

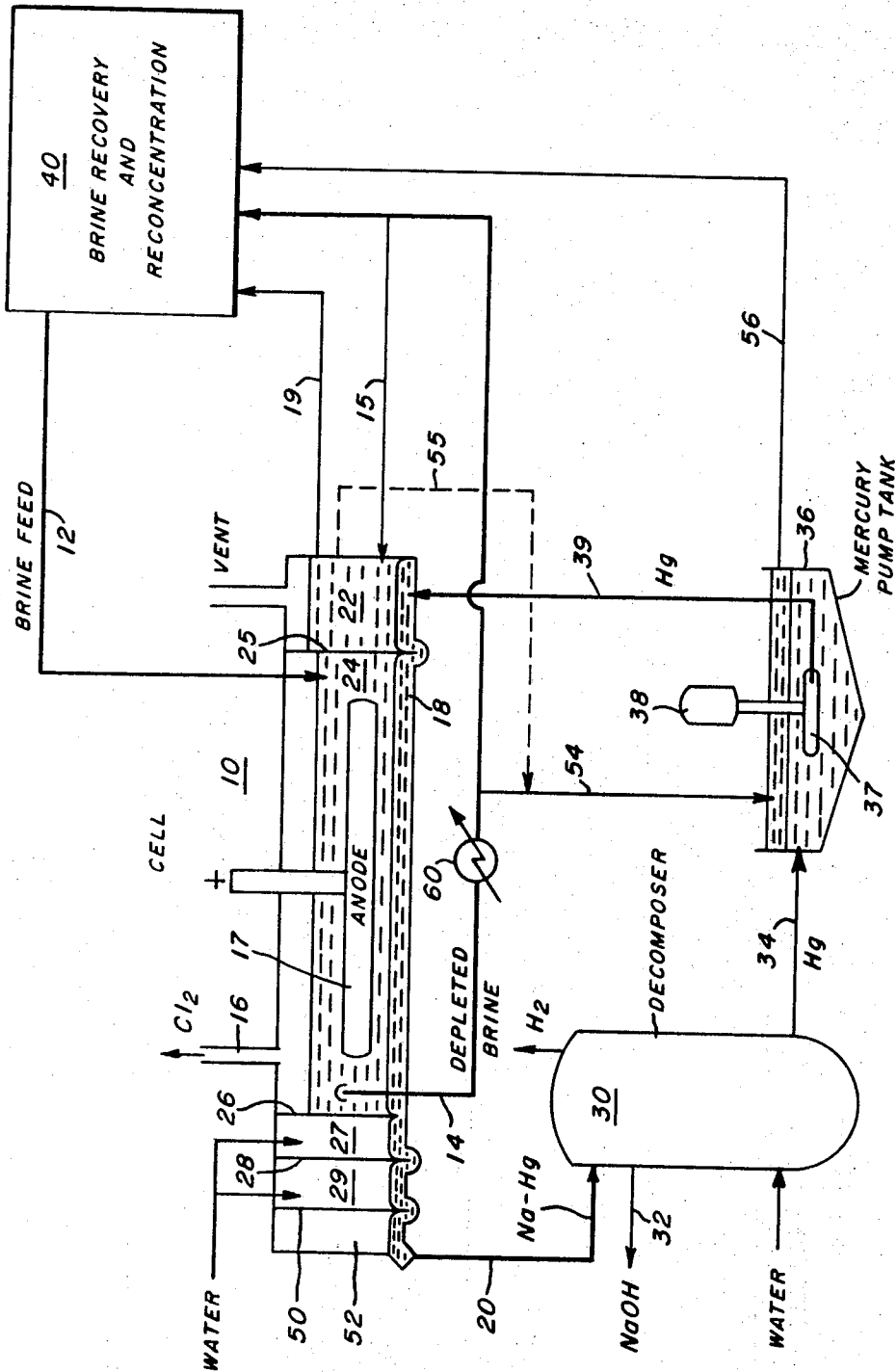
Sept. 10, 1974

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3,835,002

BRINE ELECTROLYSIS EMPLOYING MERCURY CATHODE

Filed June 13, 1973



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BRINE ELECTROLYSIS EMPLOYING MERCURY CATHODE

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Filed June 13, 1973, Ser. No. 369,561

Int. Cl. C07d 1/08

U.S. Cl. 204—99

6 Claims

ABSTRACT OF THE DISCLOSURE

The use of a concentrated brine of a defined concentration level as the cover for certain mercury portions in operating an electrolytic cell for the decomposition of brine where the mercury serves as the cathode, substantially reduces mercury vapor pollution. The depleted brine exiting the cell serves as the concentrated brine.

