Chlorine:

History and Rote in the Great Debate for Water Disinfections

By William S. Siegmund, CWS-V

Some time back, a good friend of mine presented me with a very interesting little book. This friend has a knack for inadvertently providing material relevant to me at the particular time that it's relevant. The book, *Salt & Water, Power &People*[1], chronicles the life of Elon Huntington Hooker (1869-1938), whose company, Hooker Electrochemical Corp., was infamous for its involvement in the industrial waste buried in Niagara Falls, N.Y., in the '40s and '50s that led to the environmental debacle of Love Canal. My friend found the book in an antique shop in a small Lake Michigan port, some miles north of White Lake, Mich., where the long-divested Hooker company also once ran a chemical manufacturing operation that left its own local legacy. Even today, the site is included on the state's 307 priority list of Superfund sites and the top 44 list of Great Lake" hot spots" of the U.S. Environmental Protection Agency (USEPA).

A by-product of its own

Elon Hooker used money from the Development Company of America to develop the Townsend Process. This process was invented by Clinton P. Townsend and Elmer Sperry, who also invented the gyroscopic compass that revolutionized modern navigation and the design used in soles of Topsider deck shoes. Their process involved passage of an electric current through brine (salt and water) to produce caustic soda with chlorine and hydrogen gas as a by-product. There were many uses—both household and industrial—for caustic soda, but the chlorine was to be vented off to the bleaching house and raked over with slaked lime ($CaSO_4$) that absorbed the chlorine to become bleaching powder.

In 1906, the first industrial facility using the Townsend process went into production, producing inexpensive caustic soda and chlorine." Work in the "Bleaching Chamber" was the most disagreeable job in the plant (many workers quitting before collecting their first paycheck). The highly irritating chorine gas was piped from the cell house to the bleach building where it passed from chamber to chamber over layers of slaked lime spread on the floor. By the time it passed the last layer, the lime presumably had absorbed the chlorine, when actually a substantial amount of excess gas seeped out."[1]

Finding suitable uses

Production/demand of caustic soda increased continually, literally bursting ahead during World War I, when it was used in making explosives. The chlorine production became a problem that couldn't be avoided. The newly formed research department was charged with coming up with new uses for it. Chlorine's first use for disinfecting a public water supply was in Great Britain around the turn of the century. The first use of chlorine in a U.S. public water supply took place in Jersey City, N.J., in 1908.

Other cities and towns across the country soon followed suit and the threat of waterborne diseases such as cholera and typhoid, dysentery and hepatitis A was drastically reduced to the point of virtual elimination.

Chlorine and public health

"Today," points out the Chlorine Chemistry Council's Keith Christ man, "some 98 percent of our public water supplies are 'purified' by chlorine or chlorine-based products. The director of the International Life Science Institute's Risk State Science Institute states chlorination of water supplies is the public health success story of the century."[2] Provision of safe, effective drinking water disinfect ion was also cited by astronaut Neil Armstrong— speaking on behalf of the National Academy of Engineering— as the fourth most important achievement of the 20th century behind electrification, the automobile and the airplane.

The American Water Works Association, which represents municipal water utilities, notes: "Chlorine is effective against a broad spectrum of pathogens. Any disinfecting agent must be effective against many microbiological organisms, including bacteria, viruses, and protozoa. Chlorine's residual continues to inhibit microbial growth in the distribution system. Chlorine has well understood operational requirements. Chlorine disinfections technology is far simpler than other disinfect ion technology"[4]

World Health Organization (WHO) statistics on death from illnesses and diseases transmitted via drinking water in less advanced areas around the globe only underscores the importance of chlorine. Three billion people lack sanitation facilities and, every year, more than five million people die from illnesses linked to unsafe drinking water, unclean domestic environments and improper fecal waste disposal. Every eight seconds, water-related disease claims another child's life.

"Unfortunately, the availability of safe drinking water in many areas is practically non-existent, due to poverty, poor understanding of water contamination and lack of a treatment and delivery infrastructure," Christ man said.[2]

One of the more recent examples of waterborne disease, a cholera epidemic, started in Peru in the early '90s when officials began disuse of chlorination due to fears of disinfect ion byproducts (DBPs) such as trihalo-methanes (THMs) because of USEPA studies linking them to cancer. The epidemic quickly spread to 19 Latin American countries. "An estimated one million cases resulting in 4,000 deaths were reported in 1991 alone."[3] The epidemic lasted nearly five years. A resurgence of cases occurred in 1997 because of flooding from El Nino. Central America saw a rise in cholera after Hurricane Mitch in 1998. And Madagascar and Mozambique are currently suffering from cholera epidemics. With worldwide need for some protection so high and societies' unwillingness to allocate proper funding to water treatment, it's unlikely that any technology other than the cheapest and simplest can be expected.

