

CHARACTERISTICS OF EFFLUENTS FROM MEAT PACKING PLANTS

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РЕЗЮМЕ

Были проведены исследования с учетом определения физико-химической и микробиологической характеристики сточных вод с мясокомбинатов — небольшого и среднего типа, в зависимости от ряда факторов, обуславливающих эту характеристику.

На основании полученных результатов разработаны типовые проекты биологических станций очистки для мясокомбинатов небольшого и среднего типа.

При разработке проектов предусмотрено оборудование, обеспечивающее легкое обслуживание станции очистки и полную стабилизацию линии грязи с учетом ее осадки и уничтожения вредной микрофлоры.

Станции очистки сообразны с неравномерностью суточного притока сточных вод без необходимости дополнительного оборудования и характеризуются небольшой застроенной площадью.

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On a effectué des recherches pour la détermination des caractéristiques physico-chimiques et microbiologiques des eaux résiduelles des abattoirs — de dimensions petites et moyennes — en dépendance de beaucoup de facteurs déterminant ces caractéristiques.

A la base des résultats obtenus on a élaboré des projets-modèles des stations biologiques d'épuration pour les abattoirs de dimensions petites et moyennes.

Lors de l'élaboration des projets, on a envisagé des équipements, assurant le service plus facile de la station

d'épuration et une stabilisation totale de la boue inutile en vue de son dessèchement et de l'élimination de la microflore nocive.

Les stations d'épuration sont conformées à l'inégalité de l'afflux journalier d'eaux résiduelles, ce qui n'exige pas des équipements supplémentaires, et occupent un petit terrain.

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Studies were carried out with a view to the determination of the physico-chemical and microbiological characteristics of effluents from small and medium type meat packing plants, depending on a number of factors determining those characteristics.

On the basis of the results obtained, standard designs of biological purification stations for small and medium type meat packing plants were developed.

In the development of the designs, equipment was envisaged, ensuring easy service of the purification station and complete stabilization of excess slurry with a view to its drying and the elimination of harmful microflora.

The purification stations are in conformity with the irregularity of the daily influx of effluents so that no additional equipment is required, and are characterized by a small built area.

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Es wurden Untersuchungen durchgeführt zur Bestimmung der physikalisch-chemischen und mikrobiologischen Charakteristik der Abwässer aus Fleischkombinaten kleinen und mittleren Typs in Abhängigkeit von einer Reihe Faktoren, durch welche diese Charakteristik bedingt wird.

Aufgrund der erhaltenen Ergebnisse wurden Typenprojekte von biologischen Abwasserreinigungsanlagen für Fleischkombinate kleinen und mittleren Typs ausgearbeitet. Bei der Ausarbeitung der Projekte sind Einrichtungen vorgesehen, die eine leichte

Wartung der Kläranlage und eine volle Stabilisation des Überschlussschlammes mit Rücksicht seiner Austrocknung und der Vernichtung der schädlichen Mikroflora gewährleisten.

Die Kläranlagen sind unter Berücksichtigung der Ungleichmässigkeit des täglichen Abwasseranfalls so gestaltet, dass keine zusätzlichen Einrichtungen notwendig sind, und werden somit durch eine kleine Anbaufläche gekennzeichnet.

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Many meat and poultry slaughter enterprises are situated in towns and cities, and their waste waters flow in the town or city sewer system, where purification of these waters is made using the city purification system. The problem with the waste waters from slaughter enterprises is, to achieve a minimum load of blood, fats and hard components (stomach contents, meat particles, gut pieces and others).

Practice has accepted, in accordance with the type of slaughter enterprise, two major solutions:

- maximum retaining capability for the said products, by mechanical means (mechanical cleaning) which is possible for slaughter enterprises in populated areas with existing city sewer purification system;

- prebraking the mechanical mixtures including stomach contents, to an acceptable size and then getting the waste waters in the city collector - or purification system. This is possible for slaughter enterprises which flow their waste waters in stations for cities of 800,000 to 1,000,000 inhabitants.

There are also enterprises out of inhabited areas, which flow their waste waters directly into a collector. These waters should be purified to a degree determined by the category and type of the collector.