BACKGROUND

The use of the De Nora type electrolytic cell in the decomposition of brine such as sodium chloride-water brine to produce chlorine gas and a sodium containing by-product, normally sodium hydroxide, is well known. In the process mercury flows across the bottom of the cell and serves as the cathode whereas the anode is immersed in the brine bath. Chlorine is collected at the anode and sodium is deposited in the mercury cathode to form an amalgam therewith. The sodium-mercury amalgam is then decomposed to relieve the mercury of its sodium content and the mercury is recirculated back to the electrolytic cell to resume its dual purpose of serving as cathode and as transport medium for the sodium produced in the cell. It is desirable that the mercury and the Na-Hg amalgam remain as pure as possible and washing and cooling the mercury with water as it leaves the electrolytic cell and also washing it with water or some other suitable liquid including brines of various concentration levels as it enters a cell are employed in order to minimize contamination in the mercury. One problem which is encountered in the system is that of mercury pollution of the atmosphere. At the temperatures involved, typically over 100° F., mercury has a substantial vapor pressure. Covering the mercury at any point of exposure to the atmosphere with water or other liquids substantially reduces the mercury fumes or vapors evolved but there remains considerable room for improvement in reducing the vapors to the lowest levels possible.

STATEMENT OF THE INVENTION

In accordance with the invention, the mercury as it enters the inlet of the cell is washed and covered with a concentrated, but not saturated, brine containing from 70 to 95% of the sodium chloride salt content necessary to saturate the particular brine solution at the particular temperature involved. By saturation here is meant saturation in the particular brine employed which can vary with the levels of impurities present. A most suitable source for this brine is the depleted brine exiting the electrolytic cell, a small amount of which is conveniently passed through the mercury return portions of the cell system for purposes of washing and cooling the mercury cathode material. In addition to washing and cooling the mercury with the depleted brine, the invention contemplates covering all surfaces of the mercury otherwise exposed to the atmosphere with depleted brine from the cell and it has been found that this measure, while not especially cumbersome or complex, results in very substantially reduced mercury contamination levels in the vicinity of the electrolytic cell.

DETAILED DESCRIPTION

In the detailed description reference is made to the figure which is a schematic or diagrammatic representation of the operation of a system for electrolyzing NaCl.

Referring to the drawing, there is shown the electrolytic cell 10 into which feed brine is supplied through line 12. The salt content of the brine is decreased in the cell by electrolysis and the resultant depleted brine solution exits through line 14 and is returned to the brine recovery station 40 where it is reconcentrated by the addition of further salt and otherwise treated as necessary to serve as feed brine to the cell thus conserving salt by recirculating brine values. In the cell the salt in the brine entering through feed line 12 is electrolytically decomposed to form chlorine at the anode 17, the chlorine exiting through line 16, and to form sodium which deposits in the mercury cathode 18 to form a sodium-mercury amalgam which exists through line 20. The sodium is removed from the sodium-mercury amalgam in decomposer 30 with water to produce hydrogen, a caustic soda stream 32 and separated mercury stream 34 which passes to the mercury pump tank 36. The pump tank serves as a collector and as a cooling measure for the mercury. The mercury is pumped from the pump tank 36 by pump 37 driven by a means such as electric motor 38. The mercury exiting the pump 37 is returned via line 39 to the inlet box portion 22 of the cell 10. While the cell can be operated under slightly alkaline conditions (pH of about 7 to 8) higher mercury purity and cleanliness levels are often favored by operation on the acid side (pH of about 2 or 3) and the acidity can be so maintained continuously or periodically as conditions and desires dictate.

Turning now to the operation of the electrolytic cell in more detail the mercury entering the electrolytic cell passes through the inlet end box 22 prior to passing into the active zone 24 of the cell 10. In inlet box 22 the mercury is washed and cooled by a liquid in order to remove contaminants from it prior to the mercury passing under baffle 25 to underfeed into the active zone 24 of the cell and it is at this point, the washing of the inlet brine in the inlet end box, wherein the invention contemplates washing with the concentrated brine of the salt content described herein, the concentrated brine being obtained from the depleted brine stream 14 as by line 15. Thus a depleted brine stream passes through line 15 into the inlet box where it washes and provides a cover for the incoming mercury and exits through line 19 which can conduct the brine back to the brine recovery station 40. The mercury passes through the active zone 24 of the electrolytic cell in a thin stream or film and concurrently with the brine in the embodiment shown where it takes up sodium in the form of an amalgam. This amalgam is passed beneath baffle 26 into a first wash zone 27 after which it passes under baffle 28 into a second wash zone 29 and then finally under baffle 50 into the amalgam exit chamber 52. In wash chambers 27 and 29 the amalgam is washed with water to remove salt therefrom to facilitate a relatively chloride free caustic exiting the decomposer 30. The amalgam, free of water or salt, passes from exit chamber 52 via line 20 to the decomposer 30. While the invention contemplates washing and cooling the mercury in the inlet end box 22 with concentrated brine derived from the depleted brine stream 14 the invention also contemplates passing an additional stream 54 of the depleted brine to serve as a cover for the mercury pump tank from it which can pass via line 56 to the brine recovery station. Instead of separate streams 15 and 54 shown to supply the pump tank and inlet end box separately with brine in a parallel system, line 54 could be omitted and line 19 diverted from its course to the recovery station 40 to supply the pump tank thus passing

the depleted brine first to the inlet end box and then to the pump tank in series as by line 55 which would replace line 19 in this instance. Further the invention contemplates washing or at least covering any mercury surfaces exposed to the atmosphere so as to be able to lose mercurous vapors thereto as by evaporation. These surfaces, of course, are the upper unconfined surfaces exposed to the environment thereabove.

