

Recommendations for Preventing Pool Chemical–Associated Injuries

Chemicals are added to pool^{*} water to kill disease-causing germs, maximize the efficacy of the disinfection process (e.g., pH control), improve water quality, stop corrosion and scaling of equipment, and protect against algal growth. However, pool chemicals can also lead to injury when mixed together or appropriate personal protective equipment is not used during handling. The following recommendations are based on a review of reports of pool chemical–associated injuries.[†]

Design of Chemical Storage Area and Pump Room

- o Construction
 - Include spill containment features, also known as secondary containment, in chemical storage areas to prevent pool chemical leaks or spills from mixing with any other substances.
 - Provide aquatics staff and patrons with easily accessible safety showers, eye wash stations, and other appropriate chemical safety equipment.
 - Install appropriate fire suppression equipment.
 - Consult with local fire department or code enforcement agency for guidance.
 - Provide adequate lighting for reading labels on containers throughout the chemical storage area and pump room.
- o Air handling (*for indoor pools*)
 - Follow local building codes and/or American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards.
 - Separate the air handling systems for the chemical storage area and pump room from the rest of the building.
 - Separate the air handling system for the pool area from the rest of the building.
 - If an older aquatic facility does not have separate air handling systems for the chemical storage area and pump room as well as the pool area, consider installing emergency heating, ventilating, and air conditioning (HVAC) cutoffs in these areas.
 - Ensure that the chemical storage area and pump room as well as the pool area are well-ventilated.
 - Ventilate the chemical storage area, pump room, and pool area to the outside.
- o Engineering
 - Install an alarm to alert the aquatics staff if the recirculation pump shuts down.
 - Install a device that automatically deactivates the chlorine/pH feed pumps when there is no flow in the recirculation system.
 - Install check valves in chemical feed lines. These valves allow chemicals (liquid or gas) to flow through only in one direction and stop suction events from causing an overfeeding of chemicals.

* To limit the length of this document, the word pool will be used to refer to all treated recreational water venues. Treated recreational water venues include but are not limited to pools, water parks, spas, and interactive fountains.

† Yoder JS, Hlavsa MC, Craun GF *et al.* Surveillance of Waterborne Disease and Outbreaks Associated with Recreational Water Use and Other Aquatic Facility–Associated Health Events — United States 2005–2006. *MMWR* 2008; 57(SS-9):1–38. For additional information pool chemical–associated health events, visit http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5709a1.htm?s_cid=ss5709a1_e.

- o Security
 - Secure the chemical storage area and pump room to limit access, especially to children and animals.
 - Provide locking mechanisms for the chemical controller to prevent unauthorized tampering.
- o Material Safety Data Sheets (MSDSs)
 - Ensure availability of and easy access to up-to-date MSDSs near (e.g., in the hallway just outside of) the chemical storage area, pump room, pool area, and any other location pool chemicals are stored or used.
 - Ensure availability of and easy access to up-to-date MSDSs at a location other than those listed above in case of chemical spill or accident that would prevent access.
- o Personal protective equipment (PPE) (e.g., safety glasses or gloves)
 - Ensure availability of and easy access to PPE near (e.g., in the hallway just outside of) the chemical storage area, pump room, pool area, and any other location pool chemicals are stored or used.

Chemical Storage

- o Store pool chemicals in compliance with local or state building and fire codes.
- o Store pool chemicals below 95°F/35°C and in conditions recommended by the manufacturer (e.g., low humidity and out of direct sunlight).
- o Protect stored pool chemicals from getting wet.
 - Do not store containers of any pool chemical directly on the floor.
 - Store pool chemicals away from doors and windows.
 - Cover opened containers with waterproof material.
 - Check the chemical storage area regularly for any evidence of water entry and fix any identified problems immediately.
 - Potential routes of water entry include roofs, ceilings, windows (particularly if they are open or broken), doors, walls, wall/floor joints, water pipes/hoses, sprinkler systems, drains (particularly if they are faulty or clogged).
- o Protect individual stored chemicals from mixing together or with other substances.
 - Store each pool chemical separately.
 - Separate all chlorine products from one another (e.g., liquid chlorine, calcium hypochlorite, and stabilized chlorine products such as dichlor or trichlor).
 - Store only identical chemicals above or below each other (e.g., do not stack incompatible chemicals together). This is particularly important for liquid chemicals, which can leak and then mix with other pool chemicals or substances stored below.
 - Dedicate a storage location to each pool chemical (e.g., chlorine and acid). Changing chemical storage locations can lead to chemical-mixing errors.
 - Do NOT store pool chemicals with incompatible or flammable materials, which include but are not limited to gasoline, oil, grease, fertilizer, herbicides, paint, solvents (e.g., turpentine), oily rags, and alcohol.
 - Clean the storage area, pump room, pool deck, chemical safety equipment and adjacent environmental surfaces only with chemicals that are compatible with pool chemicals.
- o Store chemicals in original manufacturer's labeled containers.
 - Consult with the chemical manufacturer if the container is damaged.
 - Dispose of deteriorating or unwanted pool chemicals or chemicals in unlabeled containers.
 - Contact the product's manufacturer or the local or state hazardous materials group for proper disposal procedures for deteriorating or unwanted pool chemicals.

