A Concentric Glass Electrode Assembly for pH Measurements

MOTT D. CANNON

Department of Biochemistry, College of Agriculture, University of Wisconsin

The electrode assembly described below, which can be made from materials usually available in laboratories, is believed to offer the advantages of good shielding and compactness.

In this design the stem of the glass electrode is placed within a slightly larger tube. The annular space between the two is filled with KCl solution and serves not only as the salt bridge of the reference electrode but also as an electrostatic shield. Such a concentric electrode assembly is particularly convenient for measuring the pH of samples in test tubes. Several electrode assemblies of this type have been built in which the outside diameter is less than 6 mm.

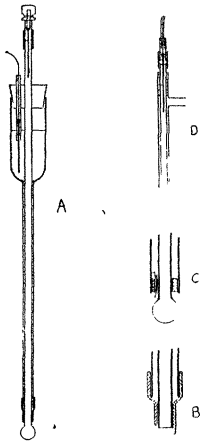

FIG. 1

In the type shown in A, Fig. 1, the annular space is closed at the bottom by a piece of Tygon tubing. This tubing is chosen to fit closely but without stretching over the stem of the glass electrode. It is then softened by steaming and forced over the end of the outer tube. The stem of the glass electrode just above the bulb is roughened on a coarse wheel or by filing (this may be done before the bulb is blown) to provide multiple fine channels through which the KCl can creep and establish a flowing junction with the sample to be measured. The outer surface of the stem of the glass electrode is wet with KCl solution and then slid up through the Tygon bushing. Assemblies which show only a very slow outflow of KCl have functioned satisfactorily. In time the Tygon may contract so as to cut off this flow, but this can be re-established by steaming the bushing in place and putting the lower end of the electrode assembly under gentle suction to draw KCl through.

Several modifications have been developed in this laboratory. A "window" type electrode may be protected by cutting the bushing diagonally and allowing one or more points to project below the delicate glass membrane (Fig. 1, B). In place of the Tygon bushing, a ring of gum rubber may be inserted between the stem of the glass electrode and the outer tube (C). Outflow of KCl is controlled by a tuft of fibrous material such as glass wool, asbestos fiber, etc., placed beneath the rubber ring before the electrode is inserted in the outer tube.

In Fig. 1, A, the KCl reservoir surrounds the stem of the glass electrode. Although this type is simple to make, it cannot be completely shielded, and electrical leakage through the stopper is apt to occur. In the design shown at D the reservoir is put at one side, connected either rigidly by glass or, if at some distance, by flexible tubing. The reference electrode is placed in this reservoir. The annular space for ½–1 inch above the side arm is filled with a mixture of half rosin and half beeswax. As this mixture is a good dielectric and forms a firm, moisture-tight bond with glass, the stem of the glass electrode needs only to extend far enough above the outer tube to fasten the Ag-AgCl electrode to it.

Electrical leakage to the reference electrode is practically eliminated, and, while supplementary shielding is easily accomplished, the short distance which the unshielded conductor is exposed usually makes it unnecessary.

Although no measurements have been made, electrical leakage through the stem of the glass electrode does not appear to be of much practical importance. Successful assemblies as long as 14 inches have been made using ordinary 7- or 8-mm. soft glass tubing for the stem. Heavy-walled barometer tubing has been used but appears to make no difference.

Other types of half-cells could probably be adapted for use with this arrangement, but the author has used silver strips plated with AgCl.

For the reference electrode these are conveniently made by soldering the silver strip before plating to a length of insulated copper wire. This is slipped into a glass tube which is then filled with the molten beeswax-rosin mixture so that the soldered joint is completely covered.

A similar strip may be used to establish contact with the buffered KCl solution within the glass electrode (D), or an insulated binding post (EBY Junior Post) can be used so that electrodes may be readily connected to a pH meter (A). The silver strip is soldered to the brass binding screw before being imbedded in wax. A Tygon collar holds the assembly in place and prevents evaporation of the solution in the glass electrode.

Staining of Oyster Larvae as a Method for Studies of Their Movements and Distribution

V. L. LOOSANOFF and H. C. DAVIS

Fish and Wildlife Service, Biological Laboratory, Milford, Connecticut

The free-swimming larval period of the American oyster (*Ostrea virginica*) is of considerable duration, sometimes lasting several weeks. During this period the horizontal and vertical distribution of larvae may be controlled by tides, tidal currents, and other factors. Because of different ecological conditions, the behavior of the larvae in different areas may show considerable variations.

In conducting observations on the movements and distribution of larvae, investigators, as a rule, have had to deal with unknown populations, because no method had been developed to mark the larvae of known broods so that they could be easily identified in plankton collections. Such a method is offered here.

Experiments on developing a method for marking oyster larvae were begun in our laboratory in 1944 by Loosanoff and