CXLVIII. A STAINLESS STEEL HIGH-PRESSURE ULTRAFILTER.

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MANY biochemical processes involve tedious filtrations which are often rendered more difficult by the impossibility of removing very fine particles by means of filter-paper. Solutions containing impurities in fine suspension which are not removed on centrifuging at 4000 r.p.m. can usually be clarified by passage through suitable filters. Application of reduced pressure is, however, contraindicated in the case of solutions of capillary active substances such as proteins, on account of frothing which inevitably results in contamination of the filtrate by coagulated protein (Ramsden phenomenon) and also because of the excessive time required for filtration of considerable volumes of solution.

In order to facilitate the preparation of certain proteins which is being undertaken at this Institute, an apparatus has been designed by means of which positive pressure filtration of liquids can be effected at pressures up to 120 atmospheres, the maximum pressure obtainable from commercial nitrogen cylinders. For clarifying liquids and for bacteriological purposes, Seitz "Entkeimungsschichten," size 6, or suitable large-pored collodion membranes may be used with this apparatus, while for high-pressure ultrafiltration circles of cellophane Nos. 300 or 600 supported by 6 cm. circles of No. 42 Whatman filter-paper are suitable.

The apparatus described differs from those of Bechhold [1907], Aitken and Kay [1927], McBain and Kistler [1931] and Nicholas [1932] in that it is made of "Staybrite Austenitic" steel throughout, possible electrolytic effects due to the use of more than one metal thus being eliminated. A surface of austenitic steel appears to be more inert to protein solutions than the surfaces of brass, nickel, bronze or silver used by the above authors.

Various aspects of the apparatus are clearly shown in Figs. 1-4. The cylinder, of 370 cc. capacity, is closed at the top by a cap provided with a pressure gauge and needle valve to which is attached a specially designed cotton-wool filter (Fig. 4) which prevents entry of particles from the feed pipe and gas cylinder. This cap when tightened against the fibre insert in the upper rim of the cylinder need not be removed, since the filter is charged with liquid through the tapped hole carrying the pressure gauge. The filtering medium, supported by a stainless steel gauze (100 mesh), in turn supported by a perforated steel plate, is pressed tightly against the fibre insert in the bottom of the cylinder when the annular screw cap is tightened against the shoulder of the funnel which collects the filtrate. The upper rim of the funnel is ground perfectly flat in order to make a gas-tight joint. A locating dowel welded into the upper rim of this funnel

Fig. 1. ($\frac{1}{8}$ actual size.) Fig. 2. ($\frac{1}{4}$ actual size.) Fig. 3. ($\frac{1}{2}$ actual size.) Fig. 4. ($\frac{1}{2}$ actual size.)

prevents twisting of the filtering medium during assembly. Lugs welded into the circumference of the filter, as shown in Fig. 1, enable the whole to be assembled by means of a key and the socket of cast iron illustrated in Fig. 5. This socket is fixed to a block of hard wood screwed to the floor. When using Seitz filters the apparatus may, if desired, be autoclaved after assembling.

A smaller filtering area than might have been obtained for the same capacity of filter was chosen so that standard 6 cm. Seitz pads could be used, and so that small volumes of liquid could be dealt with without undue loss.

The filter is connected through the needle valve and dust filter to a nitrogen cylinder by means of a flexible copper pipe tested to a pressure of 5000 lb./sq. inch. It is quite safe to apply full cylinder pressure to the filter as it also is tested to 5000 lb./sq. inch. Filtration at 110 atmospheres through Seitz pads is very rapid and even through cellophane No. 300 about 100 cc. per day of a 0.6 % solution of bovine serum-albumin may be ultrafiltered.

This apparatus has proved invaluable for numerous purposes such as clarification of biological solutions unaffected by centrifuging, sterilisation of bacteriological media without application of heat and fractionation of colloidal solutions by ultrafiltration.

SUMMARY.

A high-pressure ultrafiltration apparatus constructed solely of stainless steel is described. Various applications of the apparatus are indicated.

Our thanks are due to Mr A. E. Rowsell for his skilled technical advice in the design of this apparatus. It was skilfully made by the Pulsometer Engineering Co., Reading, and it is a pleasure to express our gratitude to Mr J. B. Clewes of that firm for the great care taken by him in supervising its construction.

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Fig. 5.