- Contact the local or state hazardous materials group for proper disposal procedures for chemicals in unlabeled containers.
- o Protect pool chemicals from heat sources and flames.
 - Do NOT store possible ignition sources (e.g., welding equipment), especially gasoline-, diesel-, or gas-powered equipment (e.g., lawn mowers, motors, grills, or portable stoves) in the chemical storage area.
 - Do NOT smoke in the chemical storage area.
- o Prioritize good housekeeping in the chemical storage area. Do NOT allow rags, trash, debris, etc. to collect in the area.
- o Limit stored supplies of chemicals by having frequent, regular deliveries.
- o Rotate inventory on a first-in, first-out basis.
- o Store and consume food and beverages away from chemical storage area.

Chemical Handling

- o Limit the authority to handle pool chemicals to those who have been trained in safe chemical storage and handling practices.
 - Give only people trained in chemical handling the responsibilities of ordering, accepting delivery, and stocking of pool chemicals.
- o Maintain good communication among trained people with the authority to handle pool chemicals.
 - Establish a chain of command among them.
 - Document the use of pool chemicals (e.g., keep records on the name of chemical added, the reason why it was added, the date and time it was added, and the amount added).
- o Post instructions on safe chemical handling practices in the chemical storage area and pump room. These messages should include:
 - Read product labels or MSDSs.
 - Contact supplier or manufacturer if additional information is needed.
 - Use only pool chemicals in original manufacturer's labeled containers. Never guess the identity of unlabeled chemicals. If a chemical is in an unlabeled container, do NOT use it.
 - Read the product name and directions before each use. Do NOT simply rely on the container's shape, size, or color to identify its contents.
 - Use appropriate PPE when handling pool chemicals.
 - Check the MSDSs to determine which PPE (e.g., safety glasses or gloves) is needed.
 - Keep children and animals away from the area when handling pool chemicals.
 - Do NOT smoke while handling pool chemicals.
 - Use caution when opening containers to avoid splashing them and generating dust (e.g., minimize the amount of dust generated when handling powdered or granular products).
 - Do NOT mix individual pool chemicals together or with any other substances.
 - Do NOT mix different types of chlorine products.
 - Do NOT mix old and fresh chemicals, even if they are the same product.
 - Dedicate equipment — such as scoops, buckets, crocks, and their lids — to one pool chemical. Do NOT use this equipment for any other chemical.
 - Label the equipment to indicate to which chemical it is dedicated.
 - Use only dry equipment (e.g., scoops) when handling chemicals.
 - Do NOT pre-dissolve solid pool chemicals or dilute liquid pool chemicals before use.
 - Add individual pool chemicals to water, never the reverse.
 - Close containers properly after each use.
 - Wash hands after working with pool chemicals.

- o Respond to pool chemical spills immediately.
 - Follow the emergency response plan.
 - Never put spilled chemicals back in the original container because they might be contaminated with substances such as dirt or grease.
 - Use separate, dedicated materials to clean up and appropriately dispose of each spilled chemical.
 - Do NOT pour spilled chemicals down the drain or sewer.

Maintenance and Repair

- o Close the pool to swimmers if the recirculation system is not running. Do NOT allow swimmers back into the pool until AFTER the recirculation system is restarted (if water quality meets required standards).
- o Close the pool to swimmers before servicing the chlorine/pH control feed or recirculation system. Do NOT allow swimmers back in the pool until AFTER the chlorine/pH control feed or recirculation system is restarted (if water quality meets required standards).
- o Turn off both the chlorine/pH control feed and recirculation systems before servicing either system.
- o Ensure that only properly trained people service chlorine/pH control feed and recirculation systems.
- o Ensure adequate ventilation in and around the pump room and pool area during maintenance and repair.
- o Use appropriate PPE when working on equipment that contains or circulates pool chemicals.
- o Develop and follow protocols for the maintenance of the chlorine/pH control feed system that will prevent mixing of different pool chemicals. Examples of procedures include
 - Clamp the chemical feed lines after turning the pumps off and before disconnecting lines to prevent spills.
 - Flush water through the chlorine feed tubing before cleaning it with acid. Flush the chlorine tubing with water again after the cleaning is completed and before reconnecting it to the chlorine feed system. Follow these steps in an area where pool chemicals other than acid (e.g., chlorine products) are neither stored nor used.
 - Monitor the cleaning processes, especially if chemicals can potentially mix. Never leave cleaning processes unattended.
- o Ensure the same person or people complete maintenance procedures, if possible.
 - Communicate clearly to the replacement staff member(s) if this is not possible. Issues to be discussed with replacement staff include
 - Why the procedure(s) is/are being done, the stage of maintenance or repair, anticipated problems, and needed actions.
- o Maintain the chlorine/pH control feed and recirculation systems according to manufacturer's guidelines.
- o Set up a preventive maintenance program and regularly replace equipment or parts before they fail (e.g., check for leaks in feed pump tubing, replace tubing regularly, and check clamps and check valves).

