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STUDY OF RHEOLOGICAL PROPERTIES OF POLYANILINE COMPOSITIONS WITH POLYACIDS

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ABSTRACT

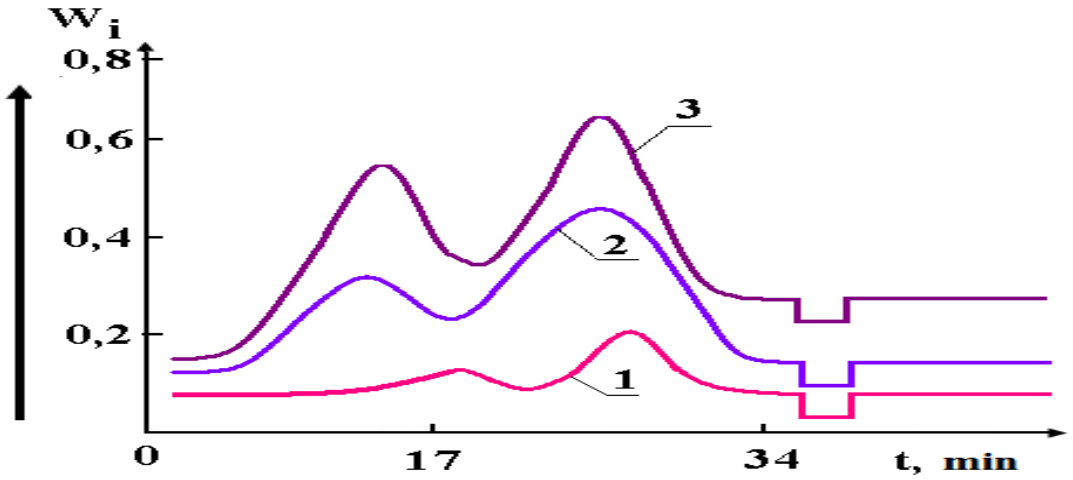
This paper describes how the characteristic viscosity of polyaniline taken as a sample increases with the average increase in the high molecular weight fraction of polyaniline in the reaction medium. It was found that the intrinsic viscosity of the obtained polyaniline samples increases with an increase in the proportion of the average high molecular weight of polyaniline in the reaction medium. This effect can be explained with the binding of lithium ions to macromolecules and unfolding of coils of the polyacrylic acid chain. The unfolding of the coils can be explained by the electrostatic repulsion of ions bound to the polymers.

KEYWORDS: *Polyaniline, Molecules, Composition, Polymer, Rheology, Sample, Viscosity.*

INTRODUCTION

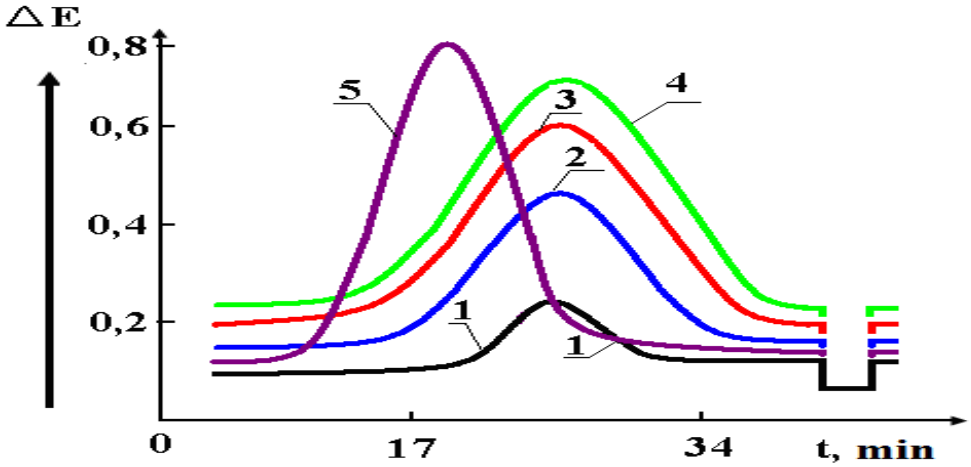
We have investigated the molecular weight parameters of polyaniline and their relationship with the synthesis conditions using gel permeation chromatography and viscometer. **[1,2]**

The dependence of the average molecular weight characteristics of polyaniline on the synthesis conditions was investigated and it was found that an increase in the concentration of the oxidizing agent ammonium persulfate leads to an increase in the proportion of the high molecular weight fraction of polyaniline. The bimodality of the molecular weight distribution of polyaniline is obviously associated with the heterophase nature of its polymerization (Figs. 1 and 2).



