# C8 CHLOR-ALKALI

## THE DIAPHRAGM CELL

CHEMICAL INDUSTRIES
RESOURCE PACK

## Electrolytic cells

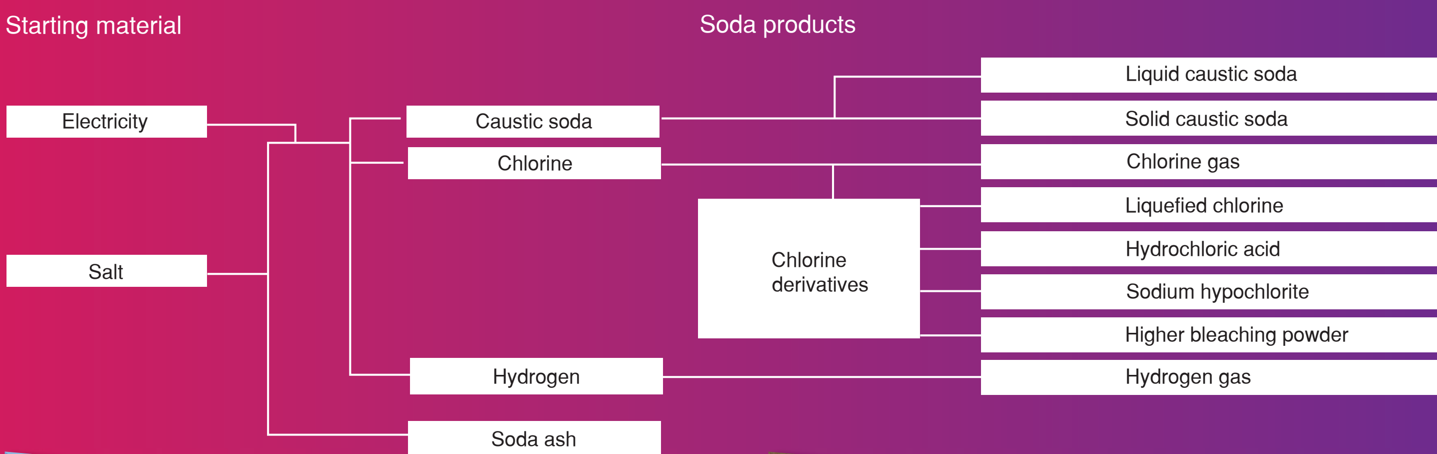
The first commercial production of chlorine through electrolysis was in 1888, and today more than 95% of the world chlorine production is achieved through this process. There are three different types of electrolytic cell that can be used for this process - the mercury cell, the diaphragm cell and the membrane cell. All three types have the same net reaction, but each technology uses a different way to separate the products when they form. Regardless of the technology used, cells are arranged in series, with each circuit consisting of several rows of cells. All electrochemical processes include some provision to separate the caustic and the hydrogen from the anode products. These provisions include:

- Asbestos diaphragm (Diaphragm process)
- Ion exchange membrane (Membrane process)
- Producing hydrogen and caustic in separate reactors (Amalgam process)

*Chlorine is used to make polyvinylchloride (PVC), a versatile polymer used in sewerage pipes, drain pipes and gutters*

*Source: Wikimedia Commons*

## The chlor-alkali industry: a summary




*Power lines*
*Source: Wikimedia Commons*

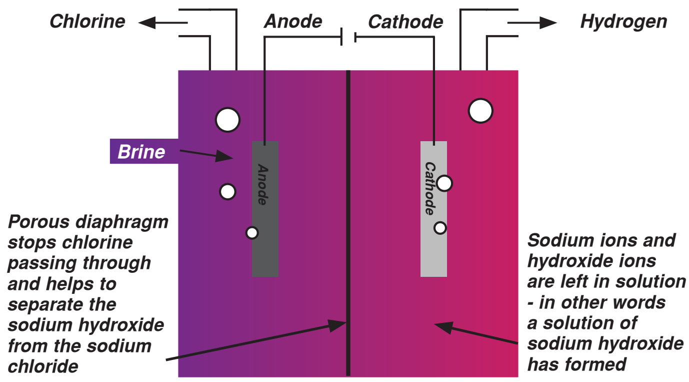

*A chlorine gas line*
*Source: Wikipedia*

# The diaphragm cell

The development of the diaphragm process started in 1885 with the Griesheim cell. However, this early cell had no diaphragm as such and relied on the flow of the anolyte towards the cathode to prevent the hydroxide ions from backmigrating. E.A. Le Sueur is credited with the design of a cell incorporating a percolating asbestos diaphragm, which is the basis for all diaphragm chlor-alkali cells currently in use.

