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Pool Tip #55: Pseudomonas Aeruginosa

In recent years, pool operators across the country have been reporting Pseudomonas aeruginosa outbreaks at their facilities, in record numbers.

Pseudomonas aeruginosa is a gram negative bacterium present in the environment. It is passed into the pool water from the human skin and gastrointestinal tract, and frequently through broken pool circulation pipes, or from dirt tracked onto the pool deck. Pseudomonas aeruginosa is often cultured from warm, moist environments, particularly when turbulent or aerated, because the bacteria grows rapidly under these favorable conditions. Because of this fact, many aquatic professionals mistakenly believe that Pseudomonas is only a problem in warm water pools and spas. Unfortunately, Pseudomonas can grow in swimming pool water as well as spa water, on the pool edge and decks, into filter liners, in the filter sand bed, and inside PVC pipe, racing lanes, and water hoses.

If bacteriological analysis of pool water is not performed on a regular basis, a pool operator will probably be unaware of the contamination problem until bathers start complaining of infection. Bathers who spend lengthy amounts of time soaking in a spa, staff members who wear wet bathing suits throughout their work shift, or patrons who swim regularly for extended periods of time are most likely to experience problems.

The most common sign or symptom of a P. aeruginosa infection is a dermatological problem resulting in a red, bumpy, itchy rash, which looks like measles. On most bathers, the rash appears on the legs, trunk, inside of the arms, lower back, neck and shoulders, or anywhere the skin is broken, or where a swim suit rubs against and irritates the skin.

Pool associated folliculitis or skin rashes from Pseudomonas aeruginosa can be prevented by taking a soapy, hot water shower in the nude, immediately after leaving the pool, and before cooling down and allowing the pores to close over the bacteria.

According to the Centers for Disease Control, other symptoms associated with P. aeruginosa infection include: earaches (otitis externa), breast inflammation (mastitis), feeling ill (malaise), inflammation of the eye membrane (conjunctivitis), coughing and sore throat caused by inflammation of the mucous membrane of the pharynx (pharyngitis), fever, lymph gland inflammation (lymphadenopathy), urinary tract infections causing impaired ability to pass urine (dysuria), flu-like symptoms, and nausea.

Although it is not uncommon to find Pseudomonas bacteria present in pool water, Pseudomonas aeruginosa outbreaks rarely occur in properly treated and rigorously maintained public aquatic facilities. To prevent the uncontrolled growth of P. aeruginosa, the following practices are recommended:

Collect water samples from the pools and spas, and take swabs from inside the filters, on a regular weekly basis for bacteriological water analysis. Simple tests for Pseudomonas are available, and can be done by the knowledgeable pool manager. If samples are sent to an independent laboratory, specifically request that tests for both the presence, and quantity, of Pseudomonas be performed.

Pressure test the pool recirculation systems to make sure there are no suction side breaks in the lines which may be allowing dirt to enter the closed systems.

Institute rigorous deck maintenance procedures. The purpose of cleaning a pool deck is two-fold. Oil, grease, dirt and debris must be removed through sweeping, rinsing, power washing, and scrubbing the pool deck with an all-purpose cleaner, detergent, or degreaser which is compatible with pool water. But more importantly, decks must be disinfected to prevent bacterial growth, including P. aeruginosa, and the formation of a slippery biofilm layer. The best, and least expensive way to disinfect a pool deck, is to spray a 20 to 1 solution of water and sodium hypochlorite on the deck, and rinse with a high pressure nozzle and hose. For clean-up of blood or bodily fluids, and to comply with the OSHA regulations for preventing transmission of bloodborne pathogens, the decks, or any contaminated surface, should be cleaned with 5.25% sodium hypochlorite (household bleach) diluted to between 1:10 and 1:100 with water. This is equivalent to disinfecting with a 1:20 solution of 10-12% sodium hypochlorite (liquid pool chlorine). Clean and disinfect the decks on a nightly, or at least twice weekly basis, depending on the level of facility use, and, immediately after any contamination with blood or bodily fluids.. Attempt to keep patrons in street shoes off the deck, or at least away from the pool edge.

Require that infants and young children who are not yet toilet trained wear tight fitting rubber pants or swim suit diapers while in the pool.

