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3,592,749

ELECTROLYTIC PROCESS OF PRODUCING AN ALKALINE PEROXIDE

Original Filed Jan. 30, 1967

2 Sheets-Sheet 1

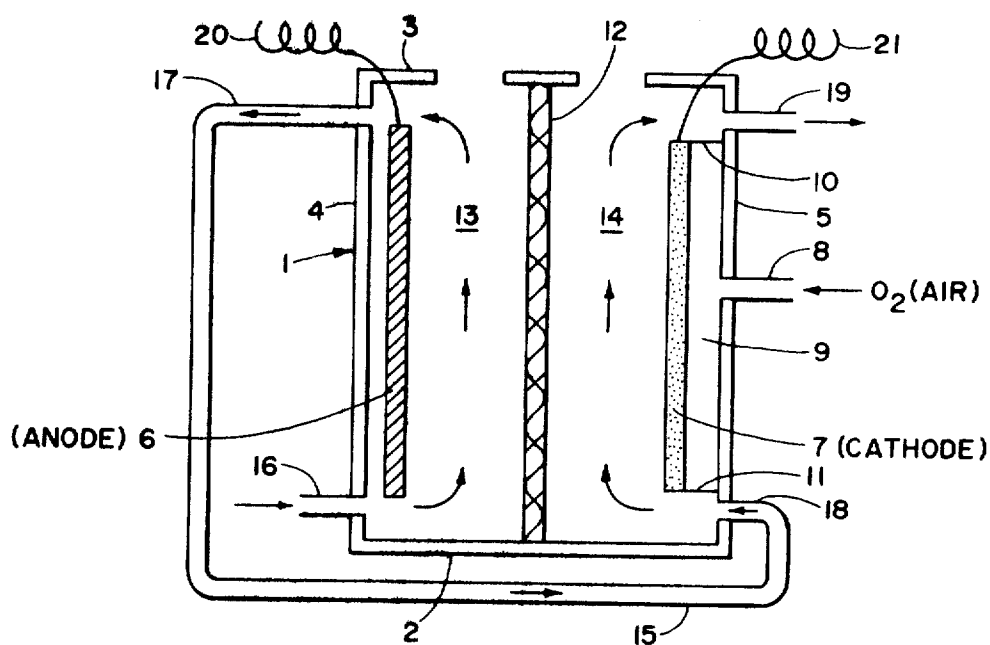


FIG. 1

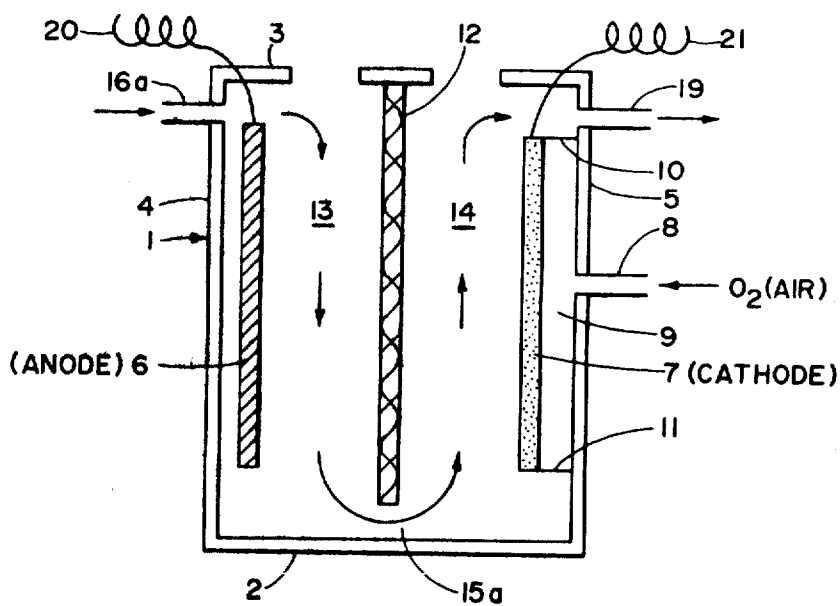


FIG. 2

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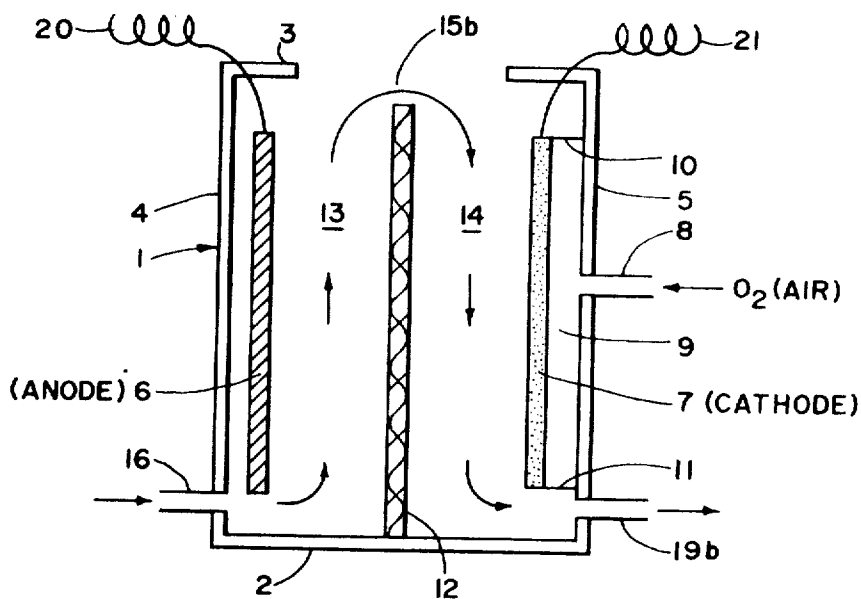


FIG. 3

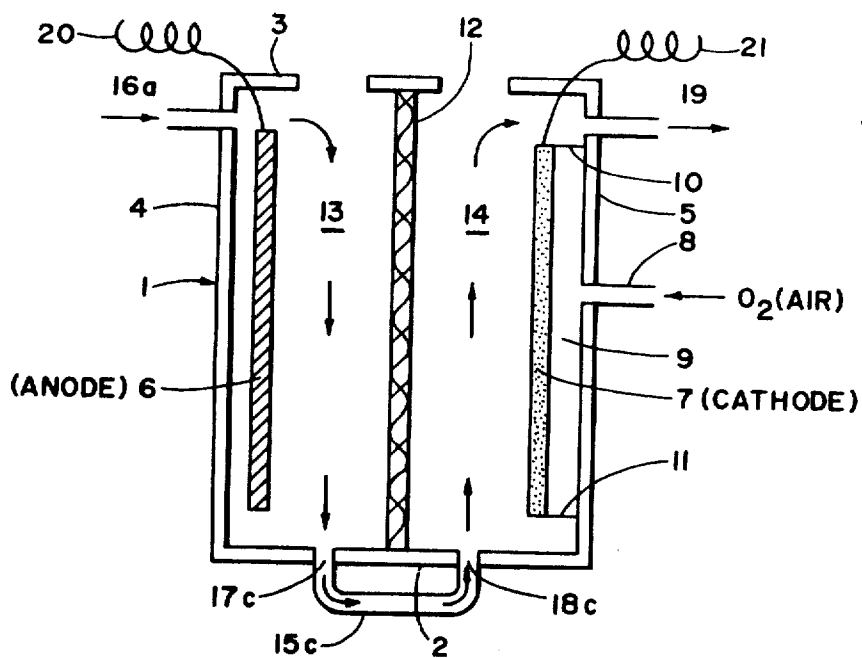


FIG. 4

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ELECTROLYTIC PROCESS OF PRODUCING AN ALKALINE PEROXIDE

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Original application Jan. 30, 1967, Ser. No. 612,469, now Patent No. 3,506,560, dated Apr. 14, 1970. Divided and this application Jan. 5, 1970, Ser. No. 588

Int. Cl. B01k 3/00; C01b 15/00

U.S. Cl. 204—84

3 Claims

ABSTRACT OF THE DISCLOSURE

An electrolytic cell for the production of alkaline peroxides. The alkalinity of the peroxide is controlled at a low value commensurate with the alkalinity of the electrolyte fed to the cell by providing cell electrolyte flow paths in which the electrolyte first passes through the cell anode compartment and then the cathode compartment where the peroxide is generated.

This application is a divisional application of my co-pending application Ser. No. 612,469, filed Jan. 30, 1967.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates to the preparation of peroxides, to electrolytic cells therefor and particularly to the manufacture of peroxide bleach solutions having an alkali concentration such that the solution is suitably directly usable in wood pulp bleaching operations, for example.

