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TREATMENT OF TANNERY EFFLUENT BY IRRADIATION

Tannery effluent is characterized by high concentration of organic matter and toxic substances, like sulphide, phenols and chromium compounds. In order to meet the standards, the concentration of phenol should be decreased to 40 g/m^3 and that of sulphide to 3.0 g/m^3 ahead of disposal into a municipal sewerage system. As a method of pretreatment the irradiation was applied.

Synthetic-vegetable tanning liquor or aqueous solution of single tannins were exposed to γ-radiation from a ^{60}Co source (activity 7.4×10^2 TBq) at room temperature; the dose rate was 0.48 Gy/s, the maximal total dose being 45 kGy. The 400 cm^3 samples of tannery effluent were irradiated at the Institute of Applied Radiation Chemistry of the Technical University in Łódź. Some samples were aerated during irradiation. The flow rate of the air was about 50 m^3/h. The compositions of irradiated solutions are presented in tab. 1.

Table 1

Characteristics of tannins solutions
Charakterystyka roztworów garbników

Solution	Concentration kg/m^3	Phenol C_0 g/m^3	COD g O_2/m^3	BOD g O_2/m^3
Synthetic-vegetable tanning liquor	—	1790	236000	26900
Synthetic-vegetable tanning liquor effluent	—	240	18900	1030
Phenol	0.9500	950	2190	54
Mimosa	10.04	18.8	12560	961
Quebrache	10.00	43.8	13290	656
Rotanine BN (I)	10.88	144	9010	277
Rotanine BN (II)	4.12	30.0	3500	95
Rotanine BNS	10.04	15.0	6730	187

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In samples irradiated the concentrations of phenols (except Rotanine BNS) and organic substances decreased, while their biodegradability (BOD_5/COD) (tab. 2, fig. 1) increased. It has been observed that in samples aerated during the irradiation the degree of phenol removal was greater. The degree of phenol removal from its aqueous solution, subject to irradiation, was consistent with the results obtained by TOUHILL [2].

Table 2

Results of treatment by irradiation the aqueous tannin solutions, dose 45 kGy, γ rays ^{60}Co
Efekt napromieniowania wodnych roztworów garbników, dawka 45 kGy promieniowania γ ^{60}Co

Solutions	Phenol		COD		BOD_5		BOD_5/COD	
	g/m^3	c/c_0	$g\ O/m^3$	c/c_0	$g\ O/m^3$	c/c_0	before	after
	Samples aerated during treatment by irradiation							
Synthetic-vegetable tanning	992	0.56	215000	0.91	20500	0.76	0.11	0.095
Synthetic-vegetable tanning liquor effluent	51.9	0.22	12100	0.64	2050	1.99	0.055	0.17
Phenol	340	0.36	1780	0.81	74	1.37	0.025	0.042
Mimosa	0.0	0.0	14600	1.00	1890	1.97	0.077	0.13
Quebrache	14.0	0.21	12600	0.94	764	1.16	0.049	0.061
Rotanine BN (II)	8.0	0.27	3500	0.92	217	3.40	0.027	0.062
Rotanine BNS	27.5	—	6190	0.92	378	2.05	0.028	0.061
	Samples nonaerated during irradiation							
Synthetic-vegetable tanning liquor	925	0.52	225000	0.95	21500	0.80	0.11	0.096
Synthetic-vegetable tanning liquor effluent	97.6	0.41	12000	0.64	1260	1.22	0.055	0.11
Phenol	560	0.59	2080	0.95	70	1.29	0.025	0.034

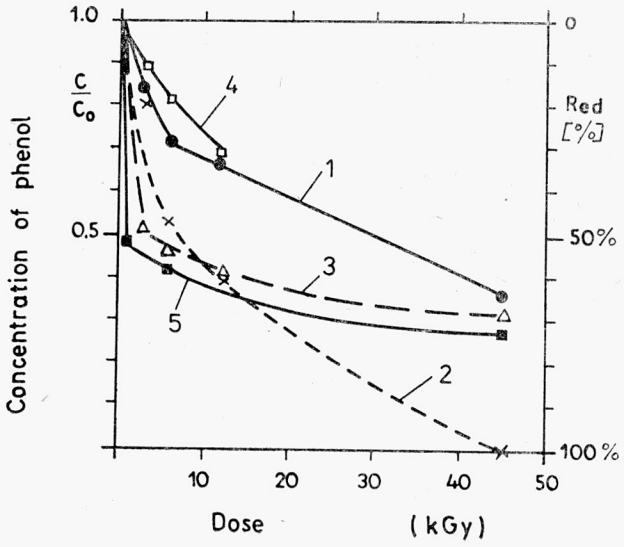

Fig. 1. Concentrations of phenol versus the dose of γ-rays in the aerated tannins solutions

1 — phenol 950 g/m^3, *2* — mimosa 18.8 g/m^3, *3* — quebracho 43.8 g/m^3, *4* — rotanine BN 144 g/m^3, *5* — rotanine BN 30 g/m^3

Rys. 1. Zależność stężenia fenoli w wodnych roztworach garbnika od dawki promieniowania $\gamma^{60}Co$

1 — fenol 950 g/m^3, *2* — mimoza 18,8 g/m^3, *3* — quebracho 43,8 g/m^3, *4* — rotanina BN 144 g/m^3, *5* — rotanina BN 30 g/m^3

The dose of 3 kGy caused a twofold decrease of phenol concentration in synthetic-vegetable tanning liquor effluent (fig. 2). Equalization of the sample results in concentrations of phenol which are acceptable in municipal sewerage systems. The cost of irradiation treatment was 29 zł/m³, assuming that 80% of the radiation energy was absorbed and that annual regeneration of the ^{60}Co source is 12.5%. For comparison: the treatment of the same tannery effluent by activated carbon costed 28 zł/m³.

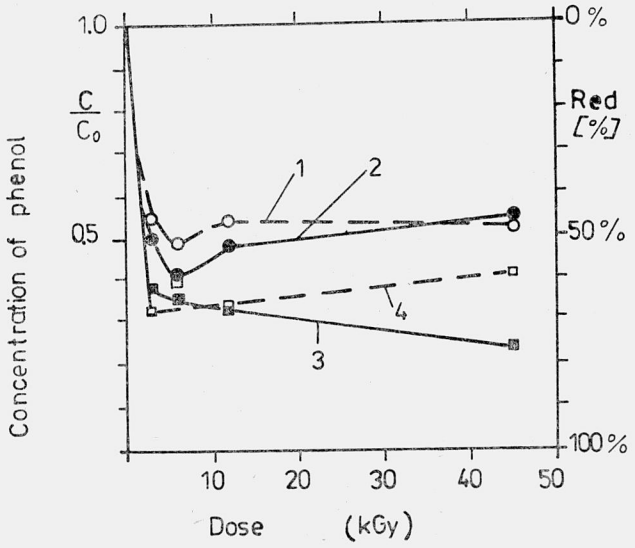

Fig. 2. Concentrations of phenol versus the dose of γ-rays in the tanning liquor

1, 2 — synthetic-vegetable tanning liquor; *3, 4* — synthetic-vegetable tanning liquor effluent; *2, 3* — aerated sample; *1, 4* — nonaerated sample

Rys. 2. Zależność stężenia fenolu w brzeczce od dawki promieniowania $\gamma^{60}Co$

1, 2 — brzeczka świeża; *3, 4* — brzeczka zużyta; *2, 3* — próby napowietrzone; *1, 4* — próby nienapowietrzone

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