Shock spas daily and pools at least weekly, or as needed if combined available chlorine levels exceed 0.2 ppm. Make sure that you allow enough time for the chlorine to reach the breakpoint. Double check your calculations to make sure the correct amount of chlorine is being used. Inject the chlorine into the return lines using a chemical metering pump, or install a slurry feed bucket so that large amounts of chemicals can be poured into the return lines. Do not hand feed or pour the chlorine directly into the pools. Do not remove high levels of chlorine from the water with sodium thiosulfate. Let chlorine levels return to normal gradually after the breakpoint has been achieved.

Install an automated pH/ORP controller, or at a minimum, purchase a portable ORP meter. Maintain a minimum 750 mV oxidation reduction potential in commercial pools and spas. Oxidation reduction potential (ORP) is a standard method of a measuring the chlorine's (or bromine, ozone or other sanitizer-oxidizer's) ability to

oxidize and sanitize the water. ORP sensors measure HOCl conductivity of water, the potential generated for oxidation, and permit constant monitoring of sanitation levels. ORP takes into consideration all water constituents, including oil, grease, TDS, cyanurates, and organic contaminants. It is a true measure of water cleanliness. ORP falls whenever pH is either high or low, and when TDS, chloramine or cyanurate levels are high. Organic and chemical loading drastically reduce the ability of the bactericide to overcome bacteria. The amount of chlorine needed by weight in parts per million (ppm) in order to maintain a 750 mV ORP level will vary from pool to pool depending on other water constituents. 650 millivolts of ORP is the minimum recommended level for residential pools and drinking water promulgated by the American Water Works Association (AWWA). The German DIN Standard recommends a minimum 750 mV ORP for commercial pools and spas.

Buy fresh chlorine and other pool chemicals from a reputable vendor, rather than from a mass merchant or local store where the chemicals may have been sitting in a warehouse or on the shelf for a lengthy period of time. Store chlorine in a cool, dark, well ventilated location. Some forms of chlorine have a very short half life and lose their effectiveness rapidly when exposed to heat or ultraviolet light. If sodium hypochlorite (liquid chlorine or bleach) is used as the primary bactericide, purchase a sodium hypochlorite test kit. Sample and test all sodium hypochlorite deliveries for percentage of available chlorine. Use sodium hypochlorite on a first in, first out, basis.

Don't use defoamers in the spa. Defoamers only change the water surface tension and hide, rather than correct, the problem. Defoamers are wetting agents that prevent foaming, or that neutralize and dissipate suds in aerated spas, fountains and hydrotherapy pools. Foaming in pools can be caused by: soft water, quaternary ammonia algaecides, body lotions and suntan oils, tile cleaners, high TDS levels, air pollution, body fats secreted by the sweat glands, and oils from the skin. Foaming water is usually an indicator that the water in the pool or spa needs to be changed. Discontinue use of the product which causes foaming or drain and refill the pool.

Drain and refill the pool and spas when total dissolved solids exceed 1,500 ppm. Dilute the water regularly to control for TDS build-up which might be interfering with the chlorine's ability to sanitize and oxidize. If scheduling, or regulations enacted as a result of drought conditions prohibit the draining and refilling of a pool, consider installing a nanofiltration system to purge the water of dissolved solids.

If high levels of Pseudomonas are found in the pool, the following procedures should be followed. Rinse pool circulation pipes and equipment with high levels of chlorine, then drain the pool completely. Remove the sand or other filter media from the filter tanks, and dispose of the media properly.

Read the material safety data sheets (MSDS) before beginning work. Make sure that the area in which you are working is extremely well ventilated. Do not work alone. Both you and your partner should be knowledgeable in first aid procedures for chemical burns, and respiratory emergencies in case one of you is overcome by fumes. Don protective clothing that covers all areas of exposed skin. Wear goggles and a half mask

respirator with fresh chlorine cartridges and particle filters, rubber boots and neoprene gloves.

Scrub the entire surface of the pool, the decks, and the interior of the filter tank with a solution of 1 part sodium hypochlorite to 20 parts of water. Spray the chlorine mixture or pour the mixture from the deck down, a small area at a time. Keep the rinse water on at all times, and rinse frequently with fresh water to cut down on the fumes. Do not allow the chlorine to collect in the bottom of the pool, and neutralize the chlorine before pumping it to waste. Refill the pool, add chelating agents, balance the water, and closely monitor the sanitizer levels.