Sustainable Progress

WORLD chlorine council®

Version 3, 2017

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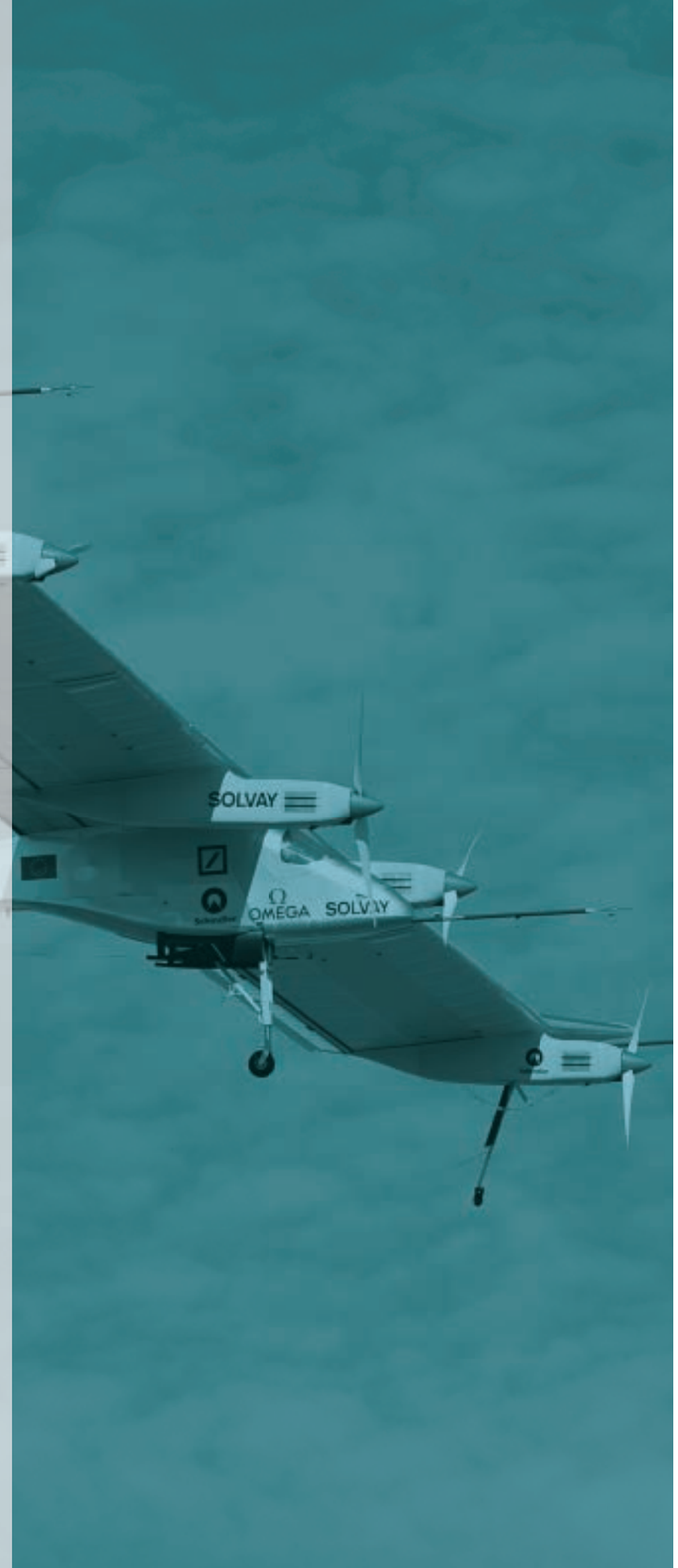
Introduction to the World Chlorine Council

The World Chlorine Council (WCC) is a global network of national and regional chlorine-related trade associations and their member companies. WCC has participation from chlor-alkali producers across Europe, North America, South America, Russia, India, Japan, China, Africa, and South Korea, but works to include all global producers. WCC primarily aims to improve the performance and sustainability of the industry by promoting responsible stewardship practices and addressing safety, health, environmental and public policy issues. It is accredited as a non-governmental organization by the United Nations (UN) General Assembly, and is a recognized major stakeholder that can provide input into the UN system on priority international issues.

Solar Impulse 2: Around the World without Fuel

Chlorine chemistry plays an essential role in innovative technology that helped the first solar-powered plane to soar through the skies! Harnessing only the power of the sun, the Solar Impulse 2 plane completed a 16-month, historic, round-the-world flight in July 2016, to the delight of clean energy enthusiasts. The flight originated and made its final landing in Abu Dhabi, United Arab Emirates.

The piloted fixed-wing aircraft is equipped with 17,000 solar cells that power its propellers while charging 600 kg of lithium batteries during daylight hours. Energy stored in the batteries power the plane at night. Chlorine chemistry is used to purify silicon for solar cells and integrated circuits, the foundation of modern electronics. Solar Impulse partners include Solvay and Bayer MaterialScience LLC (now Covestro).



Progress on Sustainability: WCC's Perspective

As the world takes stock of progress toward sustainable development, WCC is pleased to present this report of the chlor-alkali sector's achievements.