The Great Debate

We are now engaged in a great debate that pits most environmental activists and organizations and government agencies—such as Green peace, the WHO and International] Joint Committee (IJC), which is the regulatory body that oversees U.S./Cana-dian waterways including water quality of the Great Lakes—against the Chlorine Chemistry Council, the Chemical Manufacturers Association and their many allies in and associated with the chlorine industry.

The debate rages from senseless name-calling to good science. The two groups trade barbs by handing out inventive awards with a biting sarcasm that blurs the message, "Chlorophiles" (those who like chlorine or chlorine lovers)" hand out "Greenock" awards to "Ecol-Econners" (environmentalist con-men) giving the "green wash" award. Documents like "Rachel's Folly: The End OF Chlorine " strike blows at well-funded, widely accredited and accepted studies that attack the heart of the environmental movement. Activists daredevils drop banners calling for a "total ban" on chlorine production and chlorine-related products, citing hazardous industrial waste to PVC plastic piping reachable to ozone depletion and global warming.

Finding middle ground

Somewhere in the middle of the debate lies the disinfect ion of water. Activists' push for a "total ban" on chlorine is unrealistic when weighed in a health benefit vs. cost equation. The benefits of microbiological disinfect ion for a healthy world are simply too high. Chlorine, as the least costly of the current options available, makes it too valuable to consider banning. It's difficult to consider any other option when the least expensive remains under funded and underutilized around the world, particularly in underdeveloped nations. While drinking water disinfect ion is used widely in the debate promoting chlorine, because of its cost-benefit ratio, chlorine used in this fashion accounts for only a tiny fraction of total chlorine production—1.5 percent.[4] Chlorine water disinfect ion should be considered along-side currently available alternative technologies before anyone considers a total ban. Touting the benefits of chlorine as a water disinfectant must be taken from the debate because it represents such a small part of its use and total production.

Chlorine is an element natural to our environment. However, as one of the basic building blocks for many products, the chemical industry manufactures over 15,000 different chlorine-containing compounds. Controversial ones associated with environmental and health problems include dioxin, CFCs, PCBs and PVC. "Chlorines attractiveness to electrons tends to stabilize some chemical structures so they don't break down easily. Some chlorinated chemicals persist for long periods until swept up in the stratosphere, where ultraviolet light helps break them into molecular fragments that destroy ozone. Others persist in human fat tissue, where they accumulate."" Conversely, the U.S. Court of Appeals ruled in March in favor of the Chlorine Chemistry Council and against the USEPA on setting the federal standard for chloroform, a by-product of chlorine disinfect ion of drinking water. Chloroform has long been associated as a carcinogen, with the MCLG, or maximum contaminant level goal set at zero in 1998. The court ruled "best available science" indicates that above a certain "threshold" level chloroform is not carcinogenic and ordered the USEPA to establish a non-zero MCLG—a major blow against the concept of DBPs as inherently dangerous at any level.

Conclusion

The total banning of chlorine is unlikely and unrealistic. The current administration's Clean Water Act initiative to develop a "National strategy for substituting, reducing or prohibiting the use of chlorine and chlorinated compounds,"" is a realistic approach. Inexpensive, abundant, cost effective and efficiency assures chlorine's continued use as a water disinfectant. Developed nations may be able to afford a switch to a more environmentally friendly technology with less potential health risks—but with world wide clean water needs so strong, chlorine represents the possibility of some treatment vs. no treatment.

On a recent trip I took to the Dominican Republic, water from the tap was chlorinated. Because treatment was inconsistent we were advised not to drink anything but bottled water. Here, in Jamaica (which is where I'm writing this paper while on vacation), water from the tap has chlorine residual. At the requests of several friends and family, I brought carbon block filtration units; with an NSF *International* listing that includes chlorine, volatile organic compounds (VOC), THMs and cyst reduction. For me, traveling in other countries and encountering the smell of chlorine in tap water brings a small sense of relief. We always take it out, but it's somewhat reassuring to have it there. □

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