

CHLORINE WORLD

HISTORY

1774

Carl Wilhelm Scheele, a Swedish Chemist discovered Chlorine



Carl W. Scheele, a Swedish chemist, discovered chlorine in gaseous state while he heated manganese dioxide with hydrochloric acid. He also observed that the gas was soluble in water, had a permanent bleaching effect on paper, vegetables, and flowers besides it acted on metals and metal oxides

1805

Thomas Northmore, discovered properties of chlorine

He has noted that Scheele's gas became a yellowish amber liquid under pressure, and upon release of the pressure it volatilized rapidly and violently into a green gas. He further noted that it had a pungent odor and caused severe damage to machinery.

1810

Sir Humphry Davy, named this new element as Chlorine, from the Greek word chlōros, meaning green, yellow.

He was unable to decompose Scheele's gas. On July 12, 1810, before the Royal Society of London, he declared the gas to be an element, in which muriatic acid is combined with hydrogen. Therefore, he proposed to name the gas "chlorine" from the Greek chloros, variously translated "green" "greenish yellow" or "yellowish green" in allusion to its color.



1823

Michael Faraday observed Liquid Chlorine



On March 5, 1823, he was visited in his laboratory by J.A. Paris while he was working with chlorine hydrate in a sealed tube. Paris noted a yellowish, oily – appearing substance in the tube and chided Faraday for working with dirty apparatus. When Faraday tried to open the tube, it shattered and the oily substance vanished. After studying the accident, Faraday concluded the oil in the sealed tube was liquid chlorine.

1851

Charles Watt obtained an English patent for manufacturing chlorine by the electrolyte process.

However, at that time electric current generators of sufficient size were not available. When they became available, interest in electrochemistry was greatly stimulated.

1888

Rudolf Knietsch discovered that Liquid Chlorine could be filled under pressure in steel containers

From 1805 to 1888, Scheele's gas remained a laboratory curiosity — and a dangerous one — until it began to be produced on a commercial scale. This occurred when Kneitsch discovered in 1888 that dry chlorine did not attack iron or steel, which made it possible to package chlorine as a liquid under pressure.



1890

The first commercial production of chlorine by the electrolytic method, the chlor-alkali process, was introduced by the Elektron Company in Griesheim, Germany. The first manufacturer to use an electrolytic plant in America was the Oxford Paper Company at Rumford Falls, Maine, in 1892.

1892

Hamilton Castner and Karl Kellner invented Castner–Kellner process to produce alkali hydroxide by electrolysis of an aqueous alkali chloride solution. Castner cells were operated successfully in 1895



Hamilton Castner

Two men on different continents simultaneously discovered the mercury cell process for producing chlorine and caustic. Each discoverer was unaware of the other's efforts. One was an American, Hamilton Y. Castner; the other an Austrian, Karl Kellner. Both applied for patents in 1892



Karl Kellner

1894

Bleaching Powder was manufactured first time from chlorine

1909

Liquid Chlorine was manufactured commercially and packed in 100 lb cylinders

At first, the electrolytic process was used primarily for making caustic. Chlorine was an unwanted by-product. At the Niagara Falls plant, a small amount of chlorine was used for making bleach and hydrochloric acid; the remainder was discharged into the Niagara River. Not until 1909 was liquid chlorine manufactured commercially. It was first packaged in 100 - lb steel cylinders. The demand for it grew slowly but steadily, mostly for bleaching textiles, pulp, and paper. The first American tank car, with a capacity of 15 tons, was manufactured in 1909. The next year, 150 - lb cylinders came into use, and in 1917 ton containers were made for use in chemical warfare.

1941

First Chlorine Plant started in India at Mettur Dam (Sanmar Group)

1985

Chemfab was the first plant in India to introduce and successfully implement Ion Exchange Membrane Cell technology for Chlor-alkali production, in the year.