We continue to see sustainability as a journey, underway yet incomplete, including substantial progress but also the need for continued efforts. Our products help provide essential solutions to many of society's greatest challenges. For example, safe drinking water for all remains an unmet global sustainable development goal that chlorine-based water disinfectants will help achieve.

The use of chlorine chemistry in cutting-edge technologies such as the Solar Impulse project illustrates our potential. This project turned vision into reality by flying an aircraft around the world between March 2015 and July 2016, using solar energy alone – a powerful symbol of the major efforts and technological leaps needed to ensure a sustainable future.

The photovoltaic cells on the wings of the plane are protected by a 17 micron-thick film of the high-performance coating ethylene chlorotrifluoroethylene (ECTFE). This product protects the cells from corrosion and from the harsh environment that is encountered by the aircraft on the ground and in the sky. As institutional frameworks for sustainability develop, it will be important to foster sustainability but avoid additional layers of bureaucracy. Efficiencies should be pursued wherever they can help promote sustainable outcomes. The private sector has technical expertise that can help to inform policy decisions and improve the effectiveness of implementation. The Strategic Approach to International Chemicals Management (SAICM) provides an innovative model of how multi-stakeholder frameworks can help advance sustainable development objectives. As a committee of the International Council of Chemical Associations (ICCA), the WCC supports SAICM, a policy framework to promote chemical safety around the world. The overall objective of SAICM is to achieve sound management of chemicals throughout their life cycles so that by 2020 chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.

WCC supports the ICCA position that sound chemicals management is best achieved through a combination of transparent, cost-effective, science-based regulation and voluntary initiatives. Industry led efforts – such

Our long-term vision is to achieve zero accidental releases and zero transportation/customer safety incidents.

as Responsible Care® and the ICCA Global Product Strategy (GPS) – can be effective in helping achieve sustainable development at the global and local levels, and the institutional framework should help facilitate and encourage such initiatives. It should also help build capacity and develop institutions that support implementation at the national level.

In the future, the movement toward a "green economy" requires an inclusive, multidimensional approach. A solely environmental focus risks defining green jobs and green growth too narrowly. Economic growth is critical to solving environmental and social challenges, including poverty reduction. The global chemical industry – and the private sector more broadly – has a critical role to play. The private sector is the primary source of green jobs and the principal supplier of green products and services through the innovation, commercialization and implementation of new technologies. Chemistry is essential to enabling this, because virtually all manufactured products are touched by chemistry and often by chlorine chemistry.

The chlor-alkali industry's dedication to continuous social, economic and environmental improvement – known as the "triple bottom line" of sustainability – is constant. Efforts continue at local, regional and global levels, coupled with open and timely dialogue with all stakeholders, including regulators, elected officials, scientists, the public, the media, investors and employees. Sharing best practices for optimizing safety and minimizing emissions remains a top priority as we move toward our long-term vision of achieving zero accidental releases, as well as zero transportation and customer safety incidents.

WCC has engaged positively in many national and international processes linked to chlorine chemistry over many years, including the UN chemical management conventions on hazardous wastes. As an example, WCC is a partner in the UN Environment Program (UNEP) Mercury Partnership. Our long-term commitments to phase out mercury-based chlor-alkali production, now globally covered by the Minamata Convention, illustrates that WCC continues to be an active traveller in the global journey toward sustainability.

Chlorine Chemistry Helps Control Malaria

A mosquito net treated with a long-lasting, chlorine-based insecticide has been approved by the World Health Organization (WHO) to help control malaria. Chlorfenapyr belongs to a new insecticide class for combating mosquitoes for public health, according to BASF, which developed the product in a decade-long collaboration with the Innovative Vector Control Consortium and the London School of Hygiene & Tropical Medicine (LSHTM). This is the first WHO recommendation for a product based on a new insecticide class in more than 30 years.

A second chlorfenapyr product, an indoor residual spray to coat walls and ceilings of homes, is also in the final phases of WHO evaluation for controlling insecticide-resistant mosquitoes, according to BASF.

Each year, the WHO estimates there are more than one billion cases and one million deaths due to vector-borne diseases such as malaria, dengue and schistosomiasis. Mosquitoes are the best-known disease vector. Malaria alone causes more than 400,000 deaths worldwide each year, mostly in children under five years of age. Over half the population of sub-Saharan Africa now sleeps under long-lasting insecticide treated nets, which has helped to reduce malaria cases by a third over the last 15 years, according to the LSHTM. The School's Professor Mark Rowland is quoted as saying that the new bed net "has the potential to save thousands of lives…It has demonstrated improved control of the main African malaria vector species and is now recommended for use by malaria control programmes."

Chlorfenapyr has been shown to be effective against local insecticide resistant mosquitoes in Benin, Burkina Faso, Tanzania and Ivory Coast. These and other sub-Saharan African countries report most malaria cases and deaths. This is a significant scientific breakthrough that will help meet the challenge of malaria control in areas where conventional nets are failing due to insecticide-resistant mosquitoes.

