



# Safe Storage and Handling of Swimming Pool Chemicals

The Environmental Protection Agency (EPA) is issuing this *Alert* as part of its ongoing effort to protect human health and the environment by preventing chemical accidents. We are striving to learn the causes and contributing factors associated with chemical accidents and to prevent their recurrence. Major chemical accidents cannot be prevented solely through regulatory requirements. Rather, understanding the fundamental root causes, widely disseminating the lessons learned, and integrating these lessons learned into safe operations are also required. EPA publishes *Alerts* to increase awareness of possible hazards. It is important that facilities, State Emergency Response Commissions (SERCs), Local Emergency Planning Committees (LEPCs), emergency responders, and others review this information and take appropriate steps to minimize risk. This document does not substitute for EPA's regulations, nor is it a regulation itself. It cannot and does not impose legally binding requirements on EPA, states, or the regulated community, and the measures it describes may not apply to a particular situation based upon the circumstances. This guidance does not represent final agency action and may change in the future, as appropriate.

## Problem

Pool chemicals may become a hazard when they become wetted by a small quantity of water or when they are improperly mixed, such as with other chemicals or reactive materials. Although the potential hazards of swimming pool water treatment and maintenance chemicals, also referred to as "pool chemicals," have been recognized for some time, news media reports over the last five years still show a significant number of fires, toxic vapor releases, and personnel injuries in which pool chemicals were a factor (See Table 1).

A number of the pool chemicals, especially those exhibiting oxidation properties, can potentially be highly reactive and capable of generating high temperatures, as well as releasing toxic vapors if improperly handled or stored. Reactivity may be triggered by water wetting the chemical, or by the inadvertent mixing of a pool chemical with an incompatible material. Some pool chemicals are self-reactive over time, even without moisture addition or mixing with other materials. The products of this decomposition may include chlorine gas which may cause the corrosion of piping and other metal equipment in poorly ventilated areas. These chemicals are

packaged in "breathable" containers to avoid pressure buildup while in storage. A partial listing of pool chemicals includes chlorinated isocyanurates, lithium hypochlorite, sodium bicarbonate, potassium monopersulfate, hydrogen peroxide, sodium hypochlorite, calcium hypochlorite, and certain ammonium, brominated, copper and silver compounds, and muriatic acid. Pool chemicals involved in fire or toxic vapor release are likely to include those that add chlorine or a chlorine ion to the pool water for bacterial control. Chemicals that release chlorine are among the group of chemicals that are classified as *oxidizers*. These pool oxidizer chemicals include calcium hypochlorite, sodium hypochlorite, and chlorinated isocyanurates. Other pool chemicals are used to control the growth of algae or fungus, to adjust the acidity or alkalinity (pH control), and to clarify pool water.

Large, nonresidential pools may use chlorine stored as a liquid under pressure in metal containers. The Chlorine Institute, Inc. and the Occupational Safety and Health Administration (OSHA) provide guidance on the operation of pressurized chlorine systems (see **Information Resources** section of this *Alert*).

# Hazard Triggers

The purpose of this *Alert* is to provide guidance associated with normal operating conditions and routine tasks for storage and handling of pool chemicals. It does not address the precautions to be taken by first responders in case of a fire, a large spill, or the release of toxic vapors.

**Wetting:** Under normal circumstances, pool chemicals are intended to be added to large quantities of water. If, instead, a limited volume (amount) of water is added to a chemical, an unwanted reaction may occur, resulting in an increase in temperature and the release of toxic gas. Even a small amount of water splashed on the chemical may in some cases trigger a strong reaction. The main exception to this rule concerning water addition is when very large quantities of water are needed for fire fighting, as discussed below. Although the chemicals are usually packaged in plastic bags that are stored in sturdy cartons or drums, accidents have occurred when water leaked into damaged or open containers.

Possible sources of water entry have been traced to:

- Rain water from a roof leak or from an open or broken window;
- Wet floor when the stored chemicals were not elevated off the floor;
- Leakage from fire suppression sprinkler system; or
- Hose-down water generated during area cleanup.

There are other sources of water that may come in contact with pool chemical packages, including high humidity in summer weather. However, the effects of humidity are more likely to be slow-acting, with the rate of temperature buildup and chlorine gas release being less severe.