To accept one or another system for waste water purification depends on many factors, but the main ones are the quantity of the waste waters and their character. Depending on whether we only have a slaughter enterprise or a complete packing enterprise, the quantity and character of the waste waters

varies strongly. The accepted technology beginning with the arrival of the animals down to meat expedition to market or for further processing, is the determining factor for the character of the waste waters. In countries, where the production and processing of meat is effected in state owned enterprises, with an all unified technology, it is possible and imperative to characterise the waste waters, taking into consideration the size of the enterprise, the season, month, week, day and hours, so that a full characteristic could be made. During the passed several years have been made systematic investigations on waste waters on the bases of which have been obtained the following results:

	<u>mean values</u>
pH	6.7
BOD ₅	975 mg/l
fats	345 mg/l
admixtures total	1190 mg/l
admixture after 600°C	250 mg/l
soluble substances - total	1140 mg/l
soluble substances after heating	334 mg/l
total nitrogen	62 mg/l
chlorides	3172 mg/l

Having taken into consideration data published in literature (1, 2, 5) we have accepted the following characteristic for the waste waters:

pH	6.5 - 7.8
BOD ₅ on the sedimented for 2 hours sample	520-980 mg/l
oxydation O ₂	110-320 mg/l
oxydation KMnO ₄	1420 mg/l
total dry residue 105°C	990-1300 mg/l
after 600°C	415-540 mg/l
unsolved substances	650-1700 mg/l
fats	180-400 mg/l
chlorides	400-2000 mg/l

The comparatively low degree of pollution in the waste waters from the packing houses in our country is due to the elevated expenditure of fresh water in the slaughter and processing of the meat, imposed by the high sanitary requirements in the country.

Characteristic of the waste waters from poultry slaughter enterprises varies somewhat:

pH	6.5 - 7.5
BOD ₅ (of the sedimented for two hours sample)	537 mg/l
oxydation O ₂	230 mg/l
oxidation KMnO ₄	912 mg/l
total dry residue 105°C	1162 mg/l
after 600°C	394 mg/l
losses after 600°C	768 mg/l
unsoluble matter	286 mg/l
after burning	35 mg/l
soluble substances at 105°C	876 mg/l
after 600°C	359 mg/l
losses after 600°C	517 mg/l
sulphates	44 mg/l
fats (ether extracted)	138 mg/l

We have accepted the following norms for pollution of waste waters reduced to equivalent, respective number of inhabitants, as follows:

slaughter of cattle for 1 unit	120-160 inhabitants
pigs	14-16
sheep and goats	6-8
of four birds	1

On the base of the output of the slaughter packing house, this could be distributed into four groups, as follows:

small type - with an output of	- to 20 tons/days
middle type- " " " "	- to 30-50 tons/day
big type - " " " "	- above 50 tons/day

Depending on the site the meat or poultry slaughter enterprise is situated, the character of the waste waters and the way they are conducted, we have accepted definite patterns for their purification. The accepted patterns are based on our own experience and world practice (1, 3, 4, 6, 7).

The purification of the waste waters itself could be divided into:

1. Coarse purification applied to packing houses which flow their waste waters in the city's sewer system. In such case the purification systems consist of:

- coarse and fine grids
- sand catching grid
- fat retainer

To eliminate all decay processes are envisaged aeration devices for waters, flowing through the equipment. With the bigger packing enterprises the grids are mechanized. The pollution material detained is being processed in rendering departments. To safeguard and help the fat retainer, in the bigger packinghouses such devices are usually planned on a workshop or department bases.

2. Biological purification, on the bases of the determined characteristics of the waste waters, are considered projects and designs for the biologic purification. Basic equipment for these is:

- a) mechanized grid with cutting (comminuting) machine
- b) biologic pond - low load
Volume load 0,5 - 0,7 kg BCD₅/kg C.B./day
- c) Secondary sedimentation - radial construction - 2 hours water delay.
- d) foam breaker
- e) sile for overquantities of active mud (sludge) for 2 - 3 months.
- f) drying fields

The stabilization of the sedimented active sludge is effected in the biopond.