BASF notes chlorfenapyr, which was derived from a bacterial toxin, "is new to the public health market, but has been used in agriculture and urban pest control, including in homes and food handling areas, worldwide since 1995." The product works by disrupting the mosquito's ability to produce energy, a different mode of action from current WHO-approved insecticides for public health.

Product Benefits

Chlor-alkali producers are a vital part of the chemical industry and provide benefits in an array of sectors including healthcare, public health, energy and the environment. The industry makes a significant social contribution – and offers products and technology to improve lives and help to achieve the Post-2015 Sustainable Development Goals.

Healthcare:

Chlorine-based products play a key role in medical devices and pharmaceuticals. For example, in the United States, approximately 88% of top-selling pharmaceuticals contain or are manufactured using chlorine, including products to treat HIV/AIDS, allergies, arthritis, cancer, depression, diabetes, heart disease, hypertension, infections, pneumonia and ulcers.

Through its use in polyvinyl chloride (PVC), chlorine also contributes to safety in tamper-resistant and sterile pharmaceutical packaging and in "blister" packs, which help extend shelf-life and make it easier for patients to take the correct dose.

An estimated one-quarter of medical devices depend on chlorine chemistry. Chlorine-based plastics are used to manufacture intravenous drips and blood bags, sterile tubing and packaging, prosthetics and heart catheters. Chlorine is also used to help make semiconductors for diagnostic instruments. In hospitals, chlorine compounds help protect patients from infection through their use in sanitizing and disinfecting, and as antiseptics.

Nutrition:

Chlorine chemistry is used to help manufacture crop protection chemicals, which help boost crop yields and quality. In commercial food preparation, chlorine-based products are used for:

- Sanitizing and disinfecting equipment and food contact surfaces (destroying food-borne bacteria such as *Salmonella*, *Escherichia coli* and *Campylobacter*)
- Manufacturing packaging to keep food fresh and to prevent contamination

Public safety:

Chlorine's role in public safety includes:

- Routinely purifying public water supplies and decontaminating those damaged by humanitarian crises and natural disasters, such as hurricanes, floods, tornadoes and earthquakes, and preventing mold growth on surfaces – particularly as floodwaters recede
- Materials used in protective equipment for police and other first re-

sponders, such as bullet-resistant vests, face shields and helmets, as well as fire-resistant clothing

- Communications equipment and components for emergency services, such as radios, smart phones and microprocessors

Environmental protection:

Chlorine, sodium hydroxide (caustic) and downstream products provide a wide range of environmental benefits, including:

- PVC is one of the most resource efficient materials for many applications; many PVC products have a long life, ensuring maximum use is made of natural resources used in their manufacture, and in over 50% of PVC applications, the products last over 35 years
- PVC pipes are strong, durable and immune to corrosion, helping to minimize water loss and energy needed to pump water throughout municipal water systems
- Many energy efficient building products, such as foam insulation based on polyurethane, and PVC windows, are based on chlorine chemistry
- PVC requires less oil for production and emits about 50% less carbon dioxide than some other polymers if incinerated at the end of its useful life; it can be recycled on an industrial scale for most applications
- Renewable solar energy reduces society's dependence on fossil fuels; it is harnessed by solar panels constructed of thousands of wafers of silicon that are purified using chlorine chemistry
- Sodium hydroxide neutralizes acidic environmental pollution, such as acid mine drainage, and is an effective disinfectant to quarantine veterinary disease outbreaks, for example
- Used aluminum beverage cans and packaging containers represent a large source of aluminum in the municipal solid waste stream; chlorine gas is bubbled through molten aluminum scrap during the recycling process to reduce magnesium and other impurities in the aluminum melt

Safe drinking water:

According to the WHO and the UN Children's Fund (UNICEF), 2.1 billion people worldwide lack access to safe and readily available water at home. More than 500,000 children die per year due to diarrheal diseases, according to UNICEF. Some 94% of the burden of diarrheal disease is attributable to environmental and associated risk factors such as unsafe drinking water and poor sanitation and hygiene. Wherever they have been used, chlorine-based drinking water disinfectants have helped to virtually eliminate waterborne diseases such as cholera, typhoid and dysentery.

> "The filtration of drinking water plus the use of chlorine is probably the most significant public health advance of the millennium."
>
> *- LIFE Magazine*

Economic benefits:

Regions represented by the WCC include over 400 production sites with a total capacity over 75 million metric tons per year. The industry directly employs over 300,000 people worldwide and creates many more jobs in downstream and closely related industries.

Chlorine chemistry helps drive national economic engines in many ways. For example, in the United States:

- Chlorine-related industries supply over 245,000 U.S. jobs
- Chlorine-related industry employees earn more than $14 billion in wages each year
- It is hard to think of any product which is not produced with the help of chlorine chemistry
- The vast majority of U.S. water systems use chlorine to help provide safe drinking water
- Chlorine chemistry is used in 88% of top-selling U.S. pharmaceuticals and 89% of crop protection chemicals
- Durable, corrosion-resistant PVC pipe, a product of chlorine chemistry, is a sustainable solution for water infrastructure renewal
- Hydrogen, a co-product of the chlor-alkali process, can be used as a zero CO_2 emission fuel in plant boilers, reducing a facility's carbon footprint

> “WCC members have **reduced their mercury emissions by 80%** since 2002.”