1-0,5/1; 2-1/1; 3-1,5/1

Fig. 1. Gel chromatograms of polyaniline samples obtained by a chemical method at various oxidant/monomer ratios



1, 2, 3, 4, (5, 9, 12, 15, 30 min); 5-gel chromatogram of polyaniline obtained by electrochemical method

Fig. 2. Combined gel chromatograms of polyaniline. Retention time dependence of absorption

The ratio of the average molecular weights of the polyaniline fractions was judged by the change in the peak areas in 2 and 3. In methylpyrrolidone, the peak has a larger area than in dimethylfomamide, which is due to the better solubility of polyaniline in the first case. **[3]**

It was found that the intrinsic viscosity of the obtained polyaniline samples increases with an increase in the proportion of the average high molecular weight of polyaniline in the reaction medium. Therefore, by changing the monomer-oxidant ratio, it is possible to control the formation of the average molecular weight of polyaniline. With an increase in the duration of synthesis to 30 min, the average molecular weight of polyaniline increases, and multimodal, the nature of the molecular weight distribution of samples with a 9-minute exposure turns into

unimodal. The revealed correlations confirm the previously proposed mechanism of aniline polymerization: the growing chain is formed by oxidation of the monomer followed by addition to the oxidized dimer, etc. **[4,5]**

Consequently, a stepwise polycondensation character of the polymerization of anilines is observed. The more oxidizing agent in the reaction medium, the more active sites capable of polymerization, the higher the degree of conversion and the value of the average molecular weight of polyaniline (Table 1 and 2).

This effect can be explained with the binding of lithium ions to macromolecules and unfolding of coils of the polyacrylic acid chain. The unfolding of the coils can be explained by the electrostatic repulsion of ions bound to the polymers. From the above, it follows that polyanilines, like polyacrylic acid, exhibit the properties of polyelectrolytes. This is expressed in a similar behavior of solutions, despite the fact that the chains of polyaniline and polyacids are oppositely charged. **[6]**

TABLE 1 MOLECULAR WEIGHT PARAMETERS OF POLYANILINE DEPENDING ON THE CONDITIONS OF CHEMICAL SYNTHESIS

Mole ratio monomer oxidant mole/mole	Peak area				$[\eta]^*, дм/л/с$ $\eta_{уд}/с$
	DMF		MP		
	2	3	2	3	
1:0,5	3,2	96,8	16,5	83,5	0,65
1:0,75	16,9	93,1	31,4	68,6	0,72
1:1	24,4	85,6	38,1	61,9	0,94
1:1,25	31,6	68,4	46,5	53,5	1,43
1:1,5	39,1	60,9	62,3	37,7	1,94

TABLE 2 MOLECULAR MASS PARAMETERS OF POLYANILINE DEPENDING ON THE CONDITIONS OF ELECTROCHEMICAL SYNTHESIS

Electrode potential $+B$	Peak area				$[\eta]^*, дм/л/с$ $\eta_{уд}/с$
	DMF		MP		
	2	3	2	3	
0,65	6,6	93,4	24,2	75,8	0,75
0,8	26,5	73,5	38,1	61,9	0,82
0,85	37,4	62,6	46,4	53,6	0,98
0,9	44,6	55,4	57,1	42,9	1,52
1	59,2	50,8	64,2	35,8	2,24

On going from dimethylformamide to methylpyrrolidone, the area of the first peak increases, while the second decreases. The ratios of fractions with low (fig.1) and high (fig.2) molecular weights were judged by the change in the area of peaks 1 and 2 (Table 1 and 2).

Studies show that with an increase in the duration of the synthesis to 30 min, the average molecular weight of the polymer increases, and the multimodal nature of the molecular weight distributions of samples with a 9-minute exposure becomes unimodal.

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