Chlorine is corrosive to metals such as steel and copper. Instances have been reported where exposed water piping has become corroded causing leaks, and also where metal storage shelves have corroded and collapsed, leading to chemical spillage.

**Improper Mixing:** The most common pool chemicals are inherently incompatible with each other. Intentional or accidental mixing of incompatible chemicals is likely to lead to a chemical reaction that may generate temperatures high enough to ignite nearby combustible materials. Mixing can also lead to the release of highly toxic and corrosive chlorine gas. Reactions have also been traced to the mixing of old (partially

decomposed) and new chemicals of the same type. The mixing of pool chemicals with completely unrelated materials such as swept material from the floor, oily rags, and other miscellaneous materials have been known to cause strong reactions with the potential for a resulting fire.

Improper chemical mixing incidents have occurred when:

- Tools and equipment used to handle one chemical were used with a different chemical before being cleaned;
- Spilled substances (e.g., from damaged containers or from sloppy handling) and other miscellaneous substances on floors were swept up together and mixed; and
- Containers, residues, or wastes are disposed resulting in inadvertent mixing in disposal containers or at waste disposal sites.

Liquid chemicals, such as sodium hypochlorite (bleach), if spilled, can leak into other containers or seep into cracks in the floor. Liquids, because of their properties, can create hazards not associated with solid or granular products and must be carefully handled.

## Hazard Control

Facility management is responsible for knowing and understanding the hazards associated with these chemicals and ensuring that pool chemicals are safely stored and handled. Hazardous substances are capable of being safely handled day-after-day through a management system that ensures that good, written procedures are prepared, posted, and followed by trained employees. Also, the facility needs to be properly designed and maintained. Finally, facility management should very carefully plan for emergencies and work with first responders to mitigate incidents that occur.

Recommendations for addressing the major hazards associated with pool chemicals are described below.

**Keep Pool Chemicals Dry.** Facility management should design and maintain designated areas for pool chemical storage so that water does not come in contact with containers or packaging.

Any evidence of potential water entry from the following possible sources should receive prompt corrective attention:

- Roof, windows, and doors;
- Wall and floor joints;
- Water pipes or hoses and sprinkler systems; and
- Drains.

You should look for ways to prevent water contact with stored pool chemicals such as:

- Close containers properly;
- Cover opened or damaged packaging;
- Store chemicals away from doors and windows;
- Ensure that there are no roof leaks, open or broken windows, or leaks from water pipes, hoses, or the sprinkler system;
- Ensure that floors are sloped to keep water drained away;
- Store chemicals on shelves or pallets to keep containers off the floor;
- Use waterproof covers on packaging;
- Exercise particular caution to prevent water contact with stored chemicals any time water is used for cleanup of floor areas near stored packages; and
- Ensure that water will not back up from faulty or clogged floor drains.

**Avoid Chemical Mixing.** You should conduct a review of chemical storage arrangements and chemical handling tasks to identify situations where chemicals could be intentionally or accidentally mixed:

- Separate incompatible substances; avoid storing containers of liquids above containers of other incompatible substances;
- Do not mix old chemicals with fresh chemical, even if they are the same type;
- Consider separate, designated tools for each chemical. Handle only one chemical at a time and make sure that tools used with one substance are not used with another unless all residues are removed;
- Use separate, designated containers for cleanup of spilled materials to avoid inadvertent mixing of spilled substances. Consult your local hazardous waste disposal facility for more detailed information on proper waste disposal; and
- Make chemical storage area housekeeping a priority. Don't allow rags, trash, debris, or other materials to clutter hazardous material storage area. Keep combustible and flammable substances away.

For storage and handling of large quantities, see the American Chemistry Council (formerly the Chemical Manufacturers Association) *Guidelines in the Safe Transportation, Handling, and Storage of Dry Chlorinated Pool Chemicals -2001* listed under the **Recommended Reading** section of this *Alert*, for guidance on stack height and separation of different chemical types and separation of oxidizers from combustibles.

**Fire Prevention.** Facility management should prevent a chemical reaction ignition by avoiding wetting or mixing chemicals as described above.

