Understanding Interlocks and Chemical Safety

Introduction

Chemical injuries are a significant concern for aquatic venue operators. According to the the Centers for Disease Control and Prevention (CDC), from 2015 to 2017, an estimated 13,508 emergency department visits were due to pool chemical injuries (source). Of these injuries, at least 10.8% occurred at commercial aquatic venues.

In June 2022, 20 children were impacted by an accidental chemical release, with four children under the age of 10 being transported to the emergency department by EMS (source). While there are no documented deaths from pool chemical accidents reported to CDC's National Outbreak Reporting System (NORS) or the U.S. Consumer Product Safety Commission, the potential short-term and long-term injuries from these releases can have a significant impact on human health and safety.

The following guidance is intended for commercial aquatic venues, to help prevent injuries from accidental chemical releases and exposures. Residential pool owners should consult with a pool professional on guidance specific to their residential pool.

Feeding Pool Chemicals

To understand the risks and how to reduce injuries, one must first understand how pool chemicals are typically fed into the aquatic venue. There are multiple methods to deliver sanitizing and pH adjusting chemicals.

Automatic Chemical Feed Equipment with a Controller

Commercial aquatic venues ofen utilize a computerized controller that monitors Oxidation Reduction Potential (ORP) and pH. Controllers may offer an option to estimate chlorine levels. In some instances, the manufacturer will also provide a sensor that reads true chlorine levels in parts per million (ppm). Typically, the option to read chlorine in ppm is an additional feature and not standard on the controller.

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Automatic Chemical Feed Equipment with a Controller *(continued)*

These automated controllers will sense the ORP and pH and, based on settings selected by the qualified operator, will control sanitizer and pH on-demand, using a variety of sanitizing and pH control chemicals. These feed systems will use gravity, vacuum-to-pressure, or pressure-to-pressure based chemical injection methods, which might include hard-plumbed piping or tubing that is fitted to the aquatic venue return line.

The use of automated controllers is an aquatics industry standard. The Model Aquatic Health Code (MAHC) requires automated controllers to be installed within 1 year of adoption.

Automatic Chemical Feed Equipment without a Controller

In some instances, operators of commercial aquatic venues will utilize automatic feed equipment without a controller. This method injects sanitizer and pH control, typically sodium hypochlorite and muriatic acid, through either a peristaltic or diaphragm pump. In this setting, these pumps are typically feeding chemical on a delayed setting. The intent is to provide a constant rate of feed. There is no automatic monitoring of sanitizer and pH in the aquatic venue.

Stand Alone Erosion Feeders

Another option is the use of stand-alone erosion feeders. Generally, these feeders use TriChlor, a stabilized form of chlorine often found in puck form and fed on a steady basis typically through a manual setting. These feeders are plumbed into the aquatic venue return line and usually do not have any electrical components.

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Floating Feeders and Hand Feeding

The use of floating feeders is a common practice on residential pools. However, floating feeders are not appropriate for commercial aquatic venues as bathers will have easy access to chemicals. Regular hand feeding to maintain proper sanitizer and pH is a practice to be discouraged. This practice is not effective and can result in wild fluctuations in sanitizer and pH readings. Commercial aquatic venues that utilize hand feeding techniques are recommended to consult with a professional service provider on the installation of appropriate controllers and chemical feed equipment.

How Injuries Occur

When a pump failure causes aquatic venue return lines to have poor or no flow from the circulation pump, an intentional shut down of the circulation pump – or the failure of a valve or control – sanitizers and chemicals that control pH can mix in the return line which can create toxic chlorine gas. When flow is restored, this toxic chlorine gas is rapidly injected into the pool water, causing bathers and anyone around the pool to be exposed to highly dangerous gases and chemical concentrations.

Exposure can cause:

- Vomiting
- Respiratory distress and potential short- and long-term lung damage
- Extreme eye and skin irritation

Pool chemical injuries are often significant enough to warrant calling EMS and can frequently result in the impacted individuals being monitored in the emergency department, and, in some cases, may result in them being admitted to the hospital for additional monitoring or treatment.

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Prevention of Injuries Through Proper Interlocks

The use of properly design and installed interlocks are critical for the prevention of pool chemical injures. In CDC's Model Aquatic Health Code (MAHC), the following is recommended per section 4.7.3.2.1.3:

"All chemical feeders shall be provided with an automatic means to be disabled through an electrical interlock with at least two of the following: 1) Recirculation pump power, 2) Flow meter/flow switch in the return line, 3) Chemical control power and paddle wheel or flow cell on the chemical controller if safety test confirms feed systems are disabled through the controller when the pump is turned off, loses prime, or filters are backwashed."

Recirculation Pump Power

Because it is an electrical connection to the controller, when the recirculation pump is off or has lost power, the feed pumps will also lose power and not operate. A common and practical application is that controllers/feed equipment receive electricity from the same source as the recirculation pump.

Flow Switch

Typically pressure based, a flow switch is a device installed for each feed pump that will not allow the feeder to operate in low- or no-flow situations. These devices are independent of any automated controller and installed between the electrical source and the chemical feed pump, featuring a feed tube that measures the water flow. This device is critical when using chemical feed pumps without an automated controller.

Paddle Wheel & Flow Cell

When automated controls are used, manufacturers will typically install a device that ensures proper flow, commonly through a rotary switch also known as a paddle wheel.

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Paddle Wheel & Flow Cell *(continued)*

The paddle wheel sends an electrical signal to the controller when the flow cell has flow. Once the flow decreases and the signal is no longer sent, the controller will go into a low flow situation and will not send a signal to engage the chemical feeds pumps.

While a rotary switch is common, please refer to the manufacturers installation manual as other devices do exist to monitor appropriate water flow to the controller.

Steps for the Qualified Operator

The qualified operator can take the following steps to reduce the likelihood of an accidental pool chemical injury:

- Ensure that all feeders are properly interlocked and installed per the manufacturer's specifications
- Ensure all feeders and automated controllers are Certified, Listed, and Labeled to NSF-50
- Test the interlocks monthly per MAHC 5.7.3.5.1.4.1.1
- Clear the pool of bathers when backwashing or any other time where the flow of the aquatic venue is being altered or reduced
- If the aquatic venue does not currently have automated controllers or chemical feeders, implement a plan to install this equipment as soon as possible.

If needed, the qualified operator should utilize the services of a reputable service provider with expertise in controllers and feed equipment for commercial pools.

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Summary

Proper design, installation, and operation of interlocks for chemical feeder systems are critical to preventing injuries and illness from accidental mixing of chemicals and exposures to swimmers.

For more information on preventing chemical injuries, please visit:

- CDC's Healthy Swimming Pool Chemical Safety resource center
- Mini-MAHC: Preventing Pool Chemical Injury
- Mini-MAHC Annex: Preventing Pool Chemical Injury (Scientific Rationale)
- Mini-MAHC: Preventing In-line Production of Toxic Gas Events
- Mini-MAHC Annex: Preventing In-line Production of Toxic Gas Events (Scientific Rationale)

If you have any questions or for additional guidance, contact CMAHC's Technical Director Dewey Case at Dewey.Case@CMAHC.org or email CMAHC@CMAHC.org.

About CMAHC: The Council for the Model Aquatic Health Code (CMAHC) promotes health and safety for public swimming facilities in the United States. As a member-driven organization, CMAHC exists exclusively to advocate, evolve, innovate, promote implementation, organize research in support of, and advise the Centers for Disease Control and Prevention (CDC) on needed updates to the Model Aquatic Health Code (MAHC). Owned by the CDC, the MAHC is the only all-inclusive national pool code that addresses current aquatic issues.

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