(2) Description of the prior art and the problem

Commonly, in the cells proposed for the production of alkaline peroxide solutions, the cell arrangement includes in spaced apart relation a porous cathode, an anode, and an interposed diaphragm. An alkaline electrolyte is in contact with the anode and cathode through the medium of the diaphragm which tends to inhibit migration of solution between electrodes. The diaphragm restricts liquid flow but is sufficiently pervious that, when using for example, NaOH as the alkali, sodium ions will migrate toward the negatively charged electrode; conversely, negatively charged hydroxyl ions, for example, will migrate toward the anode. Such action is, in fact, necessary in order for the cell to function in the manner desired. The tendency is, however, for a buildup of constituents to appear in such cells, particularly a buildup in concentration of the caustic in the cathode compartment. Such a buildup is undesirable because the alkaline strength of the product is then generally higher than desired for bleaching purposes.

SUMMARY OF THE INVENTION

A primary object of this invention is to provide a cell arrangement which permits the cell to be supplied with caustic solutions of moderate strength and which may be so operated that buildup of caustic is itself materially restricted. I have found that this and other objects of the invention may be achieved by passing the caustic solution in which the peroxide is to be produced through the anode compartment of a cell prior to passage thereof through the cathode compartment. The peroxide generated in the cathode compartment is withdrawn in a solution of substantially constant alkali strength.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood by reference to the following detailed description and accompanying drawings wherein:

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FIG. 1 schematically illustrates one arrangement of a cell for the electrochemical reduction of oxygen in accordance with the invention wherein the anode and cathode compartments of the cell are connected by fluid passage means external to the cell;

FIG. 2 illustrates a further modification of a cell arrangement wherein the fluid passage means is internally of the cell;

FIG. 3 illustrates yet another modification of the cell in which the fluid passage means provided internally of the cell are such that back feeding of the electrolyte is substantially inhibited; and

FIG. 4 illustrates yet another modification of a simplified structural arrangement having external fluid passage means.

In the drawing corresponding parts are identified by corresponding numerals insofar as practical.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawings, the numeral 1 (FIG. 1) generally designates a casing of rectangular section and of electrically non-conducting material having a bottom wall 2, a partial top wall 3 open to the atmosphere and side walls 4, 5. An anode 6 is mounted within the casing adjacent wall 4 and a porous cathode 7 of active carbon or the like is mounted within the casing adjacent wall 5. Wall 5 is provided with an inlet 8 for an oxygen containing gas and a spacing or manifold zone 9 communicates the inlet 8 with the cathode. Spacing 9 is in the nature of a source of supply of the oxygen containing gas for the porous cathode and is sealed from other components of the cell by the union of the cathode and casing at 10, 11. Any form of sealing arrangement to prevent the entry of electrolyte to the spacing 9 behind the cathode electrode 7 is satisfactory.

Interposed between the anode 6 and cathode 7 is a diaphragm 12 of sheet asbestos or the like. This diaphragm separates the cell into anode compartment 13 and cathode compartment 14. The diaphragm (FIG. 1) is supported from wall 3 in any convenient manner and in the embodiment illustrated extends the full height of the cell and above the tops of the anode and cathode in order to effect anode cathode separation in a most satisfactory manner.

Casing 1 has an opening 16 into compartment 13; the casing also has an exhaust connection 17 leading outwardly of compartment 13; a conduit 15 connects the compartment 13, 14 in series through cathode compartment inlet 18 and outlet 19 and, accordingly, there is provision for unrestricted flow from compartment 13 to compartment 14 and the exterior of the cell.

The cathode has an electrical lead 21, and the anode a lead 20 which are adapted for connection to a source of direct voltage (about 2 volts).

In the operation of the structure thus described a solution of sodium hydroxide (about 2% sodium hydroxide by weight) is fed through the inlet 16 as the cell electrolyte. The solution is fed continuously through conduit 15 and compartment 14 and is expelled at 19 with its content of peroxide.

The voltage applied across electrodes 20, 21 and the provision of oxygen on the porous activated carbon cathode causes the generation of perhydroxyl ions at the cathode and such ions flow outwardly with the electrolyte through port 19. To occasion this reaction, sodium ions tend to be drawn from the compartment 13 to the cathode 7 through the semi-permeable diaphragm 12 under the influence of the applied voltage. Such action in and of itself tends to cause an alkali (sodium ion) buildup in the cathode compartment and a hydroxyl ion buildup in the anode compartment. The latter is insignificant since

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the hydroxyl ion is decomposed to water and oxygen at the anode. The sodium ions, however, are not decomposed and, as a consequence, buildup in the cathode compartment. In fact, such rate of buildup is directly proportional to the current flow.