Destruction of eggs from Ascarides and Helminths contained in the sludge is effected by the 2 - 3 months long storage in the silo.

Biologic purification of waste waters from poultry slaughter enterprises has its own peculiarities. We have conducted basic investigations with an purification station in one of the poultry slaughter enterprises in this country, and give some details herein. The station was built and has attained a total biologic purification involving the following equipment:

- coarse grid

- biologic trench (aeration by means of Kestner drum)

- secondary sedimentator

- silo for the surplus sludge

- drying fields

Initial capacity of the station was 1.100 m^3 . At times this station was overloaded up to 50 - 60%, but still functioned very well. The results obtained, as well as all analyses made were effected during a period of three years. The diagrams at the end of this paper give the monthly characteristics of performance for this purification system during the month of august 1972.

From year round investigations of the system is seen that the station works with a sludge index of 100 - 200, with dry substance of the biologic mixture of 4 - 7.5 g/l. The biologic sludge with very few exceptions has a very good sedimentary characteristics. Very interesting for this station is, that it works with relatively high load of sediment, i.e. 600 - 900 mg/l. The sedimentation capacity varies with the volume of the sediments and represents 80 - 120% from the total inflow of waste waters. This permits a partial mineralization of the active sludge in the biologic purification process as well as a downfall of the volume.

The transfer of the active sludge is effected periodically i.e., when the sedimented sludge exceeding 850 mg/l is ready. Then the excess sludge is pumped out in a special silo where the fermentation process continues. The fermented sludge, taken out on the drying fields is without any bad smell and has good drying quality.

