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PROCESS FOR CARRYING OUT ELECTROLYSES

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This invention relates to a process for carrying out electrolyses of the most varied kind with aqueous electrolytes with employment of porous diaphragms.

According to the invention diaphragms are employed which consist essentially of a polymeric artificial resin or a mixture of polymeric artificial resins and have been treated with a wetting agent or wetting agents.

The diaphragms may for example consist of polyacrylic acid compounds, for example polyacrylic acid esters, polymethacrylic acid compounds, for example polymethacrylic acid esters, polyvinyl compounds or mixtures thereof or of interpolymers. The polymers may contain the usual additional substances such as softeners and the like. As examples of polymers of the above mentioned kind there may be mentioned: polymethacrylic acid methyl ester (Plexigum), polyvinyl carbazole (Luvikan), polystyrene (Trotitul), polyvinyl halide (Igelit). By suitable choice of the artificial resin or the composition of the artificial resin mixture desired properties can be imparted to the diaphragms as regards strength, hardness, elasticity, resistance to chemical attacks, temperature resistance etc.

The diaphragms can be produced in very simple manner in that particles of artificial resin of suitable order of size, for example grains of the same order of size, are brought into moulds, the artificial resin particles caused to cohere together therein at their points of contact and, after sufficient solidification has taken place, the structures are removed from the moulds. Cohesion can for example be brought about in that the thermoplastic artificial resin particles are superficially softened by supplying heat thereto or in that they are rendered capable of cohesion by treatment with solvents or swelling agents or in that organic binders suitable for uniting them, for example solutions of polymeric artificial resins, are employed. The particles which have been rendered capable of cohesion are united with one another in the mould by a slight pressing pressure, the pressure being so proportioned as not to cause an undesired constriction or stopping up of the pores. Artificial resin particles can advantageously be employed for building up the diaphragms, which per se are porous or microporous.

Since the polymeric artificial resins are more or less water-repellent, it was not to be expected that diaphragms consisting of such artificial resins could usefully be employed technically. In fact so far as I am aware such diaphragms have never been employed technically, although the excellent properties of polymeric artificial resins, especially their extraordinary resistance to chemical actions of the most varied kind, have been known for a number of years.

It has now been established by extensive experiments that artificial resin diaphragms of the kind described can be employed with excellent results if they are subjected to a treatment or pre-treatment with wetting agents. Comparative experiments have shown inter alia that it is possible when working with artificial resin diaphragms with wetting agents to reduce the electrical resistance by about 200–300%, thus coming within the range of electrical resistance of the previously usual diaphragms and making possible the utilisation of the special properties and advantages of artificial resins for electrolysis.

As wetting agents there may be employed the commercially usual products, for example such as are employed in the textile industry. There may be mentioned as examples sulphonates, such as are obtained by treatment of high molecular aliphatic alcohols with sulphonating agents. The wetting agents which are known under the trade names 'Neckal', 'Igepon' and 'Humectol' have among others proved well suited. The wetting agent or mixture of wetting agents which is most suitable in any particular case can readily be determined by simple preliminary experiments. The treatment of the diaphragms with the wetting agents can be effected by steeping, painting or spraying, if desired repeated painting or spraying. The wetting agents can also be employed in the form of solutions. This is advisable in particular for the treatment of fine-pored diaphragms.

The invention offers the advantage of being able to employ diaphragms which possess an extraordinary resistance to chemical attacks, for example to the attacks of alkalis, acids, halogens, for example chlorine, etc. Moreover there is the advantage that the diaphragms can be produced readily and in a very short time in any desired shape, for example also in the shape of curved plates, in cylindrical shape or the like, and in one piece, that the structures first produced can readily be altered to another shape because of the thermoplastic properties of the material, and that they can readily be inserted and removed. Further advantages are the production and utilisation of diaphragms of small wall thickness and low weight. The surprisingly favourable effect of the wetting agents, and especially the fact that

permanent effects can well be obtained by treating the diaphragms with wetting agents, was not to be foreseen.

The following experiments were carried out for determining the permeability to liquid of porous plates produced from an artificial resin by the process according to the invention. The experiments were all carried out both before and after treatment with a wetting agent in an electrolytic cell filled in one case with 20% sulphuric acid and in the other case with 20% common salt solution, by measuring the resistance between two bright platinum sheets each of 30 x 40 mms. inserted in the cell as electrodes with a current density of about 7.1 amps/dm² per electrode. The cell was so arranged that the resistance between the electrodes could be determined alternately and without interposition of a diaphragm plate of the material to be investigated.

The determination of the resistance was carried out at room temperature with a distance between the eelctrodes in each case of 40 mms., by measurement of the strength of the current passing through and the terminal potential difference between the electrodes, and calculation of the resistance given by the observed values, whilst the current density was permanently maintained as far as possible constant by two rheostats. Porous plates of 4 mms. thickness were investigated, which were produced from the artificial resin known under the trade name "Plexigum" (methacrylic acid methyl ester), by causing particles of this resin to cohere at their points of contact and then subjecting them to treatment with a wetting agent.

The wetting agent employed was a 1% solution of "Humectol" in which the plates were immersed for a short time prior to use.

The following results were obtained:

No.	Electrolyte	Diaphragm	Treated with wetting agent	Amp.	Volt.	Ohm.
1	20% H_2SO_4	No diaphragm		1.50	2.63	1.76
2	do	Diaphragm	0	1.75	7.80	4.46
3	do	do	Yes	1.75	4.95	2.83
4	20% NaCl	do	0	1.60	18.00	11.25
5	do	do	Yes	1.69	4.90	2.90

From the above table it can be seen that by treatment of the artificial resin plates with the wetting agent the resistance in 20% sulphuric acid is reduced by 1.63 ohm and that the resistance of the artificial resin plates in sulphuric acid was only 1.07 ohm greater, after treatment with the wetting agent, than the liquid resistance between the electrodes without interposition of a diaphragm. In the 20% common salt solution the reduction in resistance produced by treatment with the wetting agent amounted to 8.53 ohm.

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