

Volatile Chlorine-Based Pool Water Disinfection Byproducts

Throughout many indoor pool facilities, the issue of pool water chemistry has been regarded as a necessary evil that requires little understanding of its use. This problem is compounded when poor pool water chemistry management leads to problems with both the occupants and the facility.

To the contrary, chlorine-based sanitizers can be quite detrimental to both swimmers and occupants causing asthmatic-like condition, skin and eye irritation. Generally it's known that chlorination is used primarily to prevent pathogenic micro organisms from growing. In this article published in the Perdue Alumnus, it describes how new research is detecting and analyzing how chlorine reacts with organic materials like sweat and urine but also with other contaminants like personal care products and deodorants.

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PURDUE LAB WORKS TO IMPROVE CONDITIONS AT INDOOR SWIMMING POOLS

By Emil Venere *Purdue Alumnus Magazine*

Researchers at Purdue University have determined how certain airborne contaminants are created when chlorine reacts with sweat and urine in indoor swimming pools, a step toward learning how to reduce the formation of "volatile disinfection byproducts" that cause respiratory irritation.

"Some indoor swimming pools seem to have a characteristic chlorine odor," says Purdue environmental engineering professor Ernest R. Blatchley III. "You may think you're smelling chlorine, but you are probably smelling a mixture of disinfection byproducts. If their concentrations get high enough, then they can become an irritant to your respiratory system, to your skin, and to your eyes."

The problem received national attention last summer (2008) when the U.S. National Swimming Championships in Indianapolis were interrupted after swimmers experienced difficulty breathing.

Uncovering Concerns

Standard tests for swimming pool water detect inorganic byproducts, or chemical compounds that do not contain carbon-hydrogen bonds. The Purdue researchers are the first to identify the presence of organic "volatile disinfection byproducts," which become airborne and pose health concerns.

Swimming is the most popular recreational activity for children in the United States, and anecdotal evidence suggests that children might be more sensitive than adults to the irritating effects of disinfection byproducts, says Michael Beach, acting associate director for healthy water in the Centers for Disease Control and Prevention's National Center for zoonotic, vector-borne, and enteric diseases.

Chlorination is used primarily to prevent pathogenic microorganisms from growing.

"What we are trying to do is investigate the chemistry of the reactions between chlorine and the stuff that people put in swimming pools: sweat and urine," Blatchley says. "We will also investigate what happens when chlorine reacts with other contaminants, including personal care products like makeup and deodorants."

Path to Permanent Solutions

The Purdue researchers analyzed swimming pool water for the presence of organic compounds generated when chlorine reacts with creatinine, urea, and amino acids, which are contained in human urine and sweat. Measurements have allowed the researchers to hypothesize specifically how the urea, creatinine, and several amino acids react with chlorine to produce the disinfection byproducts. "We focused on a couple of the amino acids that we believe are representative of those that are present in sweat and urine and likely to be present at high concentrations in swimming pool water," Blatchley says.

"Basically, what we want to do is relate our measurements to the operating characteristics of the pool," Blatchley said. "To address this issue, we are collecting samples from a number of public pools and analyzing them to determine the concentrations of volatile disinfection byproducts that are present in operating pools."

"It's amazing how little we know about swimming pool chemistry," Blatchley says. "And that's why we have pools being shut down for reasons that are probably avoidable. We want to solve this problem so that businesses and municipalities can operate their swimming pools in a manner that doesn't cause people to get sick."

The research has been funded by the DuPont Experimental Station in Wilmington, Delaware, and the National Swimming Pool Foundation.

"Once we know the chemistry, our industry can unleash solutions to improve air quality, reduce negative health risks, and enhance the aquatic experience," says Thomas M. Lachocki, CEO of the National Swimming Pool Foundation. "We want to move toward reducing exposure to chemicals that are not natural."

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