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pH Changes Accompanying Filtration Through Cellophane Membranes.

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Previous studies[1] led us to expect pH changes on filtration of buffers through cellophane membranes. We present a preliminary report of data which confirm our expectations.

We used phosphate buffers of pH 7.0 and 7.2, having phosphate concentrations of 0.005 M and 0.01 M. They were prepared by the addition of CO_2-free NaOH to twice recrystallized $NaH_2PO_4:H_2O$. The 0.5 M stock solution was diluted with conductance water. Prior to filtration the cellophane 600 plain membranes were evacuated at 20 mm. Hg. and the buffer solution added. After repeated washing and soaking for several days the unsupported membrane was placed between pyrex cylinders of 2 cm. diameter and filtration carried out at 38 cm. Hg. The upper cylinder, into which the filtrate passed, communicated with a 125 cc. Erlenmeyer flask containing some of the buffer. Concentration of the filtrate by evaporation was thus prevented. The pH measurements were carried out according to the micro method of Bodine and Fink,[2] quinhydrone being used. A 25° C. ± 0.01° thermostat and type K Leeds & Northrup potentiometer were used. pH determinations of the original buffer and of the filtrate were carried out simultaneously. As we are here interested only in pH differences, the quinhydrone salt error was not evaluated. About 30 filtrates were examined with 2 or more pH determinations on each filtrate. The maximum fluctuation on duplicate determinations was 0.015 pH. The filtrate of the 0.005 M pH 7.2 phosphate buffer showed a maximum change toward the acid side after 3 hours of 0.46 pH and an average of 0.24 after from 2 to 15 hours. The filtrates of 0.01 M pH 7.2 and pH 7.0 gave maximum changes after 1 hour of 0.26 and 0.28 pH, respectively, and averages of 0.17 and 0.19 after from 1 to 3 hours, always toward the acid side. Shorter filtration periods were not investigated. Two membranes were used throughout. After approximately 130 hours of discontinuous filtration these membranes still showed the same effect. In order to evaluate the combined

[1] Bishop, G. H., Urban, F., and White, H. L., *J. Phys. Chem.*, 1931, **35**, 137.

[2] Bodine, J. H., and Fink, D. E., *J. Gen. Physiol.*, 1925, **7**, 735.

influence of atmospheric CO_2 and membrane a few drops of buffer solution were left in contact with squares of cellophane treated as the filters had been. These were placed in small Petri dishes and left from 2 to 17 hours. The maximum changes were 0.02 pH, barely beyond the limits of the method. If small amounts of acid had been present in the membranes it seems reasonable that they would have disappeared after prolonged soaking. The control results substantiate this opinion. Cellophane 600 plain is not a molecular sieve; a P.D. of only a few millivolts is observed across it with KCl solutions with a concentration ratio of ten to one.

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Effect of Ions on Filtration Rates Through Cellophane Membranes.*

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When distilled water is filtered through cellophane membranes which have been evacuated prior to several days' soaking in water, it is found that the rate of filtration usually decreases during the first hour, finally reaching an essentially constant value. We predicted that it should be possible to raise or lower the value of this final "steady" rate of filtration by adding varying amounts of $ThCl_4$ to the water. The preliminary results given below show that the steady rate of filtration is affected by $ThCl_4$.

The membrane was placed between glass cylinders and supported by a coarse alundum disc. Filtration was carried out at 10 cm. Hg. The rate of filtration was determined by following through a microscope equipped with a micrometer eye-piece the displacement of the meniscus in a capillary. A solution of 10^{-3} gms. $ThCl_4$ per liter gave a 25% increase in the rate of filtration over that of distilled water. Solutions of 1 gm. and of 10 gm. $ThCl_4$ per liter showed a decrease in the rate of filtration of 29% (average of 5 determinations) and 35% (average of 3 determinations), respectively. A solution of 10^{-2} gm. $ThCl_4$ per liter showed no large effect. A hypothesis concerning the mechanism of these processes, together with an extension of experimental results, will appear in a subsequent communication.

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