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MOLECULAR WEIGHTS OF CELLULOSE NITRATES BY OSMOTIC PRESSURE MEASUREMENTS

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As is well-known, nitrocelluloses are employed for a variety of purposes. Broadly speaking, nitrocelluloses with relatively high nitrogen content are used in propellant and explosive manufacture.; nitrocelluloses with lower nitrogen content find application in celluloid, in the lacquer industry, in cellulose paints, etc.

The conditions for the production of various types of nitrocelluloses vary a great deal, both from the point of view of the mixed acids, and operational technique employed.

During the course of investigations designed to produce suitable nitrocelluloses for use in certain types of demolition explosives and for special requirements of the Defence Services in respect of varnishing ammunition components, etc., it was considered that determinations of molecular weights of these nitrocelluloses would be of considerable interest. The method adopted was the measurement of Osmotic pressure of solutions of these nitrocelluloses in acetone.

An Osmometer was specially devised, for the object in view. The membrane that was employed was a Cellophane membrane, P.T. 600 of British Cellophane, Ltd., obtained through the courtesy of Mr. E. A. W. Hoff of Cavendish Laboratory, Cambridge. The Cellophane discs were submitted to suitable solvent treatment through various stages. The solvent used, viz., acetone, was specially purified by elaborate means. The solutions of the various nitrocelluloses in acetone were all prepared under identical conditions and kept in clean glass stoppered bottles. Before starting any measurements with the actual nitrocellulose solution on one side and the pure solvent on the other side, measurements were carried out with pure acetone on both sides of the apparatus. In other words, everytime before an actual experiment was performed, it was ensured, that the apparatus was in the proper condition for taking measurements. The whole of the apparatus was mounted on suitable retort stands and the measurements were carried out at constant temperature. Readings were taken at different pressures, the apparatus being connected to a pressure system.

The concentrations of solutions employed differed with different nitrocelluloses. It was noticed, for instance, that with some nitrocelluloses higher concentrations did not produce satisfactory or reliable results or again very high pressures were required and for such reasons, such concentrations had to be rejected.

The concentrations of solutions throughout were comparatively very low and for that reason, the method was of somewhat limited applicability though it would be easily possible to extend the method by suitable changes in the construction of the apparatus. The experiments, however, were designed for the specific purpose of the

particular categories of nitrocelluloses that were under examination and this object has been achieved. It must also be stated that with this apparatus it was not possible to have any results for any nitrocelluloses of higher molecular weight like guncotton, used in propellant manufacture, even in very low concentrations, for the apparent reason of the high viscosity of the solutions.

It is proposed to carry out viscosity measurements and correlate molecular weights with viscosity. Rough viscosity measurements carried out have indicated a satisfactory degree of correlation.

The recorded molecular weights may actually be the average of molecular weights of a series of nitrocelluloses. It is hoped to obtain measurements and molecular weights of components, separated by known methods of fractional precipitation.

It is also hoped to determine initially the viscosities of the various cotton celluloses, that would form the starting material, in solutions of the cellulose, in modern solvents like Triton, F., etc. (Benzyl, Phenyl, Ammonium hydroxides) and correlate viscosity obtained by this method with the viscosities and molecular weights of the corresponding nitrocelluloses obtained from these starting materials. An extension of the research in this direction is bound to yield very valuable results.

The importance of the work and its fundamental nature cannot be overemphasised. If one is able to obtain a clear picture of the types of nitrocelluloses and their molecular weights, one would be in a stronger position to predict with some degree of certainty the properties of the various nitrocelluloses.