

Chlorine and caustic soda

Key chemical building blocks ...



Water + Salt

- ... advanced composite materials
- aerosol spray
 - airbags
 - aluminium cans coating
 - anti-adhesive coatings
 - antibiotics
 - antifoaming agents
 - antifreeze fluid
 - audio and video tapes
 - backpacks
 - brake and transmission fluids
 - bullet-resistant glass
 - bumpers
 - cable insulation
 - car seats
 - catalysts (silica & alumina)
 - CDs and DVDs
 - ceramics
 - coatings
 - concrete
 - cooling medium/refrigerant
 - corrosive agents
 - cosmetics
 - credit cards
 - cutting oils for metal processing
 - dashboard panels
 - degreasing agents
 - dishwasher detergents
 - disinfectants and biocides
 - drilling fluids
 - drinking water
 - dry cleaning
 - electronic instruments
 - epoxy resins
 - explosives
 - fertilisers
 - flame-proof agents
 - foil packaging
 - footballs
 - fungicides
 - garden sprinkler systems
 - gaskets and seals
 - glass and fibreglass
 - golf bags
 - greenhouses
 - hairdryers
 - helmets
 - herbicides
 - household bleach
 - inflatable rafts
 - inks
 - insulation materials
 - intravenous drips and blood bags
 - keyboards
 - lab reagents
 - leather finishing
 - lighting circuits
 - lubricants
 - manufacture of vitamins
 - metal working fluids
 - microprocessors and computer equipment
 - non ferrous metals
 - nylon carpeting
 - pain relievers
 - paints and varnishes
 - paper towels
 - parachutes
 - performance plastics
 - perfumes
 - petrol additives
 - pharmaceutical blister packaging
 - pigments and dyes
 - plastic bottles
 - polystyrene coolers
 - prosthetics and heart catheters
 - pulp and paper
 - PVC and aluminium window frames
 - PVC pipes
 - radios
 - rollerblades
 - roofing
 - safety belts
 - saline solutions
 - scouring powders



EURO CHLOR
REPRESENTING THE CHLOR-ALKALI INDUSTRY

Economic barometer

Vital component for many industries

The key contributions of chlorine to the post-World War II boom in EU living standards is often underestimated. Today, chlorine and caustic soda, which are produced simultaneously in the same chemical reaction, are key raw materials for chemical, pharmaceutical and crop protection industries.

Chlorine is an “indispensable, universally applicable raw material in an innovative and productive industry.” Dr Jürgen Rüttgers, a former Germany Minister of Research, Education and Technology.

Chlorine use is closely linked to the prosperity of the economies in which it is used – the healthier the economy, the more industry depends upon chlorine and caustic soda as the raw material or intermediate to make other chemical compounds on which our quality of life depends. Chlorine is a vital component of materials used in car production, construction, electronics, aerospace, medicine and water purification, housing and sports.

Today, annual chlorine production in Europe is around 9 million tonnes, representing about 25% of the world's total. Over one-third is recycled within the manufacturing chain.


The largest single use of chlorine is in the manufacture of plastics, which are found in almost every aspect of our daily lives... from water pipes to outerwear... from blood bags to vehicle components. The best known is PVC, but an increasing proportion of chlorine production is being used as an intermediate to make other plastics such as chlorine-free polyurethane and polycarbonate. These are used for a range of products, including home insulation, upholstery, sports and leisure goods, bullet-resistant glass and compact discs. In fact, more than a third of Europe's annual chlorine production is used to make products that themselves are chlorine-free.

Although chlorine itself is more than 100 years old, it plays a critical role in today's high-tech communications and renewable energy industries. For example, computer silicon chips are made from the chlorine-based intermediate silicon tetrachloride and chlorinated solvents are essential in cleaning and degreasing microprocessors. Chlorine-based photovoltaic cells transform energy from the sun into usable power and light-weight chlorine-based plastics are used in wind turbines that generate electricity.

Few people would connect chlorine chemistry with titanium, aluminium or magnesium alloy, yet these ultra strong and lightweight materials are produced with the aid of chlorine or caustic soda. Aviation and automotive producers rely on these materials to produce energy-efficient aircraft and cars.

