C3 CHLOR-ALKALI

CHLORINE

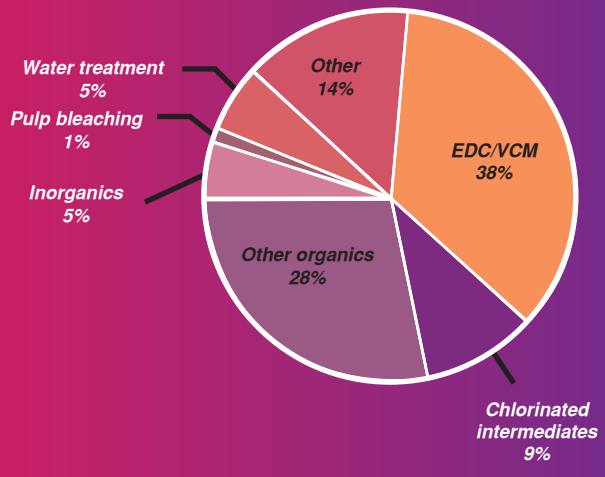
CHEMICAL INDUSTRIES
RESOURCE PACK

The use of chlorine

The first use of chlorine for disinfection dates back to 1823, when it was used in hospitals. Chlorine water was employed in obstetric wards to prevent puerperal fever in 1826, and fumigation with chlorine was practised during the great European cholera epidemic. Following the discovery that bacteria were responsible for the transmission of certain diseases, several investigators studied chlorination of both sewage and potable water in the 1890's in an attempt to destroy these bacteria. By 1912, the use of chlorine for water treatment had become a common practice. There was significant reduction in the incidence of water-borne diseases, such as typhoid. For example, from October to December 1909, 549 cases of 'winter typhoid' were reported in Montreal, Canada. After chlorination of drinking water was begun in 1910, only 170 cases were reported for the same 4-month period. Thus, virtually all the chlorine manufactured during the 19th century was consumed by these two industries. The major turning event for the growth of the chlorine industry was its use in 1912 for water purification during the Niagara Falls typhoid epidemic. It should be noted that bleaching powder was used in 1897 to clean the polluted mains during a typhoid outbreak in England.

This material was obtained from the Electrochemistry Encyclopedia. Learners - if you use any part of it you need to write it in your own words and include the following in your reference list: Bommaraju, T. V., Orosz, P. J. and Sokol, E. A. 2007. Brine Electrolysis. [Online]. Available: http://electrochem.cwru.edu/encycl/art-b01-brine.htm. [19 July 2010].

Chlorine end uses



Source: Electrochemistry Encyclopedia

DID YOU KNOW?

Hydrogen posed fewer problems for the alkali industry than chlorine. Not only was less produced but it could also be reacted with vegetable oils, such as groundnut oil, to make harder fats. These fats were first used to make margarine and for cooking. Any unused hydrogen could be burnt as an environmentally safe fuel - the product of burning was water.

Between 1920 and 1940, several new applications for chlorine were developed, for example, in the manufacture of ethylene glycol, chlorinated solvents, vinyl chloride, and others. World War II triggered the development of new uses for chlorine for military needs. This trend continued to produce new products for civilian use following the war. Progress in synthetic organic chemistry in the 19th century had led to the preparation of substitutes for natural products and entirely new and useful compounds including intermediates and final products. Chlorine, because of its reactivity, unique properties, and low price, was used in many of these, including solvents, pharmaceuticals and dyes. In 1795, dichloroethane was produced and in 1831 chloroform was synthesised. By 1848, the anaesthetic properties of chloroform were recognised and used in surgical practice.

The uses of chlorine include pulp and paper manufacturing operations for bleaching to produce a high quality whitened material, and in water treatment operations as a disinfectant. Other uses of chlorine include the production of organic and inorganic chemicals. The largest volume organic chemical manufactured that involves chlorine is polyvinyl chloride (PVC). PVC is a very versatile thermoplastic, used in a wide variety of daily products.

Chlorine profile

Chlorine is a toxic yellowish green gas, which is heavier than air and has an irritating odour. Chlorine is a member of the halogens, along with fluorine, bromine, and iodine. It is the 11th most abundant element. Chlorine is highly reactive and combines readily with other elements to form compounds. It is found as sodium chloride (salt), potassium chloride or calcium chloride in seawater and rock salts, rather than in the form of an elemental substance in nature.