Energy and the environment:

Chlorine chemistry is a critical element of sustainability, resource conservation and green energy innovation. Examples include:

- In transportation, chlorine chemistry is an important component in the development and manufacture of materials that make vehicles lighter – thereby increasing fuel mileage
- Fifty-seven percent of PVC by weight comes from salt – a quasi-infinite natural resource – and only 43% from fossil fuel
- Polyurethane foam insulation, manufactured using chlorine chemistry, increases the energy efficiency of home heating and air conditioning systems, reducing energy bills and conserving natural resources
- Energy-efficient PVC windows reduce home heating and cooling costs as well as fossil fuel energy-associated greenhouse gas emissions; PVC windows and siding are low maintenance, eliminating the need for paints, stains, strippers and thinners, and research indicates manufacturing PVC windows requires one-third of the energy needed to make aluminum windows

Green energy innovation:

- Chlorine chemistry plays an important role in harnessing solar energy – purifying the silicon found in grains of sand and helping transform it into solar panel chips; wind turbine blades of chlorine-based epoxy resins help convert wind power into electricity for a clean, renewable, and greenhouse gas-free energy source
- Clean, energy-efficient hybrid vehicles contain electric motors powered by nickel metal hydride battery packs; these batteries, which last longer than the most advanced lead-acid battery, use potassium hydroxide – a co-product of chlor-alkali production – as an electrolyte
- Hydrogen, a valuable co-product of the chlor-alkali process, is used as a fuel in buses and cars, promoting a cleaner living environment in cities

Chlorine Chemistry Helps Create Joint Replacements that Resist Infection

Chlorine chemistry is used routinely to process titanium ore for orthopedic implants, such as human joint replacements. Now researchers from the Indian Institute of Science in Bangalore are exploring the use of chlorine to treat the surface of titanium to help make joint replacements resistant to bacteria, helping to reduce the risk of post-surgical infection.

The chlorine-based etching process produces nanostructures that kill bacteria on contact by mechanically rupturing them. The treated surfaces mimic the properties of the wings of insects such as cicadas, and may provide next-generation biomaterials for orthopedic implants. The process turns the shiny titanium surface black, yet does not affect its ability to bond with human bones and tissues when implanted – a property that is essential for surgical success and patient recovery.

The next steps will be to do more tests of the treated titanium surface, and explore strategies for clinical use, according to the researchers. This innovation may also have potential in dental implant and heart stent procedures.

Chlorine Safety

The chlor-alkali industry is committed to the safety and stewardship of chlorine and products used in our industry – and has the record to back it up.

Chlorine-based products provide great benefit to society. However, the industry acknowledges the safety hazards of some aspects of its chemistry. Chlorine, as a liquid – not to be confused with chlorine bleach – causes skin and eye burns on contact. When chlorine is released into the air as a gas, it can irritate the respiratory system, mucous membranes, eyes and skin. Hydrochloric acid and hypochlorous acid, both corrosive and potentially dangerous if mishandled, can be formed when chlorine gas reacts with moisture. An acute awareness of these hazards has spurred the industry to focus intensely on safety. The WCC safety program targets continuous improvements in global safety performance – both at facilities and during product transportation. Key initiatives include:

- **WCC Incident Reporting and Tracking Program:** The WCC Global Safety Team tracks and shares lessons learned in major incidents to help prevent future incidents. Currently, most reports are from Europe, North and South America, and Japan. Human error and equipment corrosion are the two most common factors reported in the database. WCC is working to improve reporting from other regions to make this a truly global information sharing initiative.
- **Preparation and sharing of safety guidelines:** Preparation and sharing of safety guidelines across national and regional associations, dissemination of safety information through the WCC Global Network, and promotion of safety to end-users through the ICCA's Responsible Care® program. This includes posters and manuals for the safe operation of equipment and handling of chlorine products, available for download from the WCC website, www.worldchlorine.org.
- **Active participation in stewardship workshops** that are organized frequently in different countries, including expert presentations, allowing further sharing of best safety practices.

CHLOREP and TRANSCAER; models for emergency response

For more than 30 years, the Chlorine Institute has helped emergency responders prepare for and respond to chlorine emergencies in the U.S. and Canada through its Chlorine Emergency Response Plan (CHLOREP®). This program has been studied and benchmarked as a "best practice" by the chlorine industries of many countries around the world. CHLOREP quickly mobilizes industry expertise to an accident site involving chlorine. Trained emergency teams from chlorine producing, packaging and consuming plants are on alert on a 24-hour basis to handle chlorine emergencies. TRANSCAER® (Transportation Community Awareness and Emergency Response) is a voluntary American and Canadian outreach effort that focuses on assisting communities to prepare for and respond to a possible hazardous materials transportation incident. TRANSCAER members consist of volunteer representatives from the chemical manufacturing, transportation, distributor, and emergency response industries, as well as the government.