Two million European jobs depend on chlorine

Almost 39,000 jobs in Europe are directly related to chlor-alkali manufacture and 2 million in downstream industries. Production is at 85 plants across Western Europe. To minimise transportation of chlorine, which is highly toxic, most producers locate electrolysis units as close as possible to the plants using the chlorine. More than 80% of all chlorine produced in Europe is used at the same location.



More than a third of Europe's chlorine production is used to make products like CDs, that are chlorine free.

How chlorine is made by electrolysis

Chlorine is made by passing an electric current through a brine solution (common salt dissolved in water). The process simultaneously produces caustic soda and hydrogen gas. The latter is recycled. For every tonne of chlorine produced, a slightly larger quantity of caustic is generated. This alkali is widely used in many industries, including the food industry, textile production, soap, detergents, pulp and paper and aluminium.

Because chlorine production is energy intensive, the cost of energy is a critical factor in the global competitiveness of European producers. Energy taxes and high energy prices in Europe put the chlorine industry at a disadvantage compared with the USA, which enjoys much lower energy costs.

85% of medicines use chlorine



Chlorine-containing compounds are important intermediates in the manufacture of Vitamin C.

The use of chlorine for water disinfection is one of the “greatest advances in public health” of the millennium.

Life Magazine.

Throughout Europe, people are healthier and live longer than either our parents or grandparents. An ageing population poses challenges for public health systems. The pharmaceutical industry plays an essential role in delivering the health care products and medicines needed to sustain our health and wellbeing. Chlorine plays a little-known yet essential role too since more than 85% of pharmaceuticals and medicines contain or are made with this chemical or its derivatives.

Through its use in cleaning, disinfection and as antiseptics, chlorine helps protect patients in hospital from infections. Examples include disinfecting kidney dialysis machines; preventing bacterial contamination of burns and wounds. Chlorine-based plastics are used to make about 25% of medical devices, including intravenous drips and blood bags, sterile tubing and packaging, prosthetics and heart catheters.

There are, of course, numerous other applications of chlorine, and researchers continue to come up with novel ideas for using chlorine's high reactivity to create new solutions to problems. For example, US researchers are working on an antimicrobial cotton fabric that could result in clothes that kill bacteria and viruses. This technology could help reduce hospital-acquired infections and cross-transmissions of diseases in hospitals.

Protecting Europe's drinking water

Chlorine also helps protect public health – some 98% of Western Europe's drinking water is purified by chlorination. It has the major advantage of ensuring clean water right up to the tap. The action of other disinfectants – such as ozone, ultraviolet light and ultra-filtration – is only temporary.

At least one-fifth of all people worldwide lack access to safe drinking water according to a 1999 United Nations assessment of world water resources. This situation is expected to worsen with the earth's population forecast to grow from today's 6,000 million to an expected 7,300-8,300 million people by 2025.



Most crop protection chemicals use chlorine in the manufacturing process.

Industry aids disaster relief efforts

Following Hurricane Mitch devastation in Central America late 1999, a donation by Euro Chlor provided water disinfectants or PVC plastic sheeting for Honduras, Nicaragua and El Salvador and earthquake-hit Columbia. Water disinfectants were supplied also to aid relief efforts in flood-stricken Mozambique.

Feeding the world's burgeoning population represents a major challenge for the agricultural industry, which also relies on chlorine chemistry. About 96% of all crop protection chemicals are estimated to use chlorine at some stage of the manufacturing process. Without chlorine's help in making products to control pests, diseases and weeds, there would be failed crops and shortages all over the world.

Safe products – a consumer right

Safety in the production of chlorine, which is a toxic chemical, and its transportation and use is a major preoccupation of the chemical industry. Euro Chlor member companies recognise that consumers have a right to complete confidence in the safety of the manufacture and use of chlorine. And our industry sector is fully aware that its "licence to operate" must be earned from Society.