Chlorine

The element chlorine was discovered in 1774 by a Swedish chemist named C.W. Scheele. The first industrial process for the production of chlorine was the so-called Weldon process (1866). This process employs the reaction between HCl and oxygen under the catalysis of manganese dioxide to form chlorine and water.

$4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$

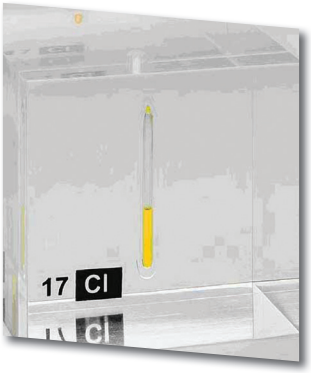
The Deacon process (1868) is a variation of the Weldon process using a cobalt catalyst instead of manganese dioxide. A variation of this process called the Shell-Deacon process is still of limited technical importance today.

$4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$

In 1892 the first electrochemical manufacturing process for chlorine production was developed. Since then electrochemical processes have been the methods of choice for most chlorine production. One of the main reasons for this is the fact that electrochemical processes produce caustic soda and hydrogen simultaneously with chlorine. With caustic soda being consumed in large quantities by various industries, the electrochemical route offers the advantage of producing two saleable products at the same time thus making the whole process more economically viable. The simultaneous production of chlorine and caustic soda is the reason that the chlorine industry is also referred to as the 'chlor-alkali' industry.

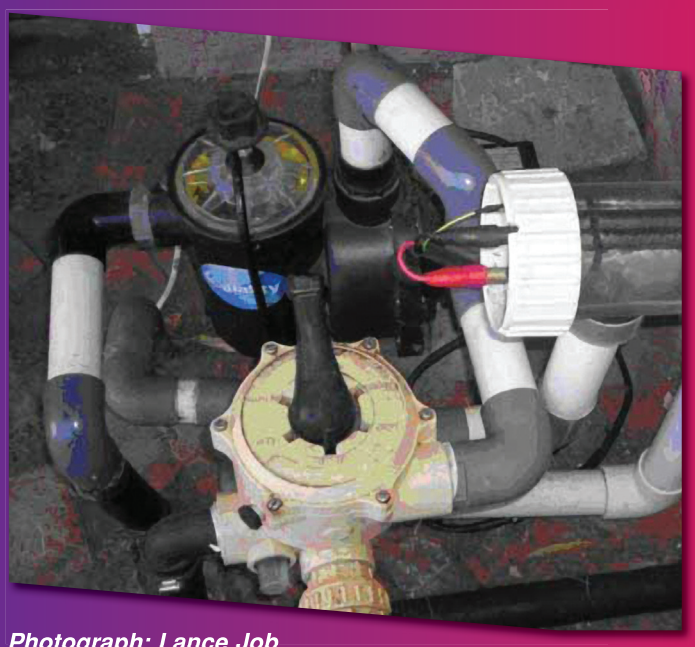
Chlorine gas

Chlorine liquid



Source: Wikimedia Commons

Salt water pool chlorinator



Photograph: Lance Job

Chlorine in pools

Pool owners make use of chlorine containing chemicals to keep their pools clear and disinfected. Common methods introduce the hypochlorite ion, which has bleaching and disinfecting properties, to the water. 'Chlorine pools' often use chemicals like calcium hypochlorite or sodium hypochlorite which are added to the water. Chlorine tablets are readily available and are either added to the pump unit or placed in floating devices that dissolve the tablet over time in the water. Some chlorine pool owners report bleaching of hair, burning eyes, dry skin and faster deterioration of swim wear as a result of these chemicals in the water.

'Salt water pools' have only salt (NaCl) added to the water and the pump unit uses electrolysis to form chlorine and sodium hydroxide. These two products react and yield the hypochlorite ion, which is then introduced into the pool. The pools are not chlorine free, but the concentration of chlorine is less than in chlorine pools. This lower concentration results in less damage to swimmers and clothing, but these pools take longer to clear up if there is bacteria present or the pH levels are not ideal.

Pool chemistry is sensitive to pH levels and therefore the pH needs to be monitored in both types of pools. Introduction of rainwater, urine, decomposing plant material and other contaminants can affect these levels and lead to the formation of other chemicals, like chloramines, which can also cause irritation to swimmers.

This material was written for the Chemical Industries Resource pack. Learners - if you use any part of it you need to write it in your own words and include the following in your reference list: UCT Chemical Engineering Schools Project. 2010. Chemical Industries Resource Pack. Cape Town.