LETTERS TO THE EDITORS

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Bacterial Cellulose for Osmometer Membranes

IN the investigation of the mechanism of polymerization reactions, it is essential to be able to count the number of polymer molecules produced. This implies that the number average molecular weight has to be measured. The best method is to use an osmometer, taking precautions with regard to the extrapolation of measurements to infinite dilution. Further, in order to get results reasonably quickly, the so-called dynamic osmometer is most suitable; but the difficulty here is to get membranes which allow the solvent to diffuse through rapidly, but which are impermeable to the polymer molecule.

Fuoss and Mead[1] have recommended denitrated collodion for this purpose, but it may be of interest to describe the behaviour of another membrane which has proved suitable for molecular weight determinations of vinyl polymers up to values of 200,000. This is a variety of cellulose elaborated by *Acetobacter xylinum*, and is prepared according to the method of Aschner[2]. Briefly, *Acetobacter xylinum* N.C.T.C. 1375 is grown at 30° C. in a vessel of convenient size and shape containing a sterilized medium composed of yeast extract, acetic acid, sucrose and alcohol to a depth of about two inches. Initially, the organism grows in the form of a loose web throughout the medium, ultimately forming a rather irregular film on the surface. This first film is removed with aseptic precautions and discarded, thereby removing the bulk of the fine particulate matter suspended in the medium. On subsequent incubation a second film of surface growth appears within twenty-four hours. This is quite regular and is left for three to four days, by which time the membrane is about 4 mm. thick. The membrane is removed, rinsed in water, and treated with 5 per cent caustic soda at 37° C. for twenty-four hours. Subsequent washing for twenty-four hours in running tap water removes the dissolved bacteria and excess caustic soda, leaving a neutral, translucent and tough membrane of pure cellulose. If such membranes are washed successively with alcohol and with benzene, they are far too permeable for use in the dynamic osmometer, even to polymethyl methacrylate molecules of molecular weight of about 300,000. On the other hand, in the dry state the membranes are completely impermeable to organic solvents like benzene. It is evident, therefore, that some control can be exercised over the permeability between these two extreme values, and therein lies the usefulness of bacterial cellulose. The following procedure has been found satisfactory for benzene solutions of polyvinyl compounds with molecular weights exceeding 10,000.

A membrane made from a new culture of bacteria is dried at room temperature by squee-geeing it on to a plate of highly polished stainless steel. When dry it is peeled from the surface and then immersed in distilled water. (If the membrane sticks to the plate, it can be more easily removed by immersion for a short period in distilled water.) Next, the membrane is washed in four or five changes of ethyl alcohol over a period of two hours and then allowed to stand in absolute alcohol for half an hour. Finally, the membrane is washed in three or four changes of benzene (or other organic solvent) to displace the alcohol. The membrane is then ready for use, and should be kept stored under benzene when not in the osmometer. Even then, such membranes gradually lose their permeability, and at room temperature permeability to benzene decreases by a half in two months. With the dynamic osmometer, readings of osmotic pressure could be obtained in thirty minutes in two runs on either side of the equilibrium point. The rate of penetration of polyvinyl acetate of an average molecular weight of 114,000 with a membrane 15 cm. in diameter and a cell depth of 0·2 cm. was less than 0·1 per cent in two hours, and even after fifteen hours only about 1 per cent of the polymer had diffused through. With another sample of polyvinyl acetate, molecular weight c. 20,000, penetration was negligible after two hours. These membranes when new do not exhibit any asymmetry by giving rise to a cell constant; but during prolonged use a cell constant of a few millimetres of benzene does develop. This can be kept at a minimum by washing the membrane with the solvent used for the osmotic experiments.

Further details of these experiments will be published elsewhere.

Our thanks are due to the director of the Research Laboratory of the General Electric Company for kindly supplying the glass-metal seals used in constructing the osmometer.

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[1] Fuoss and Mead, *J. Phys. Chem.*, **47**, 59 (1943).
[2] Aschner, M., *J. Bact.*, **33**, 249 (1937).

Supersonic Vibration Potentials and Centrifugation Potentials

THESE two electrokinetic effects have recently been found in this laboratory, the first with the collaboration of Prof. Cnops and Mr. J. Vidts, the second by my collaborator, Mr. G. Jacobs. Mr. Vidts and Mr. Jacobs will give a more detailed account of their work in the *Koninkl. Vlaamsche Acad. voor Wetenschappen*.

As for the supersonic vibration potentials, Debije[1] pointed out in 1933 that if supersonic vibrations are introduced into the solution of an asymmetric electrolyte, the difference in inertia between the two sorts of ions will cause electric potential differences of some μvolts in the solution, which should be detectable after amplification. In 1938 attention was directed to the fact[2] that this Debije effect might be multiplied by a factor 10^4 if a colloidal solution was chosen as an asymmetric electrolyte. At the same time the experimental research for the effect was started; it was interrupted by the outbreak of war, and taken up again in the beginning of 1945.

The amplitude of the alternating potential difference in a colloidal solution is approximately given by the formula

$$\psi_0 = \frac{mnD\zeta v_0 g}{4\pi\eta\sigma}, \qquad . \qquad . \qquad . \qquad (1)$$

where ζ is the electrokinetic potential of the colloidal particles, mn their mass per cm.³, D the dielectric constant, η the viscosity, σ the specific conductivity