Avoid having combustible or flammable materials near the chemicals, particularly gasoline, oil, paint solvents, oily rags, etc. Do not allow ignition sources, such as gasoline, diesel, or gas powered equipment such as lawn mowers, motors, or welding machines, in the storage area. Also, do not allow smoking in the storage area. Review bulk storage, including packaging and storage locations, relative to potential for accidental contact with water, including sprinkler systems, rainwater, etc.

**Emergency Response and Fire Fighting.** Facility management should work with local first responders (fire departments, emergency medical teams) and the LEPC on emergency response and fire fighting. LEPC contact information can be found at the website listed in the **Other Useful Websites** section. The **Recommended Reading** section provides sources of information on fire prevention and fire fighting associated with pool chemicals.

Note also that once started, fires involving pool chemicals are difficult to attack. Keep in mind that:

- Do not use dry chemical or halon-type fire extinguishers where chlorine gas may be evolving. These agents react negatively with chlorine.
- In extinguishing a fire, only large volumes (copious flow) of water should be applied and then only by persons trained in chemical fire response. Caution must also be exercised to protect against wildlife damage due to contaminated water runoff.
- Large quantities of water should be applied to the burning combustibles to remove heat and for fire intensity control.
- Once started, the reaction of wetted or mixed chlorinated pool chemicals may continue generating heat, unless the material is cooled below its heat of reaction temperature or until all chlorine is used.

## Protective Measures

Pool chemicals can cause injury if they directly contact a person's skin, eyes, or respiratory or digestive system. The chemical will immediately react when wetted by perspiration, tears, mucus, and saliva in the nose, throat, and respiratory and digestive systems. Such injuries may occur from direct chemical contact with the skin or if chemical dust in the air contacts eyes, is inhaled, or settles on food that is consumed.

**Protect Employees from Exposure.** Consult the chemical manufacturer's safety instructions as well as the Material Safety Data Sheets (MSDSs) for guidance on the appropriate personal protective equipment (PPE) necessary to protect your employees. Also, share MSDSs with local emergency medical responders and practitioners.

The following protective measures address conditions that may arise during normal operations or the execution of routine tasks. If, however, additional information is needed for fire, spill, or release intervention, we suggest that you contact the LEPC (see **Other Useful Websites**).

See that PPE is kept clean, in proper operating condition, and available for use when needed and that the following practices are observed:

Use basic PPE including, as a minimum, chemical goggles and liquid impervious gloves, and boots for any chemical handling activities.

For frequent or extended chemical handling activities, add a face shield and liquid impervious apron or coveralls to the basic PPE.

As a minimum, use a National Institute for Occupational Health and Safety (NIOSH) approved air-purifying respirator, when airborne chemical dust or mist may be present. 29 CFR 1910.134 Respiratory Protection covers the OSHA requirements for respiratory protection.

For additional information on proper selection and use of PPE, consult the OSHA regulatory standards.

In addition:

- Consider development of work practices to minimize dust generation and accidental contact with pool chemicals;

- Provide a means of ready access to water (e.g., safety showers, eye wash stations, etc.) for removal of chemicals that may accidentally contact employees;
- Consider appropriate first aid and coordinate with local first responders and medical professionals for treatment of accidental exposure until professional medical treatment can be provided;
- Avoid accidental ingestion by storing and consuming foods and beverages away from chemical storage and handling locations, and ensure that employees wash before eating, drinking, etc.; and post the numbers for the local emergency responders, and medical practitioners that are familiar with the appropriate treatment for the chemical present.

## Information Resources

### Recommended Reading

*The American Chemistry Council has several guidelines:*

**Guidelines in the Safe Transportation, Handling, and Storage of Dry Chlorinated Pool Chemicals - 2001** combines and supercedes the 1995 editions of the Guidelines for Safe Handling and Storage of Calcium Hypochlorite and Chlorinated Isocyanurate Pool Chemicals and Guidelines for Safe Transportation of Calcium Hypochlorite and Chlorinated Isocyanurate Pool Chemicals. This publication discusses product nomenclature; incompatibilities, hazards, and characteristics; storage; processing guidelines; personal protective equipment; first aid; emergency procedures; handling minor spills; do's and don'ts and emergency telephone numbers. This very clear and comprehensive publication is also available from a number of Chlorinated Pool Chemical (CPC) Panel member companies. It is strongly recommended reading for those responsible for storage and handling of pool chemicals.

