Patented Oct. 21, 1952 2,614,976

UNITED STATES PATENT OFFICE

2,614,976

ELECTRODE FOR DETERMINING CATIONIC ACTIVITY

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Continuation of applications Serial No. 75,924, February 11, 1949, and Serial No. 95,814, May 27, 1949. This application October 19, 1951, Serial No. 252,146

15 Claims. (Cl. 204—195)

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This invention concerns apparatus for making measurements of the cationic activity of electrolytes and more particularly concerns an apparatus assembly and method of making the same which is useful as an electrode for measuring the cation concentration in electrolytes.

The well-known glass electrode has been used for the measurement of E. M. F.'s from which comparative hydrogen-ion activity or hydrogen-ion concentration in electrolytes may be determined. Attempts have been made to use materials, such as glasses of various composition, for the measurements of the activity of ions other than hydrogen. This invention is based on the fact that certain compounds which have charged latices neutralized by exchangeable cations, such as for example natural hydrated zeolites, may be used as electrode membranes for the determination of cation activity. We have found that ordinary shales may serve as membranes for determining cationic activities, particularly when such a shale membrane is very thick. Such a membrane-type electrode is useful in making chemical analyses, biochemical measurements, physiological measurements, and other applications.

It is an object of this invention to provide a membrane-type electrode which is useful for the measurement of cationic activity in electrolytes.

Another object of this invention is to provide an electrode for measuring cationic activity in which the membrane comprises a material having exchangeable ions.

Another object of this invention is to provide an electrode for measuring cationic activity in which the membrane comprises a mixture of a synthetic cationic-exchange material and an inert insulating bonding resin.

Another object of this invention is to provide an improved electrode for measuring cationic activity in which the membrane comprises a finely-divided material having exchangeable ions, said material being held in place by dissemination within a matrix of inert insulating bonding material.

Another object of this invention is to provide an improved electrode for measuring cationic activity in which a low electrical resistance and high speed of response is attained in the membrane by a construction comprising the dissemination within a matrix of inert insulating bonding material of a large fraction of material having exchangeable ions.

Reference may be made to the accompanying drawing forming part of this specification and in which:

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Figure 1 shows an embodiment of the invention in which an inert insulating material containing an artificial cationic-exchange material is used as a membrane in a half-cell;

Figure 2 shows an embodiment of the invention in which an impervious inert insulating tube is closed at one end by a membrane comprising an inert insulating material having disseminated therein powdered cationic-exchange material;

Figure 3 shows an embodiment of the invention in which the closure for the lower end of an impervious inert insulating tube comprises a disc containing powdered cationic-exchange material;

Figure 4 shows an electrode assembly which employs as the membrane a natural shale fragment or an irregular mass of an insulating material having disseminated therein a substantial portion of synthetic cationic-exchange material.

An electrode assembly may be arranged in the form of a half-cell in which the wall or a portion of a wall of a container acts as a cationic-exchange membrane and the interior of the cell is filled with an electrolyte such as aqueous sodium chloride solution to which a nonpolarizable external electrical connection is made. The container or half-cell may then be immersed in the electrolyte whose cationic activity is to be determined and the electric circuit completed through an appropriate potentiometric measuring device to a standard electrode also immersed in the external electrolyte. Such an electric circuit arrangement for the measurement of ionic concentration is well known in the art.

Difficulties are encountered with half-cells of this type in that the electrical resistance of the membrane may be quite high so that an electronic amplifier must be used to measure the D.-C. voltage developed. Furthermore, the speed of response is often slow, i. e., the cell is slow to reach equilibrium with the external electrolyte whose cationic activity is being determined, thus requiring excessive time of the operator in making the measurement. Primary advantages of our invention are that low electrical resistance of the membrane is obtained resulting in the elimination of the electronic amplifier whereby the cell potential may be measured with an ordinary potentiometer. Furthermore, the speed of response is increased thereby resulting in a considerable saving of the operator's time.

Referring to Figure 1 the half-cell may be made in the form of a container 1 whose composition will be described later, the bottom portion of the container being formed integral therewith. Fig-