Chloramines & Pool Operation

Chlorine is used in pools and other chlorinated aquatic venues to kill germs, but when it binds to the body waste swimmers bring into pools (for example, sweat and urine) it can form chemicals called chloramines. Chloramines in the water, like dichloramine and trichloramine, irritate skin, eyes, and the respiratory tract (including the nose) when they off gas from the water and into the air above, particularly indoors [1-3]. In addition, chloramines can also contribute to corrosion of metals around the aquatic venue and in air handling systems.

What can pool operators do to prevent or get rid of chloramines? +

Steps pool operators should take to prevent and get rid of chloramines in the water and surrounding air +

References

1. Chen L, Dang B, Mueller C, Dunn KH, Almaguer D, Ernst JL, Otto CS. Health hazard evaluation report: investigation of employee symptoms at an indoor waterpark. [PDF – 64 pages] Cincinnati, OH: US Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health. 2008.
2. Jacobs JH, Spaan S, van Rooy GBGJ, Meliefste C, Zaat VAC, Rooyackers JM, Heederik D. Exposure to trichloramine and respiratory symptoms in indoor swimming pool workers. Eur Respir J. 2007;29(4):690-8.
3. Safranek T, Semerena S, Huffman T, Theis M, Magri J, Török T, Beach MJ, Buss B. Ocular and respiratory illness associated with an indoor swimming pool—Nebraska, 2006. MMWR Morb Mortal Wkly Rep. 2007;56(36):929-32.

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What can pool operators do to prevent or get rid of chloramines?

Chloramines are a type of combined chlorine that form in water and then off gas into the air above the water. Most city, county, and state health departments limit the amount of combined chlorine in the water to 0.4 ppm or less.

Chloramines can build up in the water, which means they can build up in the air if there is not enough fresh air surrounding pools and other places people swim in chlorinated water [1]. This is particularly true for indoor aquatic facilities where air handling systems are not bringing in enough fresh air and exhausting enough chloramine-polluted air, which is common during winter months when heating costs increase. Chloramines that off gas from the water are heavier than air. This means they settle on top of the water's surface where they can cause negative health effects in swimmers and spectators.

Three things cause the buildup of chloramines in the air:

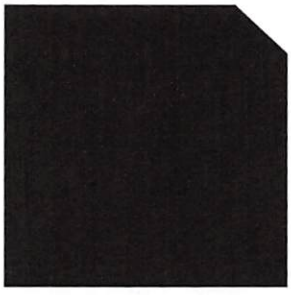
- Disturbing the water's surface (for example, when swimmers move in the water or the water is sprayed through aquatic features),
- Limiting movement of fresh air over the water's surface, and
- Using air handling [1,2] systems to limit the amount of fresh air brought into the swimming area and limit the amount of air polluted with chloramines exhausted out of the swimming area. This is common during winter months when heating costs are high.

Air handling systems might remove moisture from the air, but they don't necessarily bring in enough fresh air or exhaust enough air polluted with chloramines; pool operators need to consult with technical representatives on how to maximize the use of their air handling system to reduce chloramine accumulation while keeping heating costs down. If chloramines are not exhausted to the outside, then the recirculated air flowing over the water can become loaded with chloramines. If the air surrounding the water is full of chloramines, chloramines can't off gas in the surrounding air. This means chloramines will build up in the water and cause health effects in the swimmers.

Steps pool operators should take to prevent and get rid of chloramines in the water and surrounding air

Encourage healthy swimming to prevent chloramines from forming by stopping pee, poop, urine, dirt, and sweat from entering the water in the first place.

- Post signs or posters in the locker room that encourage swimmers and staff to:
  - **NOT** enter the water when they have diarrhea,
  - Use the toilet before getting into the water,
  - Wear a bathing cap while in the water, and
  - **NOT** to pee or poop in the water.
- Require swimmers and staff to at least take a rinse shower before getting into the water—in other words, swimmers and staff should be wet before they get into the water. Even a quick rinse shower removes much of the body waste that helps form chloramines.
- Be on alert for poop in the water; the distinctive chloramine odor in the swimming area; and respiratory, eye, or skin irritation in swimmers and staff in the swimming area.
  - If the swimmer who pooped in the water is identified, charge a fee to the swimmer or parent of the young swimmer for fecal incident clean up



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Ensure that airflow in the swimming area is set up to minimize the buildup of chloramines in the air.

- Set up the heating, ventilation, and air conditioning (HVAC) system to move fresh air across the water's surface and towards air exhaust vents to prevent the buildup of chloramines on top of the water's surface.
- Exhaust air polluted with chloramines from the swimming area to the outside.
- Bring fresh air from the outside into the swimming area. If the fresh air is cold, this will increase heating costs, but the cost of patron discomfort and illness linked to chloramines can be higher.

Monitor combined chlorine (chloramines are a type of combined chlorine) levels in the water and treat the water, especially when levels are too high.

- Calculate the level of combined chlorine.
    1. Measure the amount of total chlorine in the water.
    2. Measure the amount of free chlorine in the water.
    3. Subtract the free chlorine number from the total chlorine number:

    combined chlorine = total chlorine – free chlorine

- Get rid of chloramines in the water, especially when the combined chlorine level is too high (for example, more than 0.4 ppm).
    - Superchlorinate to off gas chloramines from the water and start to convert them to nitrogen gas.
        1. Close the pool to swimmers.
        2. Make sure the swimming area is well-ventilated, because superchlorination (also known as "breakpoint chlorination") causes off gassing of the chloramines and creates nitrogen gas.
        3. Raise the free chlorine level to 10 times the combined chlorine level.
        4. Bring the free chlorine level back down to the required operating range.
    - Break down chloramines in the water, using ultraviolet light or ozone systems, which are also known to kill *Cryptosporidium* [1].