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ANIMAL RENDERING PROBLEMS AND ENVIRONMENTAL PROTECTION

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Summary

The serious risk to the environment resulting from animal carcasses, slaughter offal and animal derived products can be decreaseed by the proper operation of animal rendering plants. This includes the way of collection of raw materials, control of technological processing lines, filtering of waste air and treatment of wastewaters. With regard to high contamination of raw materials processed the good effectiveness of treatment of wastewaters and air is an important factor in prevention of disease outbrakes and contamination of environment with toxic substances and odour. The treatment of the exhausted air by scrubbers and biofilters installed in the plant investigated ensured absorbing 97.6% of of the odours. The mechanical-chemical-biological wastewater treatment plant produced effluent which met the criteria set by regulations valid in Slovak Republic (BOD_5, COD, N - NH_4, SS, Extractible matter). The content of heavy metals and other elements of ecological importance in raw and treated water showed considerable decrease for Pb, Cu and Zn. The values of the elements investigated found in the sludge were acceptable for its application in agriculture.

Introduction

The carcasses, slaughter offal, and animal derived products pose a serious risk to the health of livestock and human population if they are not disposed of quickly and properly. The hygienic-epidemiological principles of prevention of danger to man, animals, soil and water resulting from animal wastes including the materials mentioned above, concentrate on a number of essential elements including the rendering technology.

At present, five rendering plants are in operation in the Slovak Republic. They participate in collection and harmless processing of killed animals which

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are not used for human consumption, parts of slaughtered animals including blood, bristles, feathers, fells, hides, horns, claws, bones and wool, as well as slaughter offal of healthy animals, complying with valid Slovak legislation concerning the confiscates of animal origin. One of them is the rendering plant in Senec which is situated in the most productive agricultural area of Slovakia and from the technological point of view belongs among the up-to-date rendering plants. Besides using a new modern computer-controlled technological line for processing the raw materials, it is equipped with a waste air scrubbing and filtering system and supplemented with a mechanical-chemical-biological wastewater treatment plant built by the firm ČOVSPOL s.r.o. Bratislava.

The aim of the study was to evaluate the effectiveness of the treatment of wastewaters from the microbiological and chemical point of view and to determine the dontent of selected elements in raw and treated wastewater and in the sludge.

Material and methods

Rendering and water treatment processes

The raw materials brought to the rendering plant are collected in enclosed receiving chutes to prevent contamination of the working environment. Accordint to the character of the material, a programmed preliminary special processing (crushing, disinfection, etc.) was followed by sterilization at 133 °C and pressure 0.3 MPa for 20 min., and drying of the material obtrained. The entire technological process is computer controlled. Negative pressure ventilation ensures 4-6 air exchanges per hour in the hermetically closed operational building. The exhausted air passes through water scrubbers and biofilters capable of absorbing 97.6% of the odours present (109.5 odour units before the biofilter and 3.5 odour unitts behind the filter). The treatment of wastewaters from the rendering plant is carried out in a mechanical - chemical - biological wastewater tretment plant. The wastewater fed to the treatment plant consists of waters from sterilization, dissection, rinsing and washing which are subjected to sterilization before feeding them to the wastewater treatment plant. After the mechanical and chemical primary treatment (adjustment to pH>9 and primery sedimentation), the biological treatment of wastewater is carried out in two activation tanks divided to sections allowing to create oxic and anoxic zones. After the secondary sedimentation, the excess sludge is mixed with the primary sludge, passes through a thickening tank, an organic coagulant is added and dewatering by means of a belt press is carried out.

Microbiological and chemical examination

The microbiological examination consisted in determination of plate counts of psychrophilic, mesophilic, coliform and fecal coliform microorganisms according to ČSN 830531 standard and Štěpánek (1982). Special selective media (Christensen's agar, XLD agar and SS agar) were used to examine the wastewater samples for the presence of salmonella microorganisms.

The chemical examination of raw wastewater from the rendering plant and the treated effluent for the values of biochemical oxygen demand in five days (BOD_5), chemical oxygen demand (COD), ammoniacal nitrogen ($N\text{-}NH_4$), solid substances (SS), extractible matter (fats, oils) and pH was carried out according to the valid ČSN 83 0540 (1987) standard, Horáková et al. (1986) and Sedláček et al. (1978). The content of heavy metals in the influent, effluent and sludge was determined by the method of atomic absorption spectrophotometry (AAS) in agreement with the Standard Methods for Examination of Water and Wastewater (1985).

Results and discussion

The results of microbiological and chemical examination of raw and treated wastewater and sludge are presented in the Tables 1 to 3 as mean values (n=8) and the range.

Table 1 - BACTERIOLOGIC PARAMETERS DETERMINED IN INFLUENT, EFFLUENT AND SLUDGE

	Mesophilic	Psychrophilic	Coliform	Fecal coliform
Influent	5.1×10^7	2.3×10^7	5.3×10^4	2.3×10^4
CFU. ml^{-1}	(2.8×10^5 - 1.3×10^8)	(2.3×10^5 - 1.1×10^8)	(2.0×10^2 - 9.8×10^4)	(0 - 8.6×10^4)
Effluent	7.1×10^5	4.8×10^5	1.1×10^3	1.3×10^3
CFU. ml^{-1}	(4.1×10^4 - 1.9×10^6)	(6.7×10^4 - 2.3×10^6)	(0 - 5.0×10^3)	(0 - 4.7×10^3)
Effectiveness %	98.6	97.9	97.9	97.1
Sludge	3.4×10^7	2.7×10^6	3.8×10^4	2.7×10^4
CFU. ml^{-1}	(1.3×10^6 - 1.6×10^8)	(1.1×10^5 - 1.1×10^7)	(0 - 8.5×10^4)	(0 - 9.2×10^4)

