

UNITED STATES PATENT OFFICE

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ELECTRODE FOR USE IN ELECTROLYTIC CELLS

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2 Claims. (Cl. 204—294)

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This invention relates to improvements in electrodes for use in electrolytic cells and more particularly to carbon anodes for the electrolysis of aqueous solutions of alkali metal halides.

Many proposals have been made to cut down the pore space in carbon electrodes such, for example, as anodes used in the electrolysis of brine, by impregnating them with various substances. In many cases such treatment also produces some increase in the hardness of the electrode. For example, it has been proposed to impregnate such anodes with linseed oil or chlorinated linseed oil, or with a heat-hardenable resin, such as a phenol-formaldehyde resin, which is then hardened by heating. In general, electrodes so impregnated are not entirely satisfactory, since the impregnant is not always adequately resistant to the products of electrolysis, and greater polarization occurs than with a non-impregnated anode, so that the operating voltage of the cells is increased. Again, many impregnants "bleed" out of the pores to some extent as the electrode wears away or cause partial disintegration of the superficial layers of the electrode, and thus fouling of the cell may occur.

According to the present invention an improved electrode is provided adapted for use in a cell for the electrolysis of aqueous salt solutions, e. g. brine which electrode is formed of carbon impregnated with a resinous polymer of a lower alkyl ester of acrylic acid, methacrylic acid or of α -chloroacrylic acid.

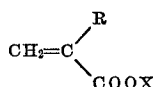
Such an electrode has a considerably increased life when used in an electrolytic cell compared with electrodes impregnated with other materials. A much greater increase in the hardness of the electrode results than when other impregnants are used, and it is found that this hardness is retained even after a considerable proportion of the electrode has been worn away. The electrode thus remains mechanically strong and capable of giving service when other anodes in a similarly advanced state of wear would break to pieces and become useless. It has also been found that electrodes so treated show much less polarization than other impregnated electrodes, so that, especially in the case of diaphragm cells, the cell can be operated at a voltage much nearer that required when unimpregnated electrodes are employed. Again, it has been found that the wearing of the electrodes during use does not result in fouling the cell. This advantage, again, is a special value in the case of diaphragm cells since any such fouling of the cell would tend to block the diaphragm

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and increase the resistance of the cell. It is also of considerable value applied to mercury cells with flowing mercury cathodes.

Electrodes according to this invention may be used in a variety of electrolytic cells intended for the electrolysis of aqueous salt solutions, and in particular for the electrolysis of solutions of halides, during which electrolysis chlorine is evolved. Thus they may be used as the anodes in electrolytic cells having flowing mercury cathodes in which a sodium chloride brine is electrolysed. They are, however, of particular value in diaphragm cells, for example of the Gibbs type or the Hargreaves type in which sodium chloride brine is electrolysed. Preferably the carbon electrode is of impregnated graphite, although non-graphitic porous carbon may also be used.

The esters which can be used according to the inventions are esters of the type



where R is hydrogen, a methyl group or chlorine, and X is a lower alkyl radical, viz., the methyl, ethyl, propyl, isopropyl, butyl or isobutyl radicals. Advantageously the esters are converted to the resinous condition in situ after they have been impregnated into the electrode. For this the esters may be used in a partially polymerised, though still liquid condition, but it is more convenient to use them in the monomeric condition. In order to promote the polymerisation, a catalyst may be present in the ester used for the polymerisation, as for example, benzoyl peroxide or succinyl peroxide, and usually amounts of the order of 0.5% are suitable. The polymerisation is brought about by heating, e. g. to 100–140° C. for a suitable time, say, 2–4 hours. Advantageously a proportion between 35% and 45% of the pore space is impregnated with the polymer.

In one method of carrying out my invention, a number of carbon, e. g., graphite, electrodes to be impregnated are placed in a pressure-resisting vessel which is then evacuated, and the vacuum is maintained for a time sufficient to enable air to be removed from the pores of the electrodes. While maintaining the vacuum, monomeric methyl methacrylate containing 0.5% benzoyl peroxide is introduced in amount sufficient to cover the electrodes. Air is then admitted, and pressure may even be supplied to ensure penetration of the monomer to all parts of the electrodes. Improved impregnation also results if the elec-

trodes are left to stand for a time, say, $\frac{1}{2}$ -1 hr. in the liquid ester. Next, the excess monomer is run off, and the temperature raised to between 100° and 110° C. for several hours, e. g. 2 to 4 hours; to ensure completion of the polymerisation the electrodes may be baked in an air oven at 70-80° C. for some hours, e. g. 12 to 20 hours or left in a warm atmosphere for several days. If any excess polymer forms a coating over the electrode when the polymerisation is complete it may be then removed, as by scraping or machining, and the electrode is then ready for use. Similar procedure may be employed for impregnating carbon electrodes with other esters according to the invention.

I claim:

1. An electrode adapted for use in a cell for the electrolysis of an aqueous salt solution, which electrode is formed of porous carbon impregnated with a polymer of a lower alkyl ester of an acid selected from the group consisting of acrylic acid, methacrylic and alpha-chloro-acrylic acid which has been polymerized in situ, said impregnation being to the extent that between about 35 and 45% of the pore space of the electrode is impregnated with the resinous polymer.

2. An electrode in accordance with claim 1 wherein said impregnated electrode is formed of a pre-formed porous carbon electrode.

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