Introduction of Chlor-alkali Electrolysis Technologies in India and worldwide

Process	Global	India
Diaphragm Cell	1892	1920
Mercury Cell	1913	1970
Membrane Cell	1970	1985

The diaphragm cell process, and the mercury cell process have been used for over 100 years and are environmentally unfriendly through their use of asbestos and mercury, respectively, but the membrane cell process was only developed in the past 60 years and is the most energy efficient, environment friendly technology. India is second country to adopt this technology across the industry, next to Japan.

“Chlorine is never found free in nature and is present in the form of soluble chlorides. Chlorine is the second-most-abundant halogen and the second-lightest halogen on Earth, after fluorine. Sodium chloride (salt) is the most common compound of chlorine and occurs in large quantities in the ocean.”

PROPERTIES



Physical →

Physical State	Gas or Liquid under pressure
Color	Greenish Yellow (Gas) or Amber (Liquid)
Odor	Acutely Irritating
Boiling Point	- 34 °C
Freezing Point	- 100.98 °C (1 atm pressure)
Specific Gravity of Liquid Chlorine	1.468 (at 0 °C and 3.617 atm)
Specific Gravity of Dry Chlorine Gas	2.482 (at 0 °C and at 1 atm pressure compared to air as unity)
Specific Volume of Liquid Chlorine	0.6812 cm ² /g (at 0 °C and 3.617 atm pressure)
Specific Volume of Dry Chlorine Gas	0.3113 m ³ /kg (at 0 °C and 1 atm pressure)
Density of dry Chlorine Gas	3.209 g/l at (0 °C and 1 atm)
Vapor Pressure	3.640 atm (at 0 °C) & 5.6 atm (at 20 °C)

Atomic Number	17
Atomic Symbol	CL
Atomic Weight	35.453
Density	3.214 g/cc
Melting Point	-150.7 °F (minus 101.5 °C)
Boiling Point	-29.27 °F (-34.04 °C)
Number of stable Isotopes	2
Most common Isotopes	35 (76 % natural abundance)
Occurrence	Found in nature bound with other elements like sodium, potassium, and magnesium
Color (isolated as a free element) *	Greenish yellow gas, which is 2.5 times heavier than air

← Chemical

**It turns to a liquid state at -34°C (-29°F), and it becomes a yellowish crystalline solid at -103°C (-153°F).*

KNOW MORE ABOUT CHLORINE

- ❖ 1 Volume of Liquid Chlorine expands to 457.6 Volume of Gas at 0 °C and 1 atmospheric pressure
- ❖ Neither liquid nor gaseous Chlorine is explosive or flammable. Chlorine may be explosive in combination with Hydrogen, Hydrocarbon, and other organic gases
- ❖ Chlorine is not combustible but may support combustion
- ❖ Because of high reactivity, dangerous reactions are possible
- ❖ Presence of Iron, Mercury or Lead Oxide catalytically initiates dangerous reactions
- ❖ It may form Nitrogen Tri-Chloride with nitrogenous matter & it is highly explosive in nature
- ❖ Fire may occur at 251 °C (if Chlorine passes through steam heated MS pipelines)
- ❖ PVC, Rubber (Hard and Soft) may cause fire or explosion with Liquid Chlorine
- ❖ Dry Chlorine attacks Titanium metal
- ❖ Titanium is suitable for Wet Chlorine (minimum water level 0.4 % at 15 °C)
- ❖ Titanium and Chlorine fire will not extinguish with water (Supply of Chlorine has to be stopped to extinguish titanium-Chlorine fire)
- ❖ Wet Chlorine is corrosive since Chlorine with moisture form hypochlorous acid and hydrochloric acid.
- ❖ Chlorine reacts with hydrocarbon oils, mineral and linseed oil at room temperature
- ❖ Chlorine reacts explosively with glycerin at 70-80 °C
- ❖ Chlorine is flammable with fluorinated compounds R-22 (CHCLF₂), R-123 (C₂HCl₂F₃) and R-134a (C₂H₂F₄) at 38-100 °C