NITRATION OF LIGNIN AND SORPTIVE PROPERTIES OF THE RESULTING PRODUCTS

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UDC 541.64

The possible use of lignin as an inexpensive and nontoxic sorbent make it necessary to study its sorptive properties. The medicinal preparation Polyphepanum is well known and has a high sorptive capacity for bacterial cells and the toxins released by them [1]. Modification is recognized as the main direction for resolving problems with the use of lignin.

Lignin preparations obtained under different conditions are not identical. Thus, nitration, oxidation, demethoxylation, and destruction of lignin molecules are noted upon treatment with nitric acid [2]. Naturally, they occur differently under different conditions.

We studied the effect of nitration conditions on the sorptivity of nitrolignins.

The nitrating agent was a 50% blend (45% HNO_3, 3.8% H_2SO_4). Table 1 shows results obtained using hydrolyzed lignin (HL) from cotton-seed husks and various lignin(g):blend(l) ratios. It was found that the solubility of lignin samples of a single size (0.25 mm) vary from 10 to 66%. Furthermore, the solubility of samples of different sizes (0.5, 0.25, 0.08 mm) that were treated with the blend under identical conditions are similar to those of samples in Expt. No. 4. Similar results were obtained for the N content.

Elemental analyses for N content of the insoluble part showed varying degree of nitration (from 0.83 to 2.08%) of lignin samples of a single size depending on the nitration conditions. For samples of different sizes treated under identical conditions, the degree of nitration was practically the same. Therefore, the degree of nitration and the solubility of lignin samples seems to depend on the nitration conditions and not the particle size.

Molecular weights (determined by ultracentrifugation) of the soluble part of the lignin samples prepared under different nitration conditions were similar in magnitude. It can be assumed that destruction processes occurring during nitration were approximately the same.

TABLE 1. Effect of Nitration Conditions on Physicochemical Properties of Nitrolignin

Sample No.	Lignin(g):blend(l) ratio	Solubility, % of nitrolignin (NL)	MW, soluble part NL	N%, insoluble part NL	Equilibrium of insoluble part NL capacity, mg-equiv/g	
					Zn^{2+}	Pb^{2+}
1	1:075	66	48000	2.08	0.88	0.58
2	1:0.5	44	48000	1.72	0.86	0.55
3	1:0.25	28	49000	1.20	0.91	0.46
4	1:0.1	11	53000	1.00	0.86	0.44
5	1:0.05	10	52000	0.83	0.93	0.35
6	HL_{init} 0.25 mm	5	53000	-	0.81	0.31
7	1:0.1 (0.5 mm)	12	52000	1.08	0.84	0.45
8	1:0.1 (0.08 mm)	14	50000	1.05	0.85	0.48

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0009-3130/02/3805-0471$27.00

The sorptivities of nitrated lignin samples were studied using Zn^{2+} and Pb^{2+}. Results for the insoluble part of nitrolignin (metal-ion concentration found by atomic absorption) indicate that the sorption capacity for Zn^{2+} is much greater than for Pb^{2+}. It is practically constant from samples 1 to 5 for Zn^{2+} whereas it gradually decreases for lignin samples of different sizes for Pb^{2+}.

Thus, the sorption depends on the chemical composition (degree of nitration), lignin particle size, and metal ion. Therefore, it can be supposed that not only chemical but also physical sorption of metal ions by nitrated lignin occurs under heterogeneous conditions.

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