Safety at production facilities

Within chlor-alkali plants and downstream production facilities, management of chlorine is especially important to protect employees, the local community and the environment. Facilities work continuously to improve equipment design, process control procedures and employee training. Additionally, WCC member organizations frequently share information to enhance operational and emergency response practices.

Transportation safety

Safe transportation of chlorine continues to be a top priority. According to 2015 data collected by the Chlorine Institute (CI), 68% of chlorine produced in the United States is transported off-site. Of the total chlorine transported, 24% is transported by rail and the remainder is primarily distributed short distances by pipeline. In the United States, the CI has worked in partnership with the railroads and government since 1924 to help improve transportation safety. The approach to safety is two-fold: avoiding accidents and accidental releases of hazardous materials; and mitigating their effects, if they do occur. Voluntary safety guidelines and strict government regulations cover all aspects of chlorine transportation by rail. The industry is working to ensure rail transportation safety continues to improve through safer rail operations and the development of new transportation technologies. However, in the spirit of continuous improvement, all parties need to continue assessing technical and operational enhancements.

In Europe, bulk chlorine has been shipped for more than 60 years without a single fatality. About 90% is used close to the production unit, and is not transported by rail or road. However, since it is used by industry to make a diverse range of products, it is inevitable that some must be transported. Railways are the main method of transport, accounting for 70% of chlorine movements in Europe (excluding pipeline). Road transport for bulk supply is used only in the United Kingdom and, to a limited extent, in Spain and Portugal.

with researchers and tank car manufacturers to ensure the structural integrity of chlorine tank cars and to seek appropriate upgrades based on current knowledge of best safety practices and new technology.

Chlorine Institute Emergency Kit "B"

Stringent safety measures are implemented during transport. Chlorine is carried in specially-designed steel containers, ranging from cylinders carrying a few kilograms of chlorine to road and rail tank cars containing 20-60 metric tonnes. The industry will continue to build on its strong safety record with continuous improvements in transport and distribution.

The global chlor-alkali industry will continue to work with governments and railways to explore ways to both improve the safety and security of rail shipments and to address the causes of any incidents. It will also continue to cooperate

Extending safety to the end-user

The industry is committed to ensuring safety at all stages of product lifecycles, from production to end-use and disposal. This includes helping to educate end-users on the correct handling of products. The European Chlorinated Solvent Association (ECSA, part of Euro Chlor) started its sustainability program in 2007 with the ambitious aim of covering the whole chlorinated solvents value chain. Nine objectives were established under the following three vision elements: sustainability by product and application; value chain engagement; and stakeholder engagement and communication.

ECSA reviewed its substantial progress in 2011. In one example, ECSA analyzed 60 applications and summarized recommendations for the safe and sustainable use of chlorinated solvents in an online toolbox. This Product & Application Toolbox contains recommendations for more than 350 individual activities. One of the six awareness programs with the value chain led to an Excellence Award for ECSA's contribution. The award recognized the program focusing on sustainable dry-cleaning processing. This involved the international initiative, E-DryClean, which aims to create practical and easily accessible education material for the European dry-cleaning industry. Six e-learning modules on best practices and working methods are available, including one on perchloroethylene, for which the ECSA was the leading partner.

Euro Chlor Conference Focuses On Sustainable Development

On May 16-18, 2017, Euro Chlor held its 10th International Chlorine Technology Conference & Exhibition in Berlin, Germany, with 360 delegates from 34 countries all over the world. Forty-two speakers gave presentations on topics related to safety, health, environmental protection and new technical developments. In parallel with the event, an exhibition allowed the participants to see and discuss the recent developments in equipment and services focused on this sector.

WCC Global Safety Team's Safety Workshop and Clorosur Technical Seminar and Table Top Expo

The WCC Global Safety Team Safety Workshop was held on November 18, 2016, in Buenos Aires. The workshop addressed a wide array of process safety issues, including advances in membrane technology, hydrochloric acid production, mercury waste treatment and liquid mercury stabilization. Presenters from three continents provided a wealth of material for discussion and sharing of lessons learned.

Clorosur, the Latin American Chlor-alkali Industry Association, held its biannual International Technical Seminar and Table Top Expo in Buenos Aires back-to-back with the World Chlorine Council's Global Safety Team's Safety Workshop. The Expo featured technology suppliers, materials and equipment manufacturers and service providers to the chlor-alkali industry.