Pool Chemical Training for Aquatic–Facility Staff

- o Train all staff in pool chemical safety basics (e.g., emergency response procedures).
- o Provide additional training to staff working with pool chemicals.
- o Include at least the following topics in pool operator training/certification to decrease the likelihood of pool chemical–associated injuries in aquatic–facility staff and patrons:
 - Impact of each pool chemical on the water's chemistry and the monitoring systems,

- If the test kit's limit is exceeded, how to measure higher chlorine levels (e.g., using dilution or higher range test strips).
- Layout of a safe chemical storage area and pump room,
- Calculation of pool volume,
- Calculation of appropriate amount of pool chemicals needed,
- Safe chemical storage and handling practices,
 - For example: 1) protect individual pool chemicals from mixing together or with other substances and 2) use PPE while handling chemicals.
 - Check out Occupational Safety and Health Administration (OSHA) resources: Chemical Hazard Communication (OSHA 3084) at www.osha.gov/Publications/osh3084.html; Compliance with Hazard Communication (OSHA 3111) at www.osha.gov/Publications/osh3111.html,
- Basics of preventive and safe maintenance of equipment,
 - For example: 1) close pool to swimmers if recirculation system not running and 2) use PPE when working on equipment that contains or circulates pool chemicals.
- First aid for pool chemical exposures, and
- Emergency response basics.

Emergency Response Plan

Before an incident

- o Develop an emergency response plan which includes
 - Spill-cleanup procedure,
 - Chemical accident and exposure response,
 - Clear chain of command and alternates with contact information,
 - Evacuation plan, and
 - Communication plan for alerting patrons, staff, and emergency responders.
- o Train the aquatics staff on the procedures in the emergency response plan.
 - Keep a copy of the emergency response plan near (e.g., in the hallway just outside of) the chemical storage area, pump room, and pool area and ensure that another copy is also available at a remote location in case of an evacuation.
 - Ensure up-to-date MSDSs are easily accessible to first responders in case of evacuation.
- o Have a phone with updated emergency numbers near (e.g., in the hallway just outside of) the chemical storage area, pump room, and pool area and ensure that a phone is accessible in case of an evacuation.
- o Practice emergency response with first responders.

In case of an incident

- o Activate emergency response plan.
 - For indoor pools:
 - If chemical fumes are released in the chemical storage area, pump room, or pool area and the corresponding air handling system is separate from other areas of the building, leave HVAC system on to ventilate.
 - If chemical fumes are released in the chemical storage area, pump room, or pool area and the corresponding air handling system is shared with other areas of the building, turn off the HVAC system immediately.

After an incident

- o Document the incident and response and report the incident to local or state permitting officials.[‡]
- o Conduct a post-incident critique with all parties involved in the response.
 - Revise the emergency response plan as needed.

Chemical Packaging and Labeling (for manufacturers and suppliers)

- o Package and label each pool chemical (e.g., chlorine and acid) so that they can be easily identified and distinguished from each other.
- o Package and label each pool chemical consistently. Changing the shape, size, or color of the container or labeling can lead to chemical-mixing errors.
- o Notify customers of any changes in the packaging or labeling of pool chemicals.
- o Consider identifying pool chemicals on the container lids.
- o Use labels resistant to both corrosion and deterioration.

Additional sources of guidance:

U.S. Environmental Protection Agency (EPA): Safe Storage and Handling of Swimming Pool Chemicals (2001) at www.epa.gov/oem/docs/chem/spalert.pdf

EPA: Chemical Emergency Preparedness and Prevention Advisory — Swimming Pool Chemicals: Chlorine (1990) at www.epa.gov/OEM/docs/chem/chlor.pdf

Transport Canada: Swimming Pool Chemicals at www.tc.gc.ca/canutec/en/articles/pool.htm

[‡] Local or state permitting officials should consider revising public health regulations in response to reports of pool chemical–associated health events to reduce the future likelihood of such events.