American Chemistry Council  
1300 Wilson Boulevard  
Arlington, VA 22209

Website: [www.americanchemistry.com](http://www.americanchemistry.com)

*The National Fire Protection Association (NFPA) has a bulletin for pool chemicals and a code for safe storage of liquid and solid oxidizers:*

**NFPA Alert Bulletin – Pool Chemicals** – 1998, 4 pages – prepared for the fire services and others in order to raise their awareness of hazards created by pool chemicals stored in retail establishments. This *Alert* bulletin discusses two major fires where pool chemicals were stored. It also gives details concerning two types of fire suppression equipment that should not be used for fires where pool chemicals are involved.

**NFPA 430, Code for the Storage of Liquid and Solid Oxidizers, 2000 edition** – 16 pages. The 2000 edition was revised to include a section addressing storage and handling at retail stores. It provides a number of useful definitions including the definition of Class 3 Oxidizers which include most pool water treatment chemicals. NFPA 430 also points out the hazards associated with not only the use but also the presence of dry chemical or halon-type fire extinguishers in an area containing oxidizer-type chemicals. NFPA 430 also points out the ineffectiveness of any extinguishing system that relies upon a smothering effect since the oxidizer chemicals do not require air to maintain reaction.

National Fire Protection Association  
1 Batterymarch Park  
Quincy, MA 02269-9101  
Telephone: (617) 770-3000  
Website: [www.nfpa.org](http://www.nfpa.org)

*The Chlorine Institute has several pamphlets of interest, including:*

**Sodium Hypochlorite Safety and Handling, Pamphlet 96, May 2000**

The Chlorine Institute, Inc.  
2001 L Street, NW.  
Washington, D.C. 20036-4919  
Telephone: (202) 775-2790  
Website: [www.cl2.com](http://www.cl2.com)

*The Canadian Transport Emergency Center, CANUTEC, has written an article in response to the calls received from individuals and fire departments requesting information on pool chemicals.*

**Swimming Pool Chemicals** - revised September 1999 - by Jacques Savard, Ph.D. This paper covers spills, disposal, neutralization, and first aid. The

paper is available on CANUTEC's website and is particularly recommended reading.

CANUTEC  
330 Sparks Street, Office 1401  
Ottawa, Ontario, Canada K1A 0N5  
Website:  
[www.tc.gc.ca/canutec/en/articles/documents/pool.htm](http://www.tc.gc.ca/canutec/en/articles/documents/pool.htm)

*EPA's Chemical Emergency Preparedness and Prevention Office has previously written an advisory targeted at LEPC's concerning chemicals used at swimming pools that may release chlorine:*

**Advisory: Swimming Pool Chemicals: Chlorine, OSWER 90-008.1, June 1990.** This publication is available from the EPA National Service Center for Environmental Publications (NSCEP).

U.S. EPA/NSCEP  
P.O. Box 42419  
Cincinnati, Ohio 45242-0419  
Telephone: (800) 490-9198

**Other Useful Websites**

**LEPC Database** This database is a list of the LEPCs in each state, including where appropriate, links to state websites.  
<http://www.epa.gov/ceppo/lepclist.htm>

## Statutes and Regulations

In addition to the recommendations for improved hazard control, you may be subject to certain regulations. In particular, you need to determine whether the following regulations related to emergency planning, release reporting, and hazardous materials worker protection are applicable to your facility.

**EPA**

***Emergency Planning & Community Right-to-Know***

- Emergency Planning [40 CFR Part 355]- Facilities that have listed substances above a specified threshold quantity must report to their LEPC and SERC and comply with certain requirements for emergency planning.
- Emergency Release Notification [40 CFR Part 355]- Facilities that release listed chemicals over

reportable quantity must immediately report the release to the LEPC and the SERC.

- Hazardous Chemical Reporting [40 CFR Part 370]- Facilities that have listed chemicals at or above threshold quantity must submit MSDSs to their LEPC, SERC, and local fire department and comply with the Tier I/ Tier II inventory reporting requirements.
- Toxic Chemicals Release Inventory [40 CFR Part 372] - Manufacturing businesses with ten or more employees that manufacture, process, or otherwise use listed chemicals above an applicable threshold must file annually a Toxic Chemical Release form with EPA and the state.

