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Figure 1. Mass distribution function. 1—cotton cellulose according to Timmel ([11]); 2—initial cotton cellulose prepared according to Corey and Gray; 3—cotton cellulose treated with dilute nitric acid; 4—cotton cellulose treated with dilute hydrochloric acid.

Figure 1: Figure 1. Mass distribution function. 1—cotton cellulose according to Timmel ([11]); 2—initial cotton cellulose prepared according to Corey and Gray; 3—cotton cellulose treated with dilute nitric acid; 4—cotton cellulose treated with dilute hydrochloric acid.

Abstract

Full Text

CHEMISTRY

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A CHEMICAL METHOD FOR HOMOGENIZING CELLULOSE BY MOLECULAR WEIGHT

(Presented by Academician V. A. Kargin, 11 VII 1958)

In a previous communication ([1]), our theoretical concepts concerning the close connection between the strength of cellulose products and the homogeneity of cellulose with respect to the length of chain molecules were experimentally confirmed. Calculations

Fig. 1. Mass distribution function. *1*—cotton cellulose according to Timmel ([11]), *2*—initial cotton cellulose, prepared according to Corey and Gray, *3*—cotton cellulose treated with dilute nitric acid, *4*—cotton cellulose treated with dilute hydrochloric acid

based on viscosity showed ([2]) that homogeneity also has important significance for the viscosity behavior of concentrated cellulose solutions. In this connection, it was of interest to evaluate individual chemical processes used in the processing of cellulose from the standpoint of homogenization. The literature contains data that make it possible to conclude that in modern cooking processes ([3]), air and chemical pre-ripening ([4], [5]), bleaching ([3]), and also in hydrolysis with hydrochloric ([6]) and sulfuric acids, substantial homogenization of cellulose is not achieved.

Experiments on the study of the absorption of acids from aqueous solutions by cellulose were carried out with cotton cellulose (prepared according to Corey and Gray) and wood cellulose (sulfate cellulose obtained by a method developed at the Institute of Organic Chemistry of the Academy of Sciences of the USSR).

Fig. 2

Figure 2: Fig. 2

Treatment with nitric acid was carried out at 92° with a concentration of 0.2 N for 1 hour for cotton cellulose and 30 min for wood cellulose. Under the same conditions cotton cellulose was treated with hydrochloric acid.

The homogenizing effect was evaluated from the mass-distribution function, calculated from data obtained by a somewhat improved standard [8] precipitation fractionation of cellulose trinitrate. The degree of polymerization (P) was calculated from viscosity data for dilute solutions of cellulose trinitrate in ethyl acetate, using the equations of Huggins [9] and of Newman, Loeb, and Conrad [10].

The experimental results obtained are presented in Figs. 1 and 2. Cotton cellulose prepared in our laboratory (Figs. 1, 2), as well as that used by Timell [11] (1), possess high molecular-weight heterogeneity. Treatment of cotton cellulose with hydrochloric acid leads to degradation of long-chain molecules with some homogenization (4), whereas the action of nitric acid is accompanied by a high degree of homogenization (3).

Fig. 2. Mass-distribution function.
1 —wood cellulose treated with dilute nitric acid; **2** —original wood sulfite cellulose treated by the method of the Institute of Organic Chemistry, Academy of Sciences of the USSR.

Treatment of wood sulfite cellulose by the method of the Institute of Organic Chemistry, Academy of Sciences of the USSR, leads to physicochemical homogenization of the cellulose, with a maximum on the mass-distribution curve at $P = 850$ (Fig. 2, 2). The action of nitric acid on this cellulose for 30 min also led to homogenization, but the maximum on the mass-distribution curve is shifted farther into the low-molecular-weight region and is located at $P = 220$.

The results obtained make it possible to conclude that treatment of cellulose with dilute nitric acid can serve as a method of chemical homogenization of cellulose with respect to the length of chain molecules. By an appropriate selection of the conditions for combined chemical and physicochemical homogenization (concentration, temperature, duration), a high degree of homogenization can be achieved at the desired value of the degree of polymerization responsible for the strength of various cellulose products (fiber, paper, films).

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CITED LITERATURE

1. B. A. Zakharov, V. I. Ivanov, G. A. Krylova, N. G. V' yunova, DAN, **122**, No. 5 (1958).
2. V. I. Ivanov, B. A. Zakharov, *Bum. prom.*, No. 9 (1958).
3. H. Boppes, *Zellstoff und Papier*, **6**, 234 (1957).
4. H. A. Wannow, Ch. Feickert, *Koll. Zs.*, **108**, 203 (1944).
5. W. Bandel, *Das Papier*, **9**, 204 (1955).
6. Y. Siegwart, L. Rebenfeld, E. Pacsu, *Text. Res. J.*, **25**, 1001 (1955).
7. V. I. Ivanov, B. A. Zakharov, *Bum. prom.*, No. 2, 5 (1954).
8. R. L. Mitchell, *Ind. and Eng. Chem.*, **45**, 2526 (1953).
9. M. L. Huggins, *J. Am. Chem. Soc.*, **64**, 2716 (1942).
10. S. Newman, L. Loeb, C. M. Conrad, *J. Polym. Sci.*, **10**, 463 (1953).
11. T. E. Timell, *Svensk. Papperstidn.*, **58**, 234 (1955).

Note: Figure translations are in progress. See original paper for figures.