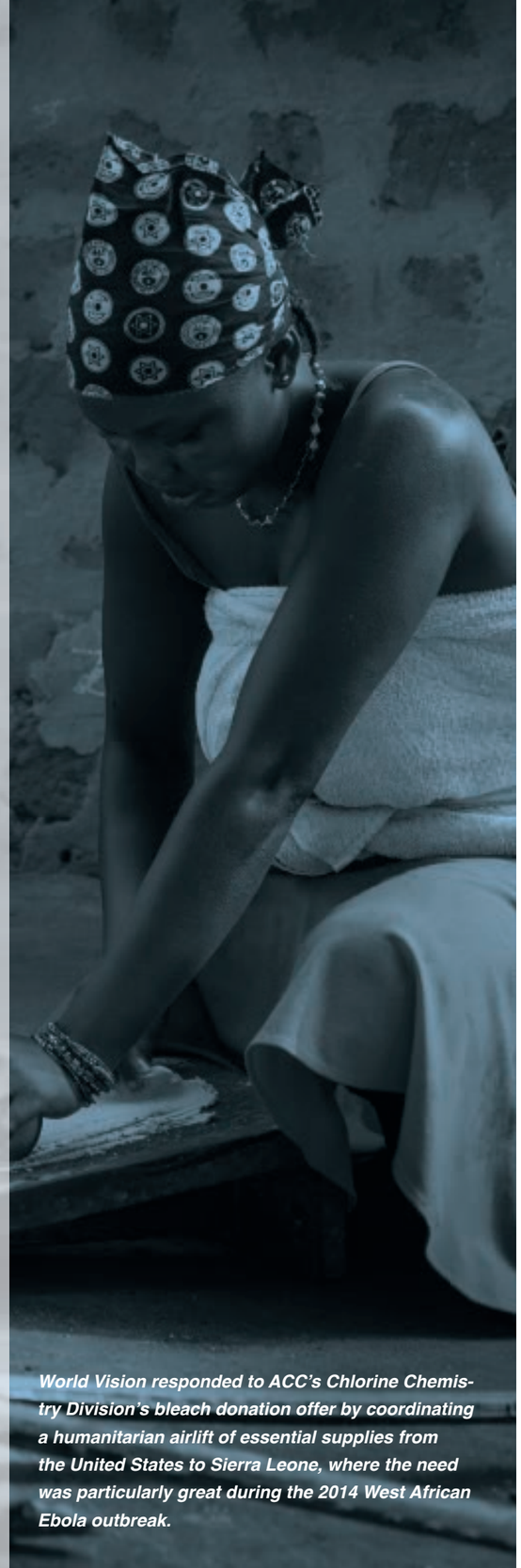
Chlorine Bleach: From the Salt of the Earth, A Critical Ally in the Ebola Wars

In the summer of 2014, as the West African Ebola crisis intensified, the American Chemistry Council's Chlorine Chemistry Division contacted the humanitarian organization World Vision to offer a shipment of donated chlorine bleach disinfectant to help control the disease outbreak in West Africa. Chlorine bleach, an aqueous solution of sodium hypochlorite, has been described as "chlorine to go." Chlorine bleach is used to disinfect drinking water, swimming pools and environmental surfaces in homes, restaurants and institutions. It is manufactured by combining chlorine and sodium hydroxide, both literally derived from sodium chloride – the salt of the Earth.

Chlorine bleach is a critical ally in the fight against Ebola. The Ebola virus can survive on inanimate surfaces, especially those that are soiled with blood or other bodily fluids from infected people. To help prevent the spread of infection, the WHO recommends Ebola virus-contaminated surfaces or objects be cleaned and disinfected as quickly as possible with a solution of 5,000 parts per million of free chlorine. For comparison, normal household disinfection is accomplished with just a few hundred parts per million free chlorine solutions.

In September of 2014, World Vision responded to the Chlorine Chemistry Division's offer by coordinating a humanitarian airlift of essential supplies from the US to Sierra Leone, where the need was particularly great. Along with other necessary supplies, thousands of gallons of donated concentrated chlorine bleach were loaded into the cargo hold of an airplane for the journey across the Atlantic. The chlorine bleach was donated by Olin Corporation; domestic transportation services for bleach were donated by CSX, the Buffalo & Pittsburgh Railroad and the Chlorine Chemistry Division; bleach bottling services were donated by The James Austin Company.

The Chlorine Chemistry Division was honored to have worked with World Vision and others to assist with this important humanitarian mission.



World Vision responded to ACC's Chlorine Chemistry Division's bleach donation offer by coordinating a humanitarian airlift of essential supplies from the United States to Sierra Leone, where the need was particularly great during the 2014 West African Ebola outbreak.

Production Technology

The chlor-alkali sector is committed to transitioning to newer production technologies under sound business management approaches.

The mercury cell process

Mercury is a transition metal that is widespread and persistent in the environment. It is a naturally occurring element and can be released into the air and water through weathering of rock containing mercury ore or through human activities such as industrial processes, mining, deforestation, waste incineration and burning of fossil fuels.

