DETERMINATION OF PHENOL COMPOUNDS IN WASTE WATERS OF MEAT PROCESSING PRODUCTION

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INTRODUCTION

The development and organization of ecologically pure technological processes at the meat processing enterprises is closely connected with the ensuring of the analytical control over both the main production and waste products.

Waste waters of the food industry enterprises are the known sourecs of the environment pollution including organic substances. Thus, waste waters of the meat processing ehterprises purified by traditional methods contain some raw material residues of the biological origin, mineral substances and organic compounds including toxicants of the phenol nature, the maximum limited concentration (MLC) for water body being 0,001-0,01 mg/dm^3 [1].

The determination of minute quantities of the phenols and the products of their chemical conversions with the help of the known methods is impossible without the preliminary concentration.

During the recent decade membrane methods tested positively for the concentration acquired a wide usage [2]. The most effective and available method of the concentration is a liquid extraction due to the expressity, known universatility, comparatively simple operations of conducting, high degree of concentration [3]. In this case, the development of the phenol determination technique of the meat processing waster water, with the use of ultrafiltration-extraction concentration is a very actual task.

MATERIALS AND METHODS

Investigations on the concentration have been carried out on the laboratory pilot ultrafiltration unit. Semi-permeable membranes on the base of stable polymers, polysulphone aromatic polyamides (with the diameter of pores 50-500 nm) have been used as the filtering materials. The control over the phenol content and evaluation of the separation effect were carried out by measuring in the initial medium and streams of the ultrafiltration separation.

As the objects of the investigation were chosen waste waters of the meat plants (average probe), at the development of the technique-phenol solutions with the concentrations 0,01-1,00 mg/cm^3. Extraction was conducted in vessels with ground plug-type glass stopper on the vibromixer. After stratafication of phases in the acqueous solutions there has been found the concentration of the phenols (S_w) upon the intensity of the light absorbtion in the ultra-violet region of the spectrum or upon the reaction with 4-aminoantipyrine in the visible region of the spectrum. Component concentrations in the phase of the organic extragent (C_o) was calculated according the difference between the initial and balanced concentrations of the substances in the acqueous phase taking into account phase volume ratio (r). Coefficients of the distribution (D) in the systems water-organic solvent were calculated as C_o/C_w ratio. The degree of the extraction (R, %) was calculated according to the formula [4]:

$$R = 100D/D + r .$$

Some neutral ethers of the phosporic acid - tripropylphophate (TPPh), tributylphosphate (TBPh), di-(ethylhexil)phenylphosphate (DEHPPh) characterized by the highest extracting ability have been used as the organic solvents.

RESULTS AND DISCUSSION

Technological waters of the meat processing enterprises consist of the streams forming at the various technological stages of the production. The composition of the latter is characterized by the combination of many components forming colloidal solutions with the different aggregative and sedimentation stability.

Composition and indices analysis of the technological waters of the meat processing enterprises Ca^{2+} - 75 mg/dm^3, Mg^{2+} - 50 mg/dm^3, CL^- - 900 mg/dm^3, Co^{2+} - 100 mg/dm^3, total Fe - 20 mg/dm^3, total N - 150 mg/dm^3, P_2O_5 - 60 mg/dm^3, NO_3^- - 0,02 mg/dm^3, NO_2^- - 0,05 mg/dm^3.

In the course of the experimental studies it has been established that as the result of the waste waters ultrafiltration the concentration increase 10 - 30 fold. But however for the determination of the phenol minute quantities 100-200 fold concentration is needed. That is why, the second stade of the concentration has been carried out by the liquid extraction.

Extraction characteristics of the phenols in systems with the phosphoorganic solvents are in the rather wide range (table 1).

Table 1

Extraction characteristics of some phenols in the systems with the ethers of the phosphoric acid; r = 100

Extracted substance	Extragents					
	TPPh		TBPh		DEHPPh	
	D	R, %	D	R, %	D	R, %
Phenol	340	77,3	450	81,8	170	63,0
o-Cresol	725	87,9	1150	92,0	470	82,5
m-Cresol	650	86,7	1050	91,3	380	79,2
p-Cresol	630	85,3	1000	90,1	340	77,3
Acids:						
Salicylic	1600	94,1	3100	96,9	980	90,7
Pyrogallic carbonic	900	90,0	1530	93,9	114	53,3
Gallic	400	80,0	490	83,1	21	17,4

High efficiency of this class of the extragents towards their attitude to the phenols, caused by the strong donor properties of the former [5], defines the ethers usage efficiency of the phosphoric acid for the phenol concentration at the analysis of the waste waters at the meat processing enterprises.

However, the direct use of the phosphoroorganic solvents, due to their density, slightly different from the water density and due to the increased viscosity, leads to the time increase of the phases stratification, which complicates the analysis. In practice, it is expedient to use these solvents in mixture with the extragents of low efficiency - aliphatic or aromatic carbohydrates, the addition of which to the phosphoroorganic solvents, up to 0,4 molar shares (table 2), is followed by slight decrease of the extraction degree and ensures the rapid phase stratification during 3 - 5 min.

Table 2

Quantitative characteristics of the phenol and salicylic acid extraction by blends of TBPh with hexan

Hexan, molar shares	Salicylic acid		Phenol		
	D	R, % (r=100)	D	R, % (r=10)	R, % (r=100)
0	3100	96,9	450	97,8	81,8
0,1	2900	96,7	430	97,7	81,8
0,2	2700	96,4	420	97,7	80,8
0,3	2500	96,2	400	97,6	80,0
0,4	2200	96,7	380	97,4	79,2
0.5	2010	95,2	350	97,2	77,8
0,6	1770	94,7	310	96,9	75,6
0,7	1310	92,9	250	96,2	71,4
0,9	440	81,5	100	90,9	50,0

The application of the binar solvents on the basis of the phosphoric acid ether does not provide the distribution coefficients of practically all the phenol compounds (of 2000 order), necessary for 100-fold concentration. For the full extraction of the phenol toxicants from the waste waters at r = 100 it is necessary to add the salting-out agents (neutral salts, e.q. sodium chloride) to the analyxed probe.

Thus, taking into account the first stage, namely ultrafiltration, 1000 fold phenol concentration increase is reached and it makes the determination of such small toxicants on the MLC level quite possible.

The total phenol determination is conducted in the reextractors (0,1 M solution of NaOH) photometrically upon the reaction with 4-aminoantipyrine or directly in the concentrations according to the own light absorption in the ultra-violet region of the spectrum.

We give the statistically treated determination results of the total phenols content of the "Meat plant "Voronezhsky" (n =10, P=0,95):

Concentration ($\overline{X}$), mg/dm^3	S_r	$\overline{X} \pm t_f S_{\overline{x}}$
0,00009	0,19	0,00009+0,00001

The time of the analysis is about 2 hours, in dependence of the detection technique, the error of the phenol determination is in the limits of MLC - 10 - 15 %.

CONCLUSION

The method of the photometric determination of the meatprocessing waste waters phenol compounds with the use of the preliminary ultrafiltration and extraction concentration has been developed. The application of 2 stages phenols concentration in the analyzed probe allows to gen 1000-fold concentration increase which is enough for the determination of such small toxicants in the limits of MLC. The methods was tested at theproduction conditions. The time of the analysis does not exeed 2 hours.

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