STAT

ELECTROLYTIC CELLS FOR THE PRODUCTION OF HYDROGEN AND OXYGEN. Separation and Removal of Gases.

Separation of Gases.

The two electrodes which dip into the water being electrolyzed may be surrounded by iron hoods which are insulated from the electrodes. Hydrogen is collected under one of the hoods and oxygen under the other. The gases are led away ~~from~~ attached to through pipes ~~at~~ the top of the hoods. This arrangement is not very convenient for industrial applications. If ~~open~~ cylindrical hoods which are open at the bottom are used, the width of the hoods necessitates placement of the electrodes at a rather large ~~considerable~~ distance from each other, so that a considerable resistance to the passage of the current results. Furthermore, the hoods surround a considerable portion of the electrodes, thereby lengthening the path of the current and increasing the resistance still further.

In modern industrial practice, ~~bags which serve as preventing the~~ bag-shaped porous diaphragms which prevent the passage of gas bubbles (and consequently the intermixing of gases) are attached to one or both hoods at the bottom. This arrangement permits a considerable reduction of the diameter of the hoods, so that the electrodes are brought closer together under corresponding reduction of the resistance. Furthermore, the electrodes may protrude to a much greater extent below the bottom edge of the hoods. If the level of the electrolyte in the cell sinks to such an extent that the diaphragm is exposed to the air, the gases may diffuse through the diaphragm. It is therefore necessary to prevent the level of the liquid from dropping too low.

Diaphragms.

Diaphragms which serve for the separation of gases must satisfy the following requirements: 1) they must have a low electrical resistance; 2) they must be dense enough to prevent the gas bubbles from passing through; 3) they must have sufficient mechanical strength; 4) they must be chemically resistant to the electrolyte.

These requirements are satisfied most fully by asbestos fabric, which is used almost exclusively in modern cells. The best alkali-resistant, long-fiber asbestos is used for weaving the fabric. Manually processed crude asbestos having a ~~ø~~ fiber length of 15-25 mm is ~~used~~ preferred. The fabric must be dense, must not

transmit light, and must have an adequate tearing strength. In the majority of cases, ~~a~~ a fabric of ordinary weave ~~3-3.5 mm~~ 1.5-2 mm thick can be used. In special cases, a fabric of double serge /diagonal/ weave having a thickness of 3-3.5 mm must be used. Occasionally the waft thread is reinforced with nickel wire 0.16 mm thick. This lends a greater mechanical strength to the asbestos fabric.

Asbestos diaphragms may be used for several years (3-5 yrs and more) unless the fabric is exposed to unusual mechanical strains resulting from fluctuations of the hydrogen and oxygen pressure as well as other causes.

Metal diaphragms are used considerably more seldom than asbestos diaphragms. As far as practical applications are concerned, diaphragms of thin nickel foil with 800-1400 small holes per square centimeter are used most often. These diaphragms are manufactured by electrolytic deposition of the nickel. ~~Matrices for depositing the nickel~~ Master sheets ~~are~~ on which the nickel is deposited are prepared by first making small pin-point depressions in a copper matrix. The matrix is then covered with an insulating lacquer, which fills the depressions. The excess lacquer is cleaned off the surface, so that only the depressions remain filled. Then the matrix is nickel-plated in such a manner that ~~only~~ the whole surface is covered with the exception of the depressions filled with lacquer. The nickel surface is oxidized lightly and used for depositing the diaphragm foil, which may be lifted easily from the surface thus treated.

Nickel diaphragms are stronger than those of asbestos. Nevertheless, they deteriorate under the action of the electrolyte and for that reason require periodic repairs, which are carried out by patching. ~~On~~ Destruction of the diaphragms ~~may~~ may bring about shortcircuiting of the electrodes, if metal diaphragms are used. For that reason, it is dangerous to place the electrodes too near to each other.

Cooling and Washing of Cases. Regulation of Gas Pressure.

The gases leave the cell at a temperature of 60-80° and carry along a considerable amount of water vapor as well as droplets containing electrolyte. In view of the fact that removal of a considerable amount of water vapor in this manner will raise the expenditure of water, while carry-over of /caustic/ alkali will increase the expenditure of alkali, measures are taken to cool the gases immediately after they have left the cell. On cooling the ~~main~~ principal quantity of water vapor condenses and flows back into the cell. To achieve adequate cooling of the gases, the covers and hoods under which the gases collect are cooled with water; the conduits through which the gases leave the cell are made sufficiently long;

the gas is bubbled through a layer of cold feed water. If the latter procedure is applied, simultaneously ~~chosen,~~ the gases are/freed from most of the alkali carried away by them and equalization of pressures in the hydrogen and oxygen spaces of the electrolytic cell is brought about.

Unequal pressures of gases in the cell may result from various causes. For instance, the pipe conduits may offer different resistance to flow; there may be formation of water locks in the pipes; the gases may be withdrawn at an unequal rate; etc. Keeping the gas pressure constant is very important, because excessive increase in/pressure of one of the gases under the hood may result in lowering of the gas level to a point below the edge of the hood, This may have the effect of ~~thus~~ exposing the diaphragm or even projecting a part of the electrolyte over the edge of the cell. Exposure of the diaphragm to air ~~may~~ will result, as has already been mentioned, in ~~to~~ mixing of the gases, so that an explosive mixture may form. Furthermore, ~~On the other hand~~, sharp and frequent fluctuations of gas pressure strain the diaphragm and ~~may~~ and lead to its rapid deterioration. For these reasons, regulation of gas pressure is very important. Regulation can be carried out for each cell individually or for a large or small group of cells.

A hydraulic pressure regulator may be ~~is~~ used, which ~~is constructed in~~ operates in the following manner. Two vessels (1 and 2) are connected by a tube at the bottom. Oxygen from the cell is conducted into Vessel 1, hydrogen into Vessel 2. If the hydrogen pressure should become higher than that of oxygen, the water level in Vessel 1 of the regulator would rise, thus compressing the oxygen and reestablishing equality of pressures.

The hydraulic pressure regulator also serves for washing the gases.

END.

Captions of Figures.

Fig. 83, p 211. Separation of Gases By Means of Hoods. 1 and 2 - electrodes; 3 and 4 - iron hoods; 5 - insulators.

Fig. 84, p. 212. Separation of Gases By Means of a Diaphragm. 1 and 2 - hoods; 3 - porous diaphragm.

Fig. 85, p. 213. Hydraulic Regulator of Gas Pressure. 1 and 2 - connected vessels of the regulator.