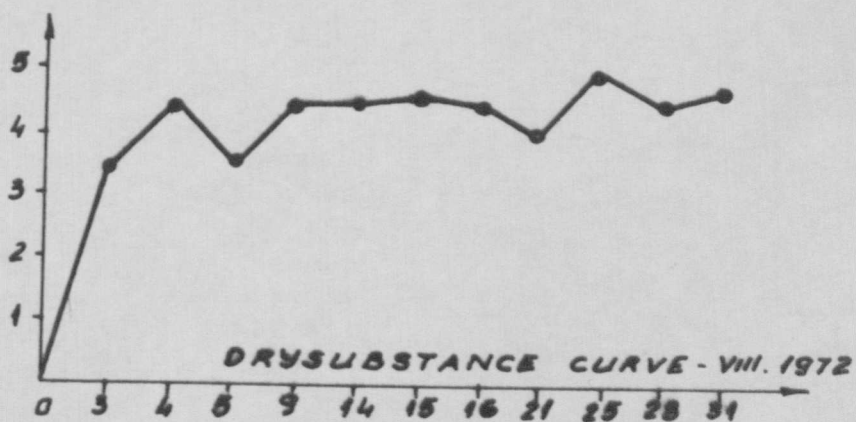
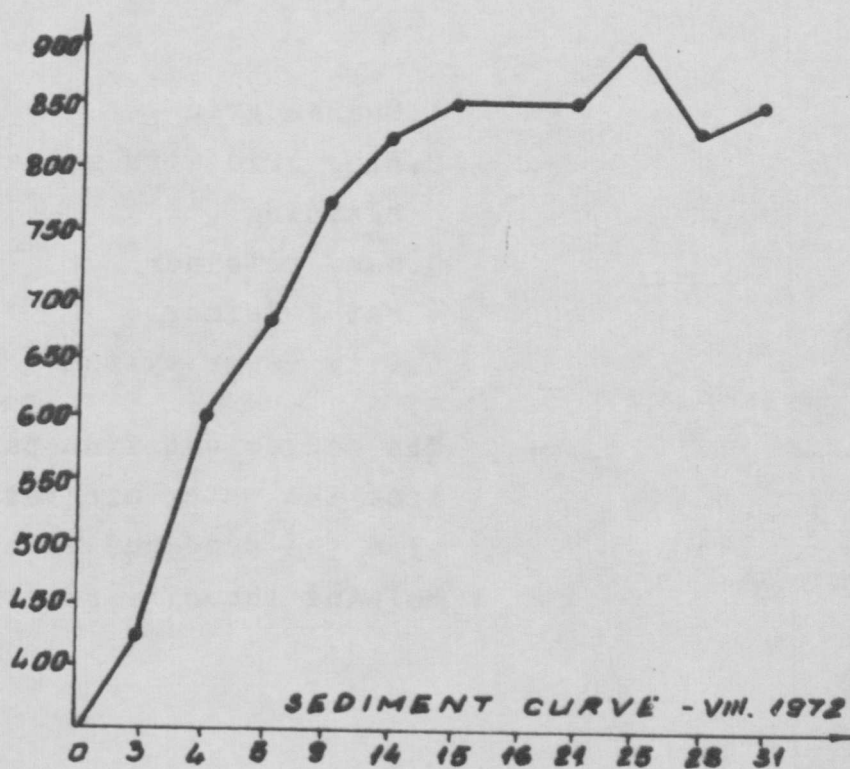
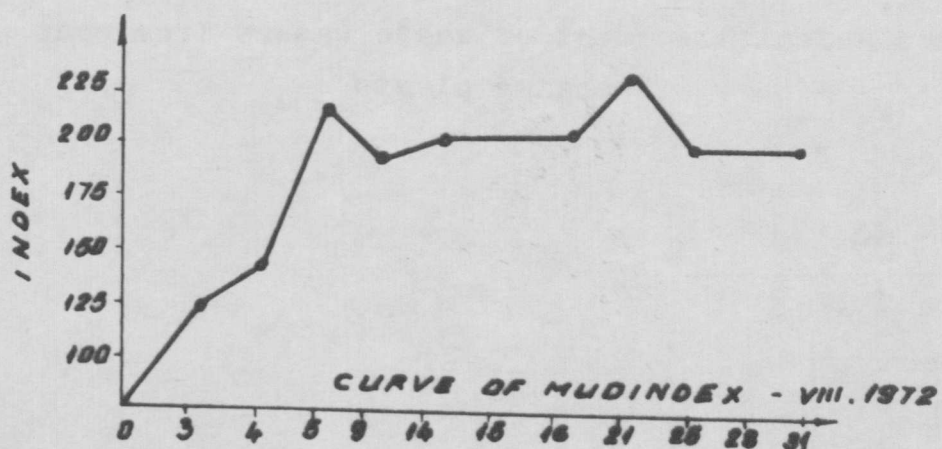
When light voluminous sludge occurs, which does not sediment readily because of sharp temperature changes or other factors, the aeration was usually increased, and from the silo only thick sludge was let out in the biotrench. This method for correction the properties of active sludge proved very successful and in a short time changed the sludge structure and increased the dry matter. The investigations in this field continue.

Characteristics of the purified water

pH	6,5 - 7,0	
BOD ₅	10 - 30	mg/l
Phosphates as P ₂ O ₅	5	mg/l
Nitrogen salts	35 - 40	mg/l
Sedimented matter	traces	

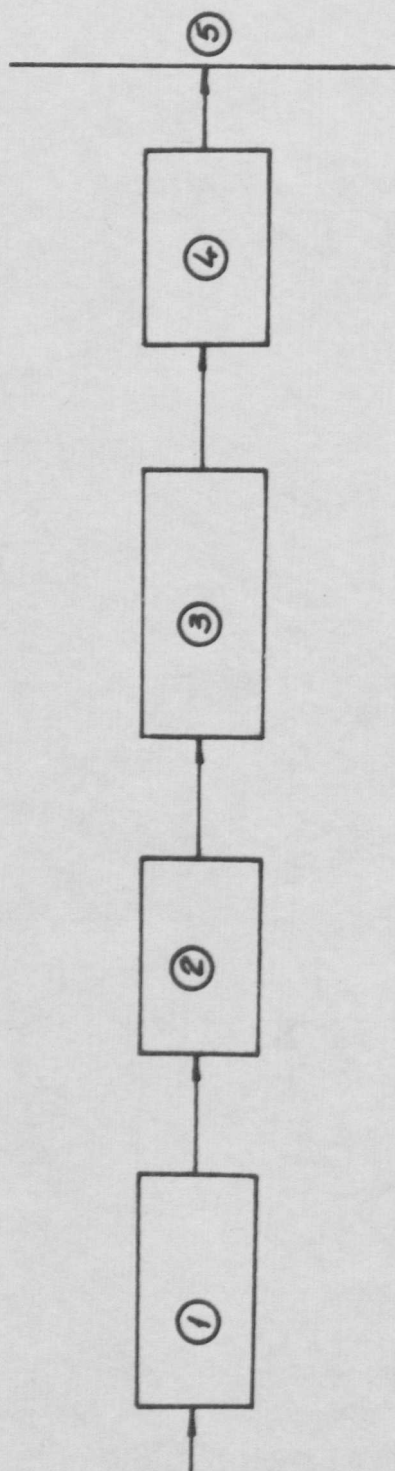
Almost the total volume of the waste water for purification passes through the purification system in 9 hours. Highest pollution of the waste water is at the end of the work shift. Characteristic is that unevenness in the volume flow as well as the pollution do not have an adverse effect on the results from the purification.

