6 \cdot 10^4$	$8,8 \cdot 10^4$	-	-
% effect.	99,9	99,9	-	-

The numbers of microorganisms in the liquid fraction with zeolite added, determined after 30 min of contact, varied from $7.3 \cdot 10^5$ to $3.4 \cdot 10^8$ while in the mixture amended with bentonite they ranged from $3.9 \cdot 10^6$ to $9.2 \cdot 10^7$. Two hours and 24 h after addition of zeolite and bentonite the numbers of microorganisms varied from $3.2 \cdot 10^4$ to $9.6 \cdot 10^7$. After 7 days of storage no fecal coliform microorganisms were detected while their number in the mixture with zeolite reached $3.4 \cdot 10^4$. In both the mixtures only mesophilic and psychrophilic germs were found after 14 days of storage. The highest effect was observed after 28 days when mesophilic and psychrophilic plate counts reached the level of the order of 10^4 .

Table 2. - MICROBIOLOGICAL ANALYSIS OF PIG SLURRY AMMENDED WITH BENTONITE (B) AND THE EFFECTIVENES IN % IN COMPARISON WITH THE CONTROL (K)

Bentonite	Mesophilic MPA	Psychrophilic MPA	Coliform EA	Fecal coliform EA
Control	$4,9 \cdot 10^8$	$9,1 \cdot 10^9$	$7,0 \cdot 10^7$	$8,6 \cdot 10^6$
After 30 min.	$8,9 \cdot 10^7$	$9,2 \cdot 10^7$	$7,6 \cdot 10^6$	$3,9 \cdot 10^6$
% effect.	81,8	98,9	89,0	54,6
After 2 h	$8,8 \cdot 10^7$	$8,9 \cdot 10^7$	$3,6 \cdot 10^6$	$9,8 \cdot 10^4$
% effect.	82,0	99,0	94,8	98,8
After 24 h	$4,1 \cdot 10^7$	$9,3 \cdot 10^7$	$5,6 \cdot 10^5$	$3,2 \cdot 10^4$
% effect.	91,6	98,9	99,2	99,6
After 7 days	$4,1 \cdot 10^7$	$7,4 \cdot 10^6$	$3,1 \cdot 10^4$	-
% effect.	91,6	99,9	99,9	-
After 14 days	$3,2 \cdot 10^6$	$6,8 \cdot 10^6$	-	-
% effect.	93,4	99,9	-	-
After 28 days	$4,3 \cdot 10^4$	$6,4 \cdot 10^4$	-	-
% effect.	99,9	99,9	-	-

In one case only, in the liquid fraction of the control mixture without zeolite or bentonite, we detected salmonellae. The samples taken from mixtures with zeolite and bentonite were salmonella free. Sedimentation of mixtures of slurry with zeolite and bentonite differed. The slurry amended with zeolite sedimented as described by Vargová et al. (1994) while that amended with bentonite formed almost homogeneous mixture without any supernatant (Sasáková et al., 1997). The separation of liquid and solid fractions in the latter mixture occurred within 24 h of storage.

Discussion and conclusion

With regard to the possibility of utilization of natural zeolite and bentonite in environmental protection and the influence of the materials mentioned on viability of pathogenic microorganisms the available literary sources show that the effect of zeolitic materials used in the treatment of excrements has not been studied previously from the point of view of their effect on plate counts of different groups of microorganisms. Little attention was paid to their influence on sedimentation of suspended solids. Despite relatively high per cent of effectiveness of decrease of the microorganisms mentioned, recorded in our experiments, the final plate counts were high (Pačajová et al., 1996). The decrease observed is important when it is associated with marked decrease in chemical contamination (Vargová et al., 1994, 1995). The results obtained point to the possibility of use of zeolite and bentonite in the treatment of excrements of farm animals. The addition of zeolite to the solid fraction can contribute to its better utilization in plant production.

The results obtained in our study point to the fact that the effect of zeolite and bentonite added to pig slurry appeared as early as after 30 min., however, the highest effect was observed after 28 days when 99.9% effectiveness of removal was recorded.

The subsequent studies should concentrate on determination of the amount of sorbents with regard to decrease in plate counts of different groups of microorganisms and the relevant economical evaluation.

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ADSORPTIVNA SVOJSTVA SORBENATA U TEKUĆEM SVINJSKOM GNOJU S MIKROBIOLOŠKOG GLEDIŠTA

Sažetak

Adsorptivna svojstva dva prirodna sorbenta, zeolita i bentonita, istraživana su promatranjem mikrobioloških i fizikalno-kemijskih parametara u tekućem svinjskom gnoju. Nakon 28 dana eksperimentalnog perioda zabilježen je izrazit porast broja mezofilnih i psihofilnih mikroorganizama, dok je broj koliformnih i fekalnih koliformnih mikroorganizama iznosio nula. Oba sorbenta doprinijela su boljoj sedimentaciji suspendiranih čestica te smanjila neugodne mirise. Rezultati ukazuju na moguće korištenje sorbenata u početnom stadiju tretiranja ekskremenata svinja.

Ključne riječi: tekući svinjski gnoj, zeolit, bentonit, mikrobiološki parametri

Primljeno: 15. 12. 2001.