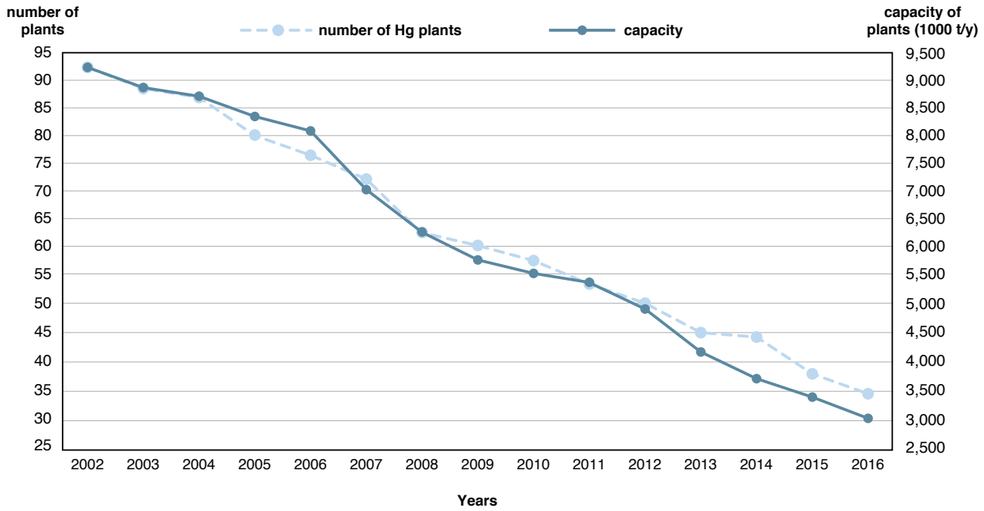
Mercury can also be released from the chlor-alkali manufacturing process and a number of mercury-containing products, including dental amalgam, electrical applications (e.g., switches and fluorescent lamps), laboratory and medical instruments (e.g., clinical thermometers and barometers) and batteries.

The mercury cell manufacturing process is one of three processes used by the chlor-alkali sector. The others are based on diaphragm technology and membrane technology. Today, about 4% of the chlor-alkali global capacity uses mercury cell technology for chlor-alkali production. Strict safety regulations and controls are followed to prevent workplace exposure and to minimize emissions of mercury.

As a UN recognized Non-Government Organization (NGO), the WCC engaged early in both regional and global initiatives

WCC – Chlor-Alkali Industry

Number of plants and capacity of mercury electrolysis units in USA/Canada/Mexico, Europe, Russia, India and Brazil/Argentina/Uruguay



to address mercury releases to the environment, including the UN Environment Program's (UNEP) Minamata Convention instrument. The Minamata Convention on Mercury entered into force on August 16, 2017, and requires a phase-out of chlor-alkali mercury cell technology by 2025, with some possibilities for deadline extension.

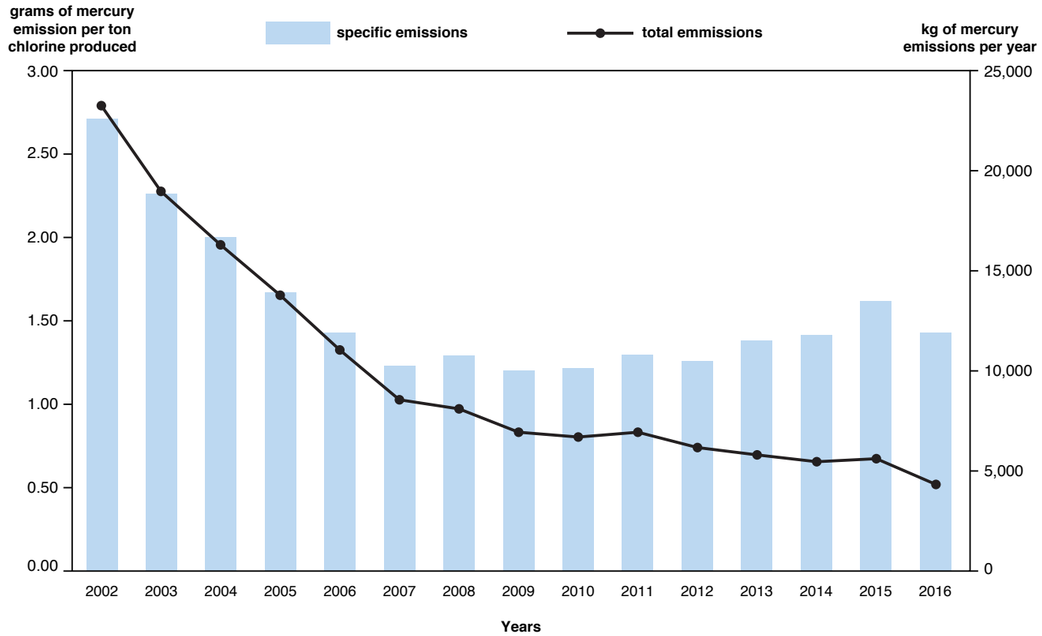
WCC recognizes that mercury is a chemical of global concern and the industry has been moving to mercury-free technologies as existing plants reach the end of their economic lives. Transitioning, however, takes time and resources. Due to the high capital investment necessary for the conversion to membrane technology and the high variability of factors influencing the profitability of such projects, funding mechanisms are often needed to support conversion.

Key Facts:

- The chlor-alkali sector accounts for less than 1% of total global natural and man-made mercury emissions; chlorine production is a very small source of mercury emissions today
- WCC members have reduced their mercury emissions by 80% since 2002

WCC – Chlor-Alkali Industry

Total mercury emissions (air + water + products) for USA/Canada/Mexico, Europe, India and Brazil/Argentina/Uruguay and Russian plants (from 2005 onwards)



The chlor-alkali sector is transitioning to non-mercury technology and has already achieved a 64 percent reduction in mercury cell capacity since 2002.