I have found that this tendency may be overcome and the alkali concentration, particularly in the cathode compartment, may be maintained quite constant by providing that the catholyte be obtained from a solution which has passed through an anode compartment, that is, a solution which has been exposed to loss of ions by migration. Under this condition the action in the important cathode compartment occurs under quite constant conditions to give quite constant results.

In specific application, if 2% by weight solutions of sodium hydroxide are fed independently to the anode and cathode cell compartments, then a significant and often undesirable rise in alkali content will occur in the cathode compartment. In many instances, particularly in the bleaching of pulps for papermaking, it is highly desirable that the ratio of caustic to peroxide be kept as low as possible. The use of caustic to peroxide ratios higher than necessary for an intended purpose not only results in higher alkali cost but chemically causes greater color reversion of the pulp which, in turn, requires the use of greater amounts of peroxide to overcome. In instances then, for example, where a 2% caustic solution is passed independently through the anode and cathode compartments, the concentration of the peroxide solution emerging from the cathode compartment, I have found, will be 10-15% higher than the alkali concentration of the solution supplied to the cathode compartment. Such additional caustic is of no value when bleaching pulp, for example, and as a consequence, simply increases the caustic and peroxide cost of bleaching. The actual degree of increase in the alkali concentration is dependent to a considerable extent upon the caustic flow rate, the amperage, and the nature of the diaphragm.

Contrariwise, if the procedure of the invention is followed by passing the alkali continuously through the anode and cathode compartment, the buildup of alkali is inhibited. This is apparently because the flowing electrolyte tends to even out in concentration, regaining in compartment 14 that which it lost through the diaphragm from compartment 13.

In specific application it has been found that in the production of alkaline peroxide solutions, other conditions being as noted above, using the conduit 15, no significant buildup of alkali occurs in the cathode compartment.

Conduit 15 in FIG. 1 provides an external path between the anode compartment 13 and the cathode compartment 14 for free flow of electrolyte from the anode compartment to the cathode compartment. FIG. 2 illustrates a simplified version similar in many respects to the cell of FIG. 1 but providing for internal fluid passage means connecting the anode compartment 13 and the cathode compartment 14. In this instance all numerals of FIG. 2 are the same as and designate parts corresponding to those in FIG. 1 except the numeral 15a which indicates the internal fluid passage and the numeral 16a which designates an inlet to the cell in the upper regions of the cell.

The structure shown in FIG. 3 is like the preceding cell arrangements and corresponding numerals designate parts corresponding to those of FIG. 1 except that a numeral 15b designates fluid passage means at the upper

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extremity of the cell, as will be noted. Also, the numeral 19b designates the outlet for the solution containing the peroxide developed in the passage through the compartment 14. In this instance the fluid passage 15b permits slow movement if desired over the diaphragm. Additionally, the cell structure is simplified through the elimination of two ports which would normally communicate the cell with the exterior of the equipment. In this respect the structure of FIG. 3 is advantageous in the same manner as the structure of FIG. 2. The structural arrangement set forth in FIG. 4 differs from the preceding structures in that the fluid passage means 15c connecting the outlet 17c of the anode compartment with the inlet of the cathode compartment is external of the cell and, in effect, also eliminates the necessity for more than two cell external port connections. In this instance, as in FIG. 2, the inlet for the electrolyte is at the upper extremity of the cell.

It is to be noted that in each of the cells the open top provides for venting of the gases developed by either anode or cathode reactions. Additionally, the flow is so controlled that the height of liquid in the cell never significantly exceeds that of the outlet port. This, of course, may be done in any convenient manner, including regulating the level of the input supply of electrolyte.

The actual cell construction employed may be in general accordance with the cell structure shown in my corresponding application co-filed herewith and entitled "Process for Producing Peroxides and Electrolytic Cell Arrangement Therefor."

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. In a process of producing an alkaline peroxide containing solution by the electrolysis of an alkaline electrolyte in a cell having an anode, an active porous cathode at which oxygen is reduced in cell operation and a diaphragm separating the cell into anode and cathode compartments, the steps of passing the alkaline electrolyte into and through the anode compartment and then successively through the cathode compartment to generate at the cathode the peroxide in the solution, and then withdrawing from the cathode compartment substantially all of the alkaline electrolyte fed to the cell.

2. A process according to claim 1 in which the process includes feeding the alkaline electrolyte from the anode compartment to the cathode compartment internally of the cell.

3. A process according to claim 2 in which the feeding of the alkaline electrolyte from the anode compartment to the cathode compartment is over the diaphragm of the cell.

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F. C. EDMUNDSON, Primary Examiner

U.S. Cl. X.R.

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