Animal rendering plants occupy a special positon in the protection of the environment. They form an essential link in the chain of processes aimed at safe disposal of animal carcasses and wastes of animal origin. If operated properly, they can prevent spreading of contagious diseases, contamination of water bodies, soil and feedstuffs as well as serious economical problems. Although the materials processed in rendering plants are, as a rule, subjected to

sterilization, the wastewater produced at rendering operations must be subjected to proper treatment before discharging them into the recipient as they can be contaminated by runoff water from washing rooms, social facilities, truck washing area, hide room, etc. With regard to the material processed as well as the high concentration of organic substances the plate counts of various groups of microorganisms, including pathogens, in rendering plants wastewaters are very high (Larsen and Much; 1986, Ondrašovičová, 1989). Disregarding the rules set on the basis of public health protection rules can lead to disease outbreaks and contamination of the environment with toxic substances and odours. The microbial component of rendering plant wastewaters and sludge poses a serious problem and is a constanc challenge to environmental and animal hygienists (Ondrašovičová et al., 1991; Novák 1994; Lauková and Juriš, 1997).

Table 2 - CHEMICAL PARAMETERS DETERMINED IN INFLUENT, EFFLUENT AND SLUDGE

Parameter	Influent	Effluent	Max. accept value	Effectiveness %
BOD_5 mg.l^{-1}	6760	31 (21 - 39)	50	99.5
COD mg. l^{-1}	9650	158 (98 - 232)	250	98.4
$N\text{-}NH_4$ mg. l^{-1}	1030	27 (25 - 30)	30	97.4
SS mg. l^{-1}	1916	15 (6-25)	50	99.2
Fats, oil mg. l^{-1}	80 - 190	< 1.0	10	
pH	8.4	7.2	not specified	

Table 3 - CONTENT OF HEAVY METALS AND OTHER ELEMENTS - AVERAGE VALUES

	Cd	Pb	Hg	Cu	Co	Zn	Mn	Fe	Na	K	Mg	Ca	Dry mater
							mg. l^{-1}	water					%
Influent	0.020	0.150	< 1	0.15	0.040	0.880	0.330	5.770	252.700	32.30	27.200	95.00	0.47
Effluent	0.020	0.090	< 1	0.06	0.040	0.190	0.240	0.670	200.400	25.40	24.600	154.200	0.31
							mg. kg^{-1} dry mater						
Sludge	1.570	19.09	< 1	35.71	7.06	291.70	33.900	5154.00	1989.00	680.2	2564.00	47619.0	19.11

The results obtained and summarized in the tables show that the water treatment plant operating at the rendering plant in Senec reached good effectiveness of removal of biodegradable and nonbiodegradable pollution which exerts demand on the exygen dissolved in water (99.5% and 98.4% effectiveness on average of removal of BOD_5 and COD, respectively). The concentrations of ammonia nitrogen, one of the most common poisons to fishdischarged to water courses, did not exceed the maximum acceptable value even at its very high levels in the influent (30 mg. l^{-1}, 97.4% effectiveness on

average). The removal of solid undissolved substances (99.2%) was also very high and satisfied the requirements. The wastewater from rendering plant often contain high amount of extractible matter (fats, oils) which can be a source of problems in the receiving water courses. The removal of these substances by the wastewater treatment plant investigated was very good and less than 1 mg. l^{-1} was detected in the effluent in all examinations. None of the investigated parameters of chemical pollution exceeded those set by the water management authorities.

The numbers of observed groups of microorganisms determined in raw and treated wastewater showed a decrease by one to two orders of magnitude. The numbers of coliform and fecal coliform organisms that serve as principal indicators of fecal contamination reached the values of the order of 10^4 in the effluent. Salmonella organisms were not detected.

The content of heavy metals and other elements shown in Table 3, determined in the raw and treated wastewater and in the sludge produced indicates that the treated wastewaters do not contribute considerably to environmental pollution with these chemical componentes. Considering the possible use of sludge for land disposal, the values in sludge did not exceed the values determined in "normal sludge" as specified by Over et al. (1988).

Conslusion

Proper operation of rendering plants and associated facilities contributes to effective prevention of disease trensmission to animals and man and spreading of pathogens and pollutants to the environment. This presupposes appropriate measures at collecting, handling and processing of carcasses and effective treatment of produced wastewaters that arise from this process.

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PROBLEMI ZBRINJAVANJA ANIMALNOG OTPADA I ZAŠTITA OKOLIŠA

Sažetak

Životinjske lešine, klaonički otpad i proizvodi animalnog porijekla predstavljaju ozbiljan rizik za okoliš koji se može umanjiti pravilnim radom kafilerije. Tu su uključeni način sakupljanja sirovine, kontrola tehnološkog procesa, filtriranje otpadnih plinova te obrada otpadnih voda.

S obzirom na veliku zagađenost sirovina važno je pri obradi otpadnih voda i zraka postići visoku djelotvornost jer je to uvjet i važan čimbenik u suzbijanju bolesti i zagađenja okoliša toksičnim tvarima i mirisima.

Obrada ispušnog zraka propiranjem i biofilterima osigurava uklanjanje 97.6% mirisa. Mehaničko-biološkom obradom otpadnih voda efluenti zadovoljavaju važeće kriterije u Slovačkoj za BPK_5, KPK, $N\text{-}NH_4$, suhu tvar.

Sadržaj teških metala i drugih elemenata od ekološkog značenja u neobrađenoj i obrađenoj vodi pokazuje značajno smanjenje Pb, Cu i Zn.

Vrijednosti istraženih elemenata u otpadnom mulju pokazuju da je prihvatljiv za primjenu u poljoprivredi.

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