The described purification system is served by one man.



Pattern 1

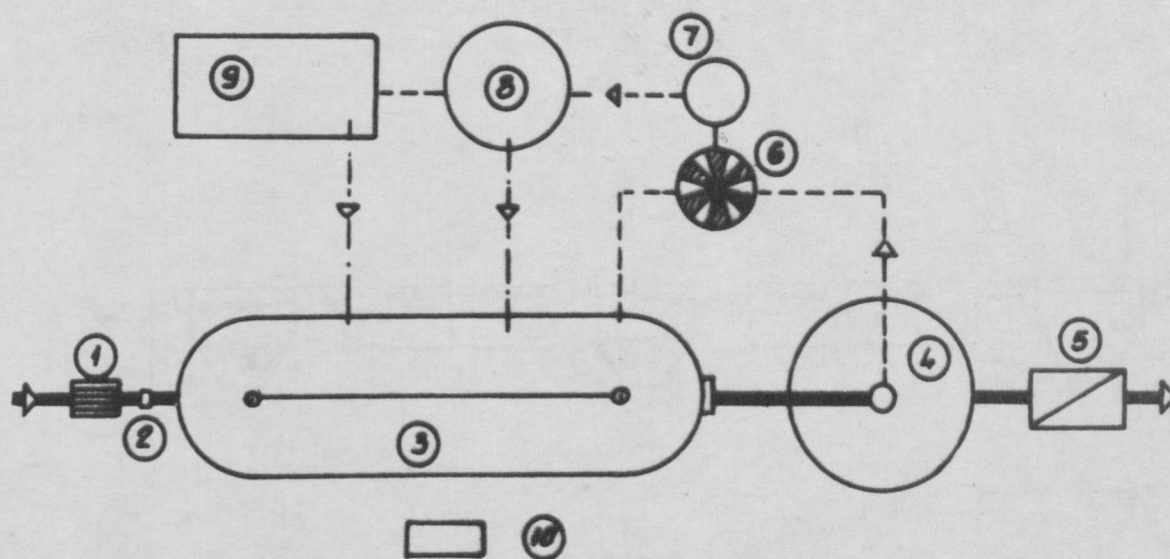
For mechanical treatment of waste waters from meat packing plants



- 1.Coarse grid
- 2.Fine grid with mechanical cleaning
- 3.Sand retainer
- 4.Fat retainer
- 5.City sewer system

The coarse and fine particles from the water are retained, also the sand and fats, this helping the city sewer system.

Pattern 2
for biologic purification system for packing meat enterprises
onestep



---- biologic water

-.-. turbid water

1. Coarse grid manually operated
2. Measuring equipment Venturi
3. Biopond
4. Secondary sedimentator
5. Foam breaker
6. Bucket wheel for the sludge
7. Sludge pit with pump for the over sludge quantity
8. Sludge silo
9. Drying fields
10. Laboratory, lavatories.

The system has a capacity of 1.300 m^3 waste water/day.