***Comprehensive Environmental Response, Compensation, and Liability Act***

- Hazardous Substance Release Reporting [40 CFR Part 302]- Facilities must report to the National Response Center any environmental release which exceeds reportable quantities. A release may trigger a response by EPA, or by one or more Federal or state emergency response authorities.

***OSHA***

***Hazardous Waste Operations and Emergency Response Standard*** [29 CFR 1910.120]- Facilities must comply with worker protection requirements for emergency response operations for release of, or substantial threats of release of, hazardous substances.

***Process Safety Management Standard*** [29 CFR 1910]- Facilities with highly hazardous substances in quantities at or above a threshold quantity are subject to a number of requirements for management of hazards, including performing a process hazards analysis and maintaining mechanical integrity of equipment.

***Hazard Communication*** [29 CFR 1910.1200]- Facilities are required to evaluate the potential hazards of toxic and hazardous chemicals. Employers transmit this information to their employees.

For additional information on OSHA standards contact OSHA Public Information at (202) 219-8151. Website: [www.osha.gov](http://www.osha.gov)

**For More Information:**

Contact the Emergency Planning and Community Right-to-Know Hotline

(800) 424-9346 or (703) 412-9810  
TDD (800) 553-7672

Monday-Friday, 9 AM to 6PM, Eastern Time

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Visit The CEPPPO Home Page on the World Web at: <http://www.epa.gov/swercepp/>

**Table 1 Recent Incidents Involving Swimming Pool Water Treatment Chemicals**

<b>Month Year</b>	<b>City State</b>	<b>Brief Description of Incident</b>	<b>Effect</b>
February 2000	Elizabethtown, Tennessee	Fire and smoke from a storage facility that contained chemicals including swimming pool water treatment chemicals. The fire was in an area isolated from the pool chemicals, however particular precautions were taken to prevent the pool chemicals from becoming involved.	Local school closed early to relieve traffic congestion; local residents advised to remain indoors. No injuries reported.
October 1999	Avon, Indiana	Fumes released from container of a strong acid that was being used to clean a high school swimming pool.	School evacuated. No injuries reported.
August 1999	Burlington, New Jersey	A pallet containing 400 lbs of calcium hypochlorite spilled at a warehouse. The spill was caused by the corrosion of steel shelving on which the material was stored. The spilled material mixed with other incompatible materials, resulting in fire and release of products of combustion and decomposition including chlorine gas.	Five warehouse workers were hospitalized from the toxic gas exposure. Twenty-four others were treated and released.
August 1999	Bergen County, New Jersey	Granular chlorinating material, similar to that used for swimming pool water treatment, spilled while moving a container in a warehouse.	Released vapors sent 28 government workers to area hospitals.
July 1999	Richmond, Virginia	Chemical exploded as it was prepared for release into apartment complex pool.	One employee injured.
June 1999	Cleveland, Ohio	Toxic fumes released at local community center swimming pool, when pool water chemicals including muriatic acid were inadvertently mixed.	Two fire fighters and two others injured and area evacuated.
February 1999	Fort Worth, Texas	Fire, smoke and vapors released from large warehouse containing pool chemicals and other materials. The cause of the fire was not reported.	Warehouse destroyed. No injuries reported; residents told to remain indoors.
December 1998	Auburn, New Hampshire	Small explosion and vapors were released when about a cup of swimming pool chemical was improperly disposed of at a regional waste treatment station.	Four minor injuries. Waste treatment station shut down.
July 1998	Dayton, Ohio	Toxic cloud was generated when muriatic acid was inadvertently mixed with a chlorinator product at local community center swimming pool.	Nine people sent to the hospital.
June 1997	Watervleit, New York	Water leaking from sprinkler system wetted water reactive pool chemicals, starting fire at pool chemical storage, repackaging and distribution building. Smoke and chlorine gas released into building and area.	Nearby residents evacuated as a precautionary measure.
July 1996	Chatsworth, California	Fire and toxic vapor release at a swimming pool supply facility was attributed to improper mixing of muriatic acid and sodium hypochlorite (bleach).	Three people were injured and an eight-block area was closed to traffic.