- WCC and its member associations will continue promoting utilization of best available techniques (BAT) and best environmental practices (BEP) at existing facilities until their closure or transition.
- The industry supports best practices, including:
  - » **Monitoring Mercury-containing Waste:** Mercury-containing waste should be managed in an environmentally sound way and controlled by national authorities; Basel Convention Guidelines should be taken into account, and national legislation and regulations should be applied
  - » **Managing Mercury Surplus From Decommissioned Cells:** The end-of-life mercury from shutdown or converted cells is 99.9% pure and equivalent to virgin mercury; end-of-life mercury should be managed in an environmentally sound manner and in accordance with the global Responsible Care® principles of the chemical industry – ensuring WCC member companies follow best practices when transporting, storing and disposing of mercury

Diaphragm technology

The diaphragm process of chlor-alkali production relies mainly on tightly controlled use of the chrysotile form of asbestos. To protect human health, facilities are operated according to industry guidelines and best practices, and the chrysotile asbestos is sourced from companies that comply with national regulations and implement the Asbestos International Association's guidelines. Member companies participate in the Asbestos International Association responsible-use initiative, and are committed to ensuring that the controlled use of chrysotile asbestos is in compliance with national laws and the WHO's recommended permissible exposure limit. More recently, non-asbestos diaphragms (using fluorocarbon polymeric fibres) have been introduced. The new materials extend the lifetime of cells.

Membrane technology

Membrane technology results from advances in the polymer industry. The technology yields a high quality product that demands approximately 25-30% less electricity than the mercury technology, but it requires additional energy (usually steam) to concentrate the caustic from 32% solution to the commercial grade of 50%. Membrane technology innovation is focusing primarily on electricity consumption reduction by improving membranes, electrodes and cells design.

All production methods

WCC is committed to promoting best practices and industry guidance, including BAT and BEP for chlor-alkali production on a global basis. Specific actions include:

- Organizing stewardship workshops in key emerging regions to share BAT/BEP guidelines for chlor-alkali facilities
- Sharing information on emerging technologies and practices to enhance chlor-alkali production, extending beyond current BAT/BEP guidelines to include other production related developments and innovations (e.g., recycling of hydrogen chloride, use of cogeneration and steam)

- Translating and disseminating industry guidance documents at the regional and global level
- Promoting technical exchanges and transfers

How we manage chemicals

The chlor-alkali sector is primarily focused on the production of chlorine and sodium hydroxide – basic chemicals vital to the full spectrum of chemistry and to a modern economy and lifestyle. Our chemicals include substances used in the chlor-alkali manufacturing process and chlorinated substances in the value chain associated with our business activities.

While some aspects of our industry present challenges in a sustainability context – particularly our use of mercury and asbestos in some production processes – we are committed to safe management of substances throughout their lifecycle. Our goal is to responsibly manage all chemicals used in our businesses, communicate openly with stakeholders about chemicals management, and for our work to be recognized for product stewardship of our chemicals consistent with the standards of Responsible Care® and the ICCA Global Product Strategy (GPS).

Responsible Care® is the chemical industry's unique global initiative that promotes continuous improvement in health, safety and environmental performance, together with open and transparent communication with stakeholders. Responsible Care® embraces the development and application of sustainable chemistry, helping our industry contribute to sustainable development while allowing us to meet the world's growing need for essential chemicals and the products those chemicals make possible. Through Responsible Care,®

the chemical industry is reporting and tracking its progress on critical elements of product stewardship, and is making further improvements to its current processes.

WCC is aligned with and has been committed to the Responsible Care® ethic for approximately three decades.

Responsible Care® has fostered the development of the ICCA GPS, which seeks to improve the industry's management of chemicals including the communication of chemical risks throughout the supply chain. GPS advocates for a combination of regulations and voluntary programs aimed at harmonizing the global level of product safety assessment by:

- Defining a "base set of information" for chemicals in commerce
- Sharing relevant information for safety assessment between companies
- Promoting a tiered process for evaluating risk and identifying appropriate risk management actions for chemicals in commerce
- Extending the guidance for safety assessment (e.g., ICCA Product Stewardship Guidelines) on a global scale
- Helping to define safe use conditions for chemicals and provide guidance to companies to enable them to meet safe use conditions
- Calling for measuring industry performance and public reporting
- Improving product stewardship cooperation

WORLD chlorine council®

WCC Members

Full & Associated Member Producer Associations

Alkali Manufacturer's Association of India (AMAI)
Canadian Chlorine Chemistry Council (C4)
China Chlor Alkali Industry Association (CCAIA)
Chlorine Chemistry Division of the American Chemistry Council (CCD)
The Chlorine Institute (CI)
Clorosur
Euro Chlor
Japan Soda Industry Association (JSIA)
RusChlor

Pending Members (No Voting Privileges)

Asociacion Nacional de la Industria Quimica
Korea Chlor Alkali Industry Association (KCAIA)
Plastics & Chemicals Industry Association of Australia

WCC is a committee of the International Council of Chemical Associations (ICCA)