As stated earlier, the temperature of the brine feed in line 12 should be at least 100° F. but can run as high as 135° or even 150° F. although normal temperatures currently range from 110° to about 130°, typically around 120° in most commercially practical operations. In a typical application where the brine is fed at a temperature of 120° F. the depleted brine stream and the sodium-mercury amalgam both would have a temperature of about 180° F. because of the heat generated in the electrolysis. The mercury exiting the decomposer 30 via line 34 is typically at a temperature of about 250° F. as a result of the exothermic conditions in decomposer 30. The mercury is cooled in the mercury pump tank and in the inlet end box to around 130° F. by the depleted brine which itself is cooled by suitable means such as heat exchanger 60 in line 14. The feed brine ranges from about 90-97% or 98% of saturation which using pure water-NaCl brine at 120° F., translates to levels of about 290 to 310 grams of NaCl per liter of water. In general the highest concentration in the brine is favored as contributing to the highest efficiencies in the cell. The depleted brine stream typically ranges from about 220 to 285 grams of NaCl per liter of water which, at about 130° F., corresponds to the 70 to 95% salt content levels desired in practicing the invention.

In order to demonstrate the extent of the improvement realized by the practice of the invention, a De Nora cell operated in the manner here described produces a mercury contamination level of about 1000 mg. per cubic meter or higher in the immediate environment. Using soft water or dilute brine at the inlet end box would reduce this vapor to a level of about 40 mg. per cubic meter, which level is still considered excessive. However, the use of the defined concentrated brine in accordance with the invention has been found to consistently reduce the mercury vapor level to only 4 mg. per cubic meter.

While the invention has been described in terms of preferred embodiments, the claims appended hereto are intended to encompass all embodiments which fall within the spirit of the invention.

Having thus described my invention and certain embodiments thereof, we claim:

1. In the process of electrolysis of brine supplied to an electrolytic cell wherein mercury serves as the cathode and the sodium chloride content of the brine is partially decomposed to produce chlorine and sodium which sodium is deposited in said mercury cathode, the electrolysis further producing a depleted brine at a concentration corresponding to 70 to 95% of saturation and wherein the mercury underflows from an inlet end chamber into the electrolytic cell wherethrough it passes to pick up the sodium deposited therein, the improvement wherein portions of said depleted brine stream are passed over the mercury in said inlet end chamber so as to wash said sur-

faces and cover the upper surface of the mercury, said improvement resulting in substantially decreased losses of mercury by evaporation and substantially decreases in mercurous atmospheric pollution.

2. The process according to claim 1 wherein the mercury-sodium amalgam produced in the electrolytic cell is removed therefrom, treated to produce caustic soda and separate the mercury which mercury is passed to a pumping tank for cooling and recirculation to said electrolytic cell and wherein the depleted brine stream is employed to cover the mercury in said pump tank by providing a flow of said depleted brine stream across the exposed surfaces of said mercury in said pump tank.

3. The process according to claim 2 wherein the said depleted brine stream is provided by the portions of said depleted brine first passed over the mercury in the inlet end chamber according to said claim 1.

4. The process according to claim 1 wherein said brine supplied to said cell for electrolysis is concentrated at a level of 90 to 98% of saturation.

5. The process according to claim 1 wherein said depleted brine is at a concentration of 70 to 95% of saturation.

6. In the process of the electrolysis of sodium chloride salt brine supplied at a salt concentration level amounting to 90-98% of saturation to an electrolytic cell wherein mercury serves as the cathode, the brine and mercury passing therethrough in concurrent fashion and the sodium chloride content of the brine is partially decomposed to produce chlorine and sodium which sodium is deposited in said mercury cathode and removed from said cell continuously with said mercury and washed with water to provide a substantially salt free sodium-mercury amalgam which amalgam is removed and treated to separate the mercury which separated mercury is passed to a pump tank for recirculation to said electrolytic cell, the said electrolysis further producing a depleted brine at a concentration corresponding to 70-95% of saturation, and wherein recirculated mercury underflows from an inlet end chamber into the said electrolytic cell, the improvement wherein portions of said depleted brine stream are cooled and passed over the mercury in said inlet end chamber so as to wash said mercury in said inlet chamber and cover the upper surface thereof, portions of said depleted brine further being passed over the mercury in said pumping tank, said improvement resulting in substantial decreases in loss of mercury by evaporation and substantial decreases in mercurous atmospheric pollution.

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U.S. Cl. X.R.

204-128