A key element in retaining this right to operate is the commitment by our companies to achieve continuous improvements in health, safety and environmental performance. Through Euro Chlor, national chlorine associations and the producers themselves, we also endeavour to communicate progress to stakeholders.

As society's expectations have changed, chlorine producers find themselves responding to ever-tougher challenges. European post-war economic prosperity has changed the emphasis from growth to meeting society's concerns about the manufacture, use and disposal or recycling of chemicals.

Throughout the past 20 years, European chlorine producers have understood the need to improve the environmental performance of their manufacturing processes. Significant reductions have been made in emissions to air, land and water. For example, during the 1985-1997 period, average production emissions to water of six major chlorinated chemicals (1,2-dichloroethane, 1,4 dichlorobenzene, carbon tetrachloride, chloroform, trichloroethylene and perchloroethylene) were cut by 90%.

Similar progress has been made in reducing emissions of mercury from the 58 plants that use mercury cell units to make chlorine (N.B. Mercury is used as the recirculating cathode in the electrolysis process and contributes to safety and product quality). During the past decade, producers have progressively reduced annual mercury emissions by more than 85% to less than 9 tonnes in 1999. This is a very small amount when set against the estimated annual natural and industrial global emissions of 16,000 tonnes.

Nonetheless, all 29 European producers using the mercury process in plants across 13 countries are committed to achieving further reductions. Through Euro Chlor, a voluntary but binding environmental agreement has been submitted to the OSPAR Convention for the protection of the marine environment. It sets limits and targets for future emissions and proposes a final date by which plants will be closed or replaced with alternative technologies.



"It is the right of every consumer to have complete confidence in the safety of our products."

Alain Perroy, Director General of the European Chemical Industry Council.

Early leader on risk assessments

Euro Chlor was an early leader in the voluntary development of risk assessments to check whether chlorinated compounds pose a risk to the marine environment. Since 1995, assessments have been developed for 25 chlorine compounds with both data on hazard and exposure.

Euro Chlor is now using this experience to support a world-wide chemical industry initiative to assess potential hazards to human health and the environment of about 1,000 high production-volume chemicals. Approximately 100 of these contain chlorine in the molecule.

Benefits outweigh disadvantages

Scientific advances have resulted in the development of a vast range of useful chlorine-based products. As in every other sphere of life, there are occasionally disadvantages associated with new benefits. For a few of the chlorinated products, such as PCBs and CFCs, the increasing weight of evidence demonstrated that the environmental disadvantages outweighed the benefits. These products are now banned within the EU. Also DDT is banned within the EU but it is recognised that in particular cases, it benefits in protecting the lives of exposed people from malaria. In fact, many chlorinated substances are used and it is the purpose of risk management to allow the use of any chemical in order to maximise the benefits whilst minimising the dangers.

The continuing challenge facing governments, international regulatory authorities and industry is how to encourage and support policies and practices that enable society to derive the maximum benefits from chemicals, such as chlorine, without harming either the environment or human life.

The industry's commitment and determination to work for a sustainable future for chlorine chemistry is underscored by its willingness to collaborate with governments and listen carefully to other stakeholders in a continuous effort to adjust and change to meet the expectations of society.



*"Chlorine is neutral,
neither good nor bad.
It is how we as a
society... exploit
it that determines the
benefits and disbenefits."*

Prof. Don Mackay, Institute
for Environmental Studies,
University of Toronto.

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An information resource

Based in Brussels, Euro Chlor is an affiliate of the European Chemical Industry Council (CEFIC) and represents 43 European chlor-alkali producers with 85 plants in 19 countries.

Euro Chlor places a strong emphasis on the provision of balanced and objective science-based information to regulators, politicians, scientists, the media and other interested stakeholders.

A wide range of general and technical information is freely available through its web site, *Chlorine Online* (www.eurochlor.org) or directly from the Brussels Secretariat:



Euro Chlor

Avenue E Van Nieuwenhuysse 4, box 2

B-1160 Brussels, Belgium

Tel: + 32 (0)2 676 7211

Fax: + 32 (0)2 676 7241

e-mail: eurochlor@cefic.be