

ductances with the computed values, Table 1 indicates the potassium concentrations which would be required to give a conductance of about 4 mhos/m—the minimum acceptable value at the outlet of a magnetoplasma-dynamic generator duct.

The potassium content of British coal is low^{6,7}, being only 0.10–0.15 per cent by weight of the coal. The data in Table 1 indicate that a temperature of the order of 2,900° K is required to produce the necessary level of conductance for an unseeded coal. Such a temperature can be realized in a coal-oxygen burner of the type we have developed.

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Structure of Ion-exchange Membranes

ARTIFICIAL membranes for ion-exchange purposes have hitherto been selected on an empirical basis only, and few attempts have been made to characterize them physically. Current theories of the structure of this type of membrane, together with some discussion of appropriate methods of investigation, have recently been summarized¹.

The membranes manufactured by Asahi Chemical Industries, Ltd., Tokyo (A.C.I.), are believed to be prepared from a block-polymerized mixture of styrene and divinylbenzene^{2,3}. Hydrophilic groups are introduced into thin slices of the hydrophobic polymer either by the action of concentrated sulphuric acid to form the cation-exchanger A.C.I. C, or by chloromethylation with subsequent quaternization of the amine groups to produce the anionic membrane A. C contains about 37 per cent water and A 27 per cent⁴.

Crabtree and Glueckauf examined ultramicrotomed sections of A.C.I. A by electron microscopy, and found that irregular pore structure and wide variation in pore size were characteristic of both C and A membranes⁵. We have confirmed this, using a similar technique⁶. Samples were prepared by a method developed for the investigation of biological ultrastructure⁷; water in the membranes was gradually replaced by alcohol and then by epoxy-resin, which was slowly cured and later sectioned.

The profiles of the pores seen in A.C.I. C in the sodium form (Fig. 1) were generally two to three times greater in length than in width, and varied in dimensions between 300 Å and 10,000 Å.

We were uncertain, however, whether the holes in these samples represented accurately the membrane pores originally filled with water. To confirm this, the surface

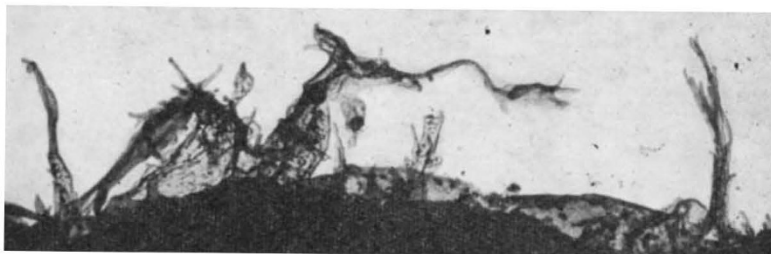


Fig. 2. Fold edge of a 'Formvar'/carbon replica of A.C.I. C membrane. ($\times c. 16,700$)

replica technique was used. The water in an A.C.I. C membrane was replaced in stages by dioxane; the surface was allowed to dry, and immediately replicas were made, using the two-stage 'Formvar'/carbon technique, with gold shadowing at 45° (ref. 8). The 'Formvar' replica was found to strip easily from the smooth surface of the membrane.

Fig. 2 shows a tangential view, resulting from the replica folding back on itself; the replicated pores stand out from the fold edge. The long intricately branching pore networks of varying, non-circular cross-section provide additional support for the theory that the irregular holes in the ultramicrotomed sample represent passages originally filled with water.

It should be possible to adapt this replica technique to rough, moist membrane surfaces and to cross-sections through membranes by the use of cellulose acetate foil⁹ or carboxymethyl cellulose solution¹⁰. Clearly the electron microscope techniques described here could be applied with advantage to the development of ion-exchange membranes, in cases where pore dimensions are smaller than the resolution limit of the optical microscope.

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Radiation-induced Oxidation of Cytosine and Uracil in Aqueous Solution of Copper (II)

BOTH the hydrated electron, e_{aq}^- , and the hydroxyl radical, OH, which are formed as the principal intermediates in water radiolysis, react rapidly with the pyrimidine bases through preferential addition to the 5, 6 double bond to

give the hydropyrimidyl radical, BH, and the hydroxypyrimidyl radical, BOH, respectively¹⁻⁴. The yields for base destruction (molecules/100 eV) in oxygen-free solutions under γ -rays are, however, consistently low, $G(-B) \leq 1$ (refs. 5 and 6), when compared with primary yields of the radical species derived from water, $G_{e_{aq}^-} = 2.85$, $G_{OH} = 2.4$ (ref. 7); recent work indicates that secondary reactions of BH and BOH lead to regeneration of the parent compound⁴. In oxygen-saturated solutions, e_{aq}^- is scavenged



Fig. 1. Part of a thin section through A.C.I. C (sodium form). Membrane embedded in 'Epon 812' and sectioned with a glass knife. ($\times c. 16,700$)