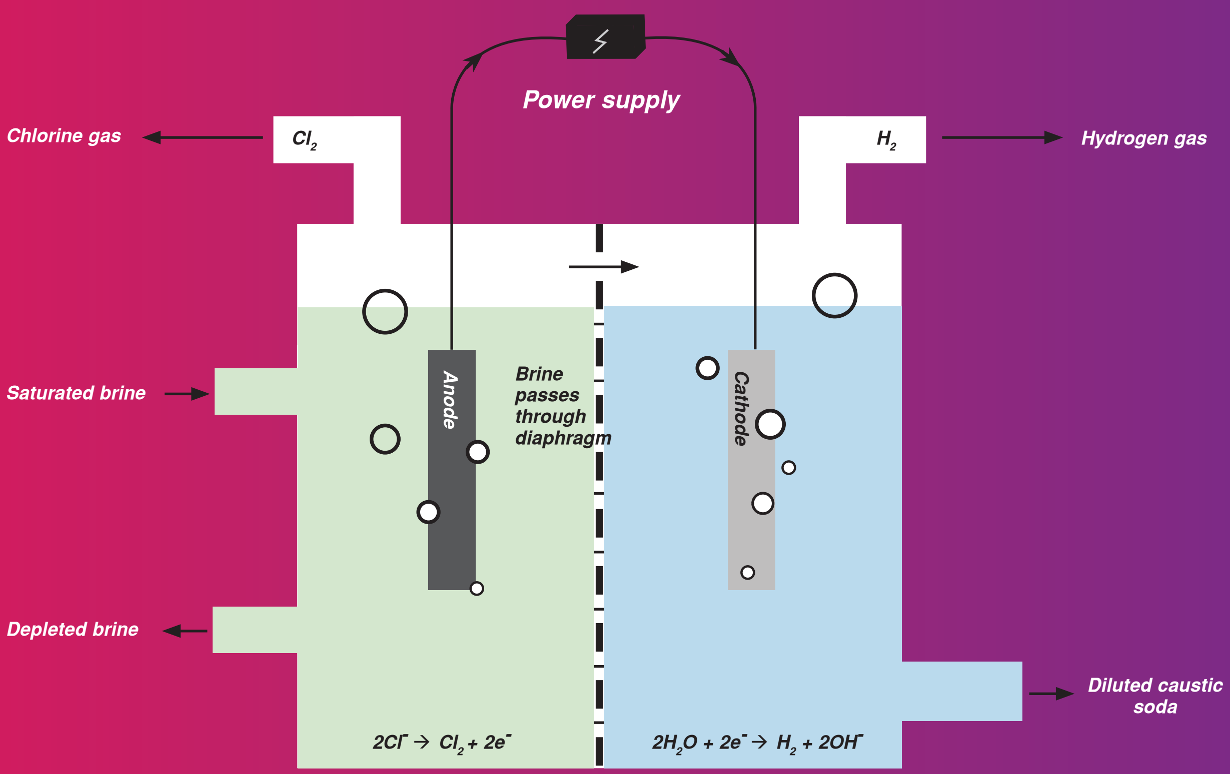
To separate the chlorine from the sodium hydroxide, the two half-cells were traditionally separated by a porous asbestos diaphragm, which needed to be replaced every two months. This was environmentally detrimental owing to the need for disposing of large quantities of asbestos. Such frequent replacement is fortunately no longer necessary, the asbestos having now been replaced in part by polymers resulting in diaphragms with a much longer life.

***The basic design of a diaphragm cell***




| Advantages of the diaphragm cell | Disadvantages of the diaphragm cell |
|---|---|
| Use of well brine | Use of asbestos |
| Low electrical energy consumption | High steam consumption for caustic concentration in expansive multistage evaporators |
| | Low purity caustic |
| | Low chlorine quality |
| | Cell sensitive to pressure variations |






***Sodium and chloride ions enter the anode compartment. Chloride ions are oxidised at the anode to give chlorine molecules. Sodium and chloride ions pass through the diaphragm. Water is reduced at the cathode to form hydroxide ions and hydrogen molecules. Sodium, chloride and hydroxide ions exit the cathode compartment.***