

Iodine Pool Treatment

IODINE'S HISTORY AS A DISINFECTANT

The usefulness of iodine as a disinfectant led to the possibility for use in swimming pools. Iodine was first discovered suitable for water treatment during World War I. After the war, studies at Harvard University led to the development of globaline by the U.S. military for disinfection of the water in canteens for use in the field. According to the CDC, iodine water treatment is still acceptable where treatment by boiling the water is unavailable. Iodine is also commonly used in the medical industry. A form of iodine, povidine-iodine is used preoperatively for sterilization of medical utensils and equipment. A similar iodine solution is also found in first aid kits for emergency application to wounds for disinfection.

Iodine- what is it?

Elemental iodine (I) belongs to the halogen group on the periodic table next to bromine (Br) and chlorine (Cl). Iodine has the heaviest atomic weight of the halogens and is the only halogen that is a solid at room temperature. In contrast to chlorine and bromine, iodine is less soluble in water and reacts at a slower pace with organic compounds. Iodine is typically available in the form of potassium iodide salt (KI). The current cost of iodine is about \$8/lb whereas chlorine is about \$0.30-0.50/lb. However, while chlorine residual is used up during disinfection, iodine residual can be regenerated. Black et al estimate that "each atom of iodine can be reused 10 to 13 times." Since the iodine residual is also more stable, the addition of iodine required for disinfection is significantly less than chlorine.

Pool Chemistry

The cheapest way to release iodine in water is by a reduction reaction of potassium iodide with chlorine to form iodide (I⁻). Depending on the pH, iodine then reacts with water to take the following forms: iodide (I⁻) at pH<5, Hypoiodous acid (HOI) at 5<pH<8, and Iodate ion (IO⁻) at pH>8. As pool water is required to be pH 7.4-7.6, hypoiodous acid is in solution at the greatest amount with some iodide. Both of these forms of iodine are good disinfectants although hypoiodous acid has been shown to kill e.coli four times faster than iodide. For optimal disinfection, it is recommended that a free iodine residual is kept in the pool at 0.8 mg/L.

Unlike chlorine, iodine does not react with organics such as ammonia and urea (introduced by bathers) and therefore is a more stable residual in pools even with heavy use. Also, no harmful disinfection byproducts occur as opposed to those formed by chlorine (i.e. Chloramines, THMs, etc). The downside is that as more organics are introduced to the pool, the compounds are not treated and accumulate. Depending on the bather load, iodinated pools require periodic "burn-out" of organics by shocking the pools with superchlorination.



Another drawback of iodine is that it is ineffective against algae formation. Since algae feed on the ammonia compounds, which have been allowed to accumulate as described above, this problem is worsened. Iodine can be combined with a supplementary algacide to solve this issue. However, pools treated with algacides are often not friendly with swimmers resulting in complaints of skin irritation and eye redness. If algacides are not used, periodic shocking of the pool with superchlorination is required.

Iodine/Chlorine Comparison

The comparison of Iodine and Chlorine can be summarized in the following table:

Factor	Chlorine	Iodine
Chemical reactivity	High	Low
Residual stability in water	Dissipates rapidly	Relatively Stable
Amount of pH correction required	High	Minimal
Amount of DBPs (ie. Chloramines)	High	None
Swimmer Discomfort (ie. Eye burn)	High	None
Microbial disinfection	High	High
Organics (ie. Ammonia, urea, etc)	Minimal, neutralized immediately	Ineffective, accumulating organics
Algae formation	None with free chlorine	Ineffective, algae formation possible
Pool shocking required	Yes	Yes

Conclusion

In summary, iodine has some benefits compared to chlorine. The free iodine residual is significantly more stable than chlorine partly due to its inactivity with organics introduced into the pool by swimmers. Therefore, iodine residual is easier to maintain in the pool despite bather loads. In addition, no harmful disinfection by-products such as chloramines are formed in iodinated pools. However, iodine cannot stand alone as an effective pool treatment. Iodine must be accompanied with an oxidant, usually chlorine, to deal with the organics. An algacide or frequent pool shocking may also be required. The addition of both oxidants and algacides increase costs, maintenance, and complexity in managing the pool chemistry. These hurdles most likely prevented further exploration in replacing chlorine with iodine as a swimming pool disinfectant.

REFERENCES:

1. Black, A.P., R.N. Kinman, M.A. Keirn, J.J. Smith, and W.E. Harlan. "The Disinfection of Swimming Pool Waters: Comparison of Iodine and Chlorine as Swimming Pool Disinfectants." American Journal of Public Health. 1970. 60 (3): 535-45. 3 March 2011. <http://ajph.apublications.org/cgi/reprint/60/3/535.pdf>
2. "Water Chemistry for Swimming Pools." North Carolina Division of Environmental Health, Department of Environment and Natural Resources. 2011. 14 March 2011. <http://www.deh.enr.state.nc.us/ehs/quality/wph.htm>
3. "Water Treatment Methods." 13 January 2011. Centers for Disease Control and Prevention. 3 March 2011. <http://wwwnc.cdc.gov/travel/content/water-treatment.aspx>.
4. Black & Veatch Corporation. White's Handbook of Chlorination and Alternative Disinfectants. 5th Ed. Hoboken, NJ. pp. 878-884. 2010.



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