Oxydation-fermentation capacity $700 - 800 \text{ kg/BOD}_5$

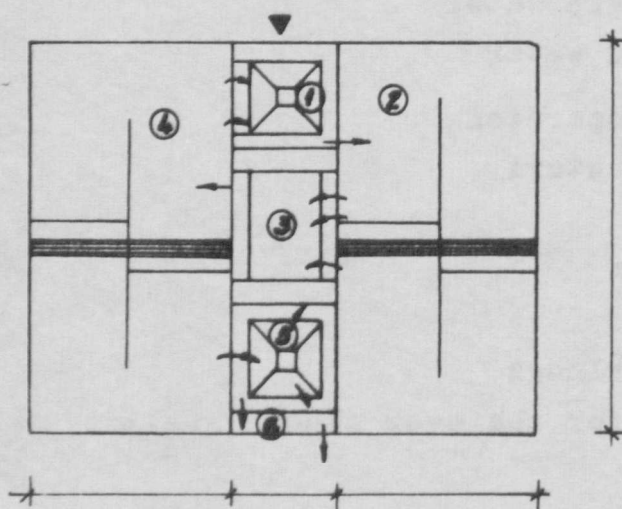
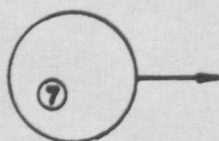
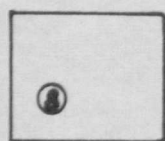
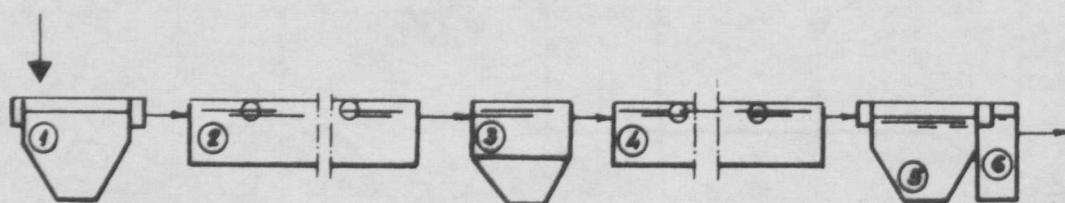
Volume load $0,5 - 0,6 \text{ kg BOD}_5/\text{m}^3$

Sludge load $0,1 \text{ BOD}_5/\text{kg dry matter}$

Sludge index $70 - 120 \text{ ml/g dry matter}$

Stabilization of the sludge is effected in the biopond and silo, drying on the drying fields BOD_5 of the purified water $10 - 15 \text{ mg/l}$.

Pattern 3
for purification of waste waters from meat packing
plants - two steps



1. Initial sedimentor
2. Biotrench I step
3. Secondary sedimentor
4. Biotrench II step
5. Tertiary sedimentor
6. Fat detainer and chlorination
7. Sludge silo
8. Drying fields

References

1. Fritsche, Ing., Treatment of waste waters from meatcaking plants of Chekoslovakia, Fleisch, 7, 1968
2. Vasile Siolda, Physicochemical and biological investigations of meat packing plants waste waters, Ind. Alimentara, 1968
3. Sv. E. Jordanesch, New methods for meat packing plants waste waters purification, Schl. u. Viehofztg., 1970, 3
4. Die Schlachtereiabwasser und die Reinigung in einer zentralen Kläranlage, Wasser und Abwasser, 1968, 11 and 12
5. Sovet ekonomicheskii vzaimopomoshti - O spopobach ochistki i pbrabotki stochnich vod razlichnich vidov proizvodstv, 1968
6. G. Kuznetzova, k. t. n., Novie metodi i sredstva ochistki jiroder jashtich stochnich vod, Miasn. Industria SSSR, 1972, 1
7. I. Pesenson, Sooroujenie dlja ochistki stochnich vod, Miasn. Industria SSSR, 1971, 8
8. H. Hagenann, Hinweise für Abteilen von Schlachthofabwasser in öffentliches Kanalnetz, Die Fleischwirtschaft, 1963, 5
9. Sv. E. Jorgensen, Neues Abwasserreinigungsverfahren für Schlachthäuser, Schlacht u. Viehofztg., 1970, 3