WATER QUALITY & HEALTH COUNCIL
PERSPECTIVES

Chlorine vs. Chlorine Bleach: What's the Difference?

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In a nutshell…

The terms "chlorine" and "chlorine bleach" are not always used accurately in reporting emergency incidents in which elemental chlorine gas or liquid chlorine bleach escape their containers. These two substances have different chemical and physical properties and represent different potential risks to human health. This article explains the differences between the substances and highlights the importance of accurate reporting on chemical incidents.

A recent emergency at a Baltimore water filtration plant highlights the importance of using accurate terms when reporting chemical incidents. According to a media report, on September 16, fire crews responded to a "chlorine leak" at the Lake Montebello Water Filtration Plant. The same article notes that residents living in the neighborhood of the filtration plant were asked to shelter in place as firefighters investigated a "chlorine spill" from the filtration plant. Fortunately, there were no injuries resulting from the incident, but the words chosen to describe the event were misleading. A chlorine "spill," implies a liquid flowing from the facility; a chlorine "leak" is less specific regarding the state of matter (e.g., liquid or gas). In reality, chlorine gas had escaped into the air, requiring a response significantly different than for a spill of chlorine bleach.

1/3 gallon of 7.5% strength chlorine bleach (left) and 150 lb. cylinders of liquefied chlorine (right). Chlorine cylinder photo courtesy of The Chlorine Institute.

Chlorine Chemistry 101

Chlorine is a naturally occurring chemical element that is extremely reactive (meaning it will react easily with other elements). It is very common in many naturally occurring salts, and is chemically bonded to other elements in numerous compounds. It is a dense, yellow-greenish gas at normal atmospheric pressures and temperatures that can be cooled and compressed into a liquid state and stored in heavy steel cylinders. When released into the atmosphere, it reverts immediately to its gaseous form referred to as "chlorine gas." Chlorine is manufactured from naturally occurring chloride salts such as sodium chloride (table salt) and potassium chloride. Chlorine is used extensively in chemical manufacturing for everything from electronics to plastics.

Elemental chlorine gas that is cooled and pressurized into a liquid may be transported for use in important applications such as water disinfection. Chlorine gas is classified by the U.S. Department of Transportation (DOT) as a toxic inhalation hazard. Inhaling even very low levels (1 part per million) of chlorine gas can cause respiratory tract irritation. Exposure to higher levels may result in changes in breathing rates and coughing, damage to the lungs, or more severe effects. Being heavier than air, chlorine gas sinks into low-lying areas. In the case of an outdoor chlorine gas leak, it makes sense, therefore, to seek the highest ground possible. In the event of an indoor leak, one should seek fresh air by going outside.

Not to be confused with elemental chlorine, but sometimes dubbed "chlorine" erroneously, is the familiar liquid known as "chlorine bleach." Elemental chlorine is used to produce bleach. A staple in many household laundry rooms at about

6-7.5% strength, chlorine bleach is a stable water solution of *sodium hypochlorite*, a compound of sodium, oxygen, and chlorine. Bleach is classified by DOT as a corrosive.

Like chlorine gas, chlorine bleach is used extensively in water treatment (but at a higher strength than the common laundry variety). Both chlorine gas and chlorine bleach are routinely transported and used for this vital public health task. Distinguishing clearly between these two substances in the event of an incident in which one of these escapes its container is very important: one escapes as a gas, the other as a liquid. Unlike chlorine gas, which disperses into the air and seeks low-lying areas, liquid bleach follows the ground surface. With a chlorine gas leak, the major risk to human health is breathing the gas, which is damaging to the mucous membranes and can be deadly within minutes at a concentration of 1,000 ppm. With a bleach leak, the goal is to prevent skin contact or inhaling fumes.

Is that a "Spill" or a "Leak"?

The emergency responder – typically the fire department – will respond much differently depending on whether the release is a "spill" of a liquid or a "leak" of a gas. Generally speaking, a chlorine gas release is a much more serious incident than a bleach spill, with greater potential for human health risk. A chlorine gas release typically results in evacuating the surrounding area and implementing emergency response procedures, such as the reported shelter-in-place order for 2.5 hours for the Baltimore neighborhood (with windows closed) affected by the September incident.

A spill of bleach is typically less serious, with efforts made to contain the spill, avoid its contact with sewers, waterways, and unpaved lands, and remove the liquid. But a major concern with a bleach spill is what else the bleach may have come into contact with.

Chlorine Bleach and Accidental Mixing

Chlorine bleach that is accidentally mixed with certain chemical substances can generate hazardous products. For example, accidentally mixing chlorine bleach with acidic substances can produce chlorine gas. Mixing bleach with ammonia can produce chlorine gas, irritant compounds known as chloramines, and explosive compounds. When organic fuels (like gasoline or coal) react with bleach, chlorine gas, explosive compounds, and chlorinated organic compounds can result.

The Chlorine Institute routinely analyzes accidental mixing incidents to "find opportunities to improve and enhance safety" in industrial chlorine production, according to the free YouTube video, "Accidental Mixing: Dangers, Incidents and Prevention during Chemical Delivery." The Water Quality & Health Council also promotes bleach safety with a freely downloadable stamp, shown at right, imprinted with the warning to "MIX BLEACH WITH WATER ONLY." The stamp was developed in response to a tragic incident in a Massachusetts restaurant kitchen in which bleach and an acidic product made contact, chlorine gas was produced, and the establishment manager died from exposure to the gas.

Accurate Language

Accurate language is critical when it comes to reporting and responding to incidents involving chemicals. Each response depends on the *hazard* represented by the specific chemical involved and the *risk* to those in the vicinity. When it comes to an incident involving chlorine, try to clarify: Is it elemental chlorine gas or liquid chlorine bleach? There's a difference!

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