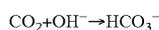


At about 80 minutes the flow was further decreased and the normalized current rose to 1.7 and the normalized CO₂ flow rose to nearly 0.5. These results demonstrate that about 50% of the incoming CO₂ can be captured. Thus we give this reactor a “chemical efficiency” of 50%. However the coulombic efficiency (1/1.7*100) is about 60%.

This is a successful demonstration of the feasibility of electrochemically generating pH gradients and using this to evolve CO₂ from feed solutions. A CO₂ chemical efficiency approaching 50% of the KHCO₃ flow and a coulombic efficiency of about 60% of KHCO₃ flow.

Referring to FIGS. 8 and 9, an assembly 60 is provided for treating a stream containing more than CO₂. As an example, stream 70 entering assembly 60 can contain effluent components, for example, nitrogen as well as CO₂. In accordance with example implementations, stream 70 can enter assembly 60 and migrate towards the upper portion of assembly 60 and further migrate across connective conduits 66 and 68 and pass through regions 18 and 19 of assembly 62, for example. In accordance with example implementations, assembly 60 can be described as including at least two portions: an adsorption column 64 and a CO₂ isolation column 62. Absorber 64 can be in fluid communication with one or both of the input or output conduits of the vessel. In accordance with example implementations, the absorber can be configured to expose the combustion gases to the electrolyte solution exiting the output conduit. As shown in FIG. 8, cathode 26A may also be singly placed outside the vessel and, for example, within absorber 64. Absorber 64 can be in fluid communication with both regions of the vessel.

According to an example implementation, as stream 70 can include both N₂ as well as CO₂ gas. Within column 64, solution 76 can include a caustic solution received from column 62 as described previously. In accordance with example implementations and with respect to the following formula, the CO₂ within stream 70 can be converted to a reduced form, and retained within the solution according to the following formula:



In accordance with this reaction, as basic solution is received from column 62, nitrogen gas 74 is unreacted and thereby separated as it evolves in gas form from solution 76 within the column 64. Solution 76 can continue on through interface 78 through conduit 66 to column 62. Column 62 is consistent with the reactors previously described wherein CO₂ is in its reduced form and exposed to acidic region 18 and basic region 19 that are maintained in those pH ranges via anode and cathode, respectively.

Referring to FIG. 8A a more detailed depiction of the transition of forms of the effluent is shown. As shown, effluent components CO₂ and N₂ are exposed to aqueous solution or electrolyte, wherein the solution has a proton depleted or basic state reacting to bring CO₂ into the HCO₃⁻ or H₂CO₃ form while N₂ remains in the gas form and able to evolve from the system. As the basic form of CO₂ transitions into the next vessel it is reacted according to the previously described embodiments.

Referring to FIG. 9, an interface 80 can be provided that is angled to prevent the transfer of gaseous particles from column 64 to column 62. In accordance with example implementations, interface 80 can direct fluid via a pressure differential while allowing gaseous particle 74 to be separated from the fluid within column 64.

It can be important for other gases not to enter column 62. In accordance with other implementations, column 64 may be configured to include a reservoir that allows gas bubbles time

such as nitrogen 74 to coalesce and rise to the exit chamber to further facilitate the efficient transfer of gaseous particles out of column 64 without being transferred to column 62. To facilitate the efficient evolution of CO₂ from column 62 for example, nucleation enhanced by ultrasonication or addition of carbonic hydrates or other chemical agents may facilitate the efficient evolution of CO₂. Nucleating surfaces such as rough oxide substrates or even suspended particulate materials that flow around with the solution may be utilized.

In compliance with the statute, embodiments of the invention have been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the entire invention is not limited to the specific features and/or embodiments shown and/or described, since the disclosed embodiments comprise forms of putting the invention into effect.

The invention claimed is:

1. An apparatus for separating CO₂ from an electrolyte solution, the apparatus comprising:
 - a vessel defining an interior volume and configured to house an electrolyte solution;
 - an input conduit in fluid communication with the interior volume and configured to convey the electrolyte solution to the interior volume;
 - an output conduit in fluid communication with the interior volume and configured to convey the electrolyte solution outside the interior volume;
 - an exhaust conduit in fluid communication with the interior volume;
 - an anode located within the interior volume and configured to provide hydrogen ions to the electrolyte solution within the vessel; and
 - a cathode located within the interior volume; and further comprising
 - a fluid conduit coupling the anode and the cathode, the cathode configured to provide H₂ to the fluid conduit, wherein the anode comprises a porous electrode configured to receive H₂ from the fluid conduit, and wherein the interior volume of the vessel is continuous between the cathode and the anode.
2. The apparatus of claim 1 further comprising an electron conduit between the anode and the cathode.
3. The apparatus of claim 2 wherein the cathode is located proximate the output conduit.
4. The apparatus of claim 2 wherein the cathode is configured to receive electrons from the electron conduit and generate H₂ for the fluid conduit.
5. The apparatus of claim 1 further comprising an absorber assembly in fluid communication with one or both of the input and output conduits.
6. The apparatus of claim 5 wherein the absorber assembly is configured to receive combustion gases.
7. The apparatus of claim 6 wherein the absorber assembly is configured to expose the combustion gases to the electrolyte exiting the output conduit.
8. The apparatus of claim 7 wherein the absorber assembly is configured to transfer the exposed electrolyte solution to the input conduit.
9. An apparatus for separating CO₂ from an electrolyte solution, the apparatus comprising:
 - an elongated vessel defining an interior volume and configured to house an electrolyte solution, the vessel having two regions, each of the two regions associated with an opposing terminal end of the vessel;
 - an input conduit extending outwardly from a wall of one of the two regions of the vessel and in fluid communication