Chemistry of Natural Compounds, Vol. 35, No. 3, 1999

INFLUENCE OF SODIUM HYPOCHLORITE ON THE MOLECULAR-MASS DISTRIBUTION OF COTTON CELLULOSE

D. S. Nabiev and G. V. Nikonovich

UDC 547.458.81

The dependence of the molecular-mass distribution of cotton cellulose on the conditions of oxidation of its solution with sodium hypochlorite in the production process has been studied.

The chemical and physical properties of cellulose esters and ethers are determined to a considerable degree by the molecular-mass distribution (MMD) of the initial cellulose, which is regulated in the process of its production [1, 2]. We have studied the possibility of regulating the MMD of cotton cellulose for its further chemical processing with a stable viscosity of 17—21 mPa·s by the oxidizing action on cellulose of sodium hypochlorite in an alkaline medium. Table 1 gives the results of a determination of the mean degree of polymerization (DP), the MMD, and the mass fraction of alpha-cellulose after treatment with a solution of sodium hypochlorite, and, for comparison, the figures for cellulose from the firm Buckeye (USA), which possesses a high reactivity in an alkaline medium, especially for xanthogenation.

In order to lower the MMD and so to bring the viscosity of cellulose solutions to 17—21 mPa·s we used a one-stage treatment of the cellulose with a sodium hypochlorite solution under severe conditions and a two-stage treatment under milder conditions.

TABLE 1. Mean DPs, MMDs, and Mass Fractions of Alpha-Cellulose after Treatment with Sodium Hypochlorite Solution

Viscosity of the cellulose, mPa·s	Mean DP	Mass fraction of alpha-cellulose, %	Fractional composition (in terms of DP), %						
			0-200	200-400	400-600	600-800	800-1000	1000-1500	1500 and above
Initial cellulose after cooking									
-	1570	99.3	-	2.31	4.47	7.92	10.17	53.76	21.37
After one-stage treatment									
17	675	97.2	15.26	26.31	37.11	17.18	4.14	-	-
19	717	97.4	13.87	23.25	26.02	29.37	7.49	-	-
21	739	97.7	9.24	25.26	24.80	30.98	9.32	-	-
After two-stage treatment									
17	701	98.3	2.53	15.96	31.42	33.98	16.11	-	-
19	735	98.6	2.44	14.55	28.73	31.56	22.72	-	-
21	769	98.7	2.00	13.87	29.02	23.69	27.87	3.54	-
Bakai cellulose									
21	745	98.5	2.42	13.91	29.94	25.84	24.31	3.68	-

Institute of the Chemistry and Physics of Polymers, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (3712) 44 26 61. Translated from Khimiya Prirodnykh Soedinenii, No. 3, pp. 390—391, May-June, 1999. Original article submitted October 5, 1998.

0009-3130/99/3503-0351$22.00

The results given in Table 1 show that the two-stage treatment led to a higher mass fraction of alpha cellulose and a higher mean DP, from which it is possible to judge the degree of degradation of the cellulose in the oxidation process. Cellulose with the same viscosity obtained in the two-stage reaction with sodium hypochlorite contained 2.0—2.5% of low-molecular-mass fractions, while cellulose obtained in the one-stage reaction contained 10—15% of low-molecular-mass fractions soluble in a solution of alkali. It must be mentioned that the cellulose obtained by the two-stage reaction with sodium hypochlorite was practically identical with the Bakai cellulose.

Thus, the possibility has been shown of regulating the MMD of cotton cellulose by changing the condition of its oxidation with sodium hypochlorite.

EXPERIMENTAL

Treatment of the Cellulose. One-stage: at a concentration of sodium hypochlorite of 2.5—3.0 g/liter, a temperature of 42—45°C, a time of 1.5—2.0 h, and a pH of 9—10. Two-stage: first stage at a sodium hypochlorite concentration of 1.5—2.0 g/liter, a temperature of 35—38°C, a time of 1.0—1.5 h, and a pH of 10—11; second stage at a sodium hypochlorite concentration of 0.2—0.4 g/liter, a temperature of 30—35°C, a time of 1.0—1.5 h, and a pH of 10—11.

DPs were determined by measuring the viscosities of 0.1% solutions of cellulose in cuprammonium solution [3], and the MMDs of the cellulose were determined in cadoxene with the successive isolation of individual fractions from the solution by the addition of a precipitant [4].

REFERENCES

1. V. M. Irklei, I. F. Aleksandrovich, S. I. Inozemtsova, N. L. Gordinets, and V. E. Nosov, *Khim. Volokna*, No. 2, 40 (1979).
2. V. I. Ivanov and L. D. Ivanova, *Izv. Akad. Nauk Kirg.*, No. 1, 60 (1971).
3. A. B. Pakshver and A. L. Konkina, *The Control of the Production of Chemical Fibers* [in Russian], Khimiya, Moscow (1967), p. 608.
4. A. K. Dibrovy and V. S. Matveeva, *The Analytical Control of the Production of Artificial Fibers* [in Russian], Khimiya, Moscow (1986), p. 336.