

What are pool chemicals?

Pool chemicals are used to maintain swimming pools and spas to reduce germs and other microorganisms in the water and keep the pool looking clean. These products include sanitizers, algaecides, pH balancers, clarifiers, and **shock**.¹ Pool chemicals are an important tool to protect the health of swimmers. Antimicrobials such as chlorine and bromine kill bacteria that can cause **recreational water illnesses**. Maintaining the proper level of these chemicals and proper water pH helps to kill bacteria and reduce irritation to swimmers.²

This fact sheet focuses on pool products that kill bacteria and other microorganisms in swimming pools and spas. See NPIC's fact sheet about **antimicrobials** for general information.



photo credit: Charles Rondeau, Pixabay

This fact sheet refers to the technical grade, or “pure” chemical of each active ingredient. Pool products you buy from the store usually include **other ingredients** as well. While many of the chemicals used as other ingredients may not pose health or environmental risks, some of them can be toxic. In some cases, the other ingredients can pose greater risks than the active ingredients themselves.

How do I know if my product is designed to kill germs or other microorganisms in my pool?

Products that claim to prevent, remove, or otherwise control algae, bacteria, and other human **pathogens** are considered antimicrobial pesticides. These products require registration with the U.S. EPA.³ Their product labels include an EPA registration number. Examples of label claims on pesticide pool products include:

- Kills algae
- Kills bacteria
- Antibacterial
- “Eliminates organic waste”
- Shock

If the label does not state that the product prevents, removes, or otherwise controls these microorganisms, it is not intended to kill germs, and is not regulated as a pesticide.³ Examples of non-pesticide label claims may include:

- “Eliminates odors”
- “Restores water clarity”
- “Shocks non-living matter”
- “This product does not sanitize or disinfect”
- “This product is not intended to control microorganisms”

NPIC fact sheets are designed to answer questions that are commonly asked by the general public about pesticides that are regulated by the U.S. Environmental Protection Agency (US EPA). This document is intended to be educational in nature and helpful to consumers for making decisions about pesticide use.

What are the different types of antimicrobial pool chemicals?

Antimicrobial pool products kill or slow the spread of microorganisms, such as bacteria, algae and viruses. They are sold as powders, tablets, and liquids. Each product may have a different mixture of **active** and **other** ingredients. Some examples of active ingredients commonly found in antimicrobial pool chemicals are:

- Sodium hypochlorite (bleach)
- Calcium hypochlorite
- Halohydroxyantoinins (bromine and/or chlorine)
- Polyhexamethylene biguanide hydrochloride (PHMB)
- Dichlor (sodium dichloro-s-triazinetriene)
- Trichlor (trichloro-s-triazinetriene)
- Zinc sulfate monohydrate⁴



photo credit: Keith Davenport, flickr

What precautions can I take when handling pool chemicals?

Pool chemicals are designed for use in specific ways. Only use your product as described on the **label**. Following the precautions and the tips below can help minimize your risk. Always read the label before you buy a product and make sure it is meant for your specific use.

- Use appropriate **personal protective equipment** including gloves, safety goggles, long sleeve shirts, pants, and closed-toe shoes in addition to clothing or equipment required by the label.
- Keep containers closed until just before use.
- Never mix products with acids, other pool chemicals, or water unless the product label says to. Never mix old products with new products of the same type. Strong reactions may occur and create high temperatures or release toxic gas.⁵
- Add chemicals to the pool water. Never add water to pool chemicals.⁵
- Face away from the chemical when adding it to pool water to avoid splashing or vapors.
- Always use pool chemicals in a well-ventilated area.
- Always store pool products out of reach of children and pets. If you can, keep them in a locked cabinet in a garden shed or garage with good ventilation. Never store them with food, animal feed, or medical supplies. Do not allow children to handle any pesticide, including pool chemicals.
- Follow all **safe use practices**, and always read the entire product label before use.

What are the health effects of pool chemicals?

All chemicals, including pool chemicals, have some level of toxicity. The toxicity depends on the specific product and route of exposure (swallowing, breathing, or touching). Each product has a **signal word** on its label describing the acute, or short-term, toxicity of the mixture in the bottle.

Pool chemicals can cause injury if they get onto the skin or eyes, or if they are inhaled or ingested.⁵ Most pool chemicals are irritating or corrosive if they get on the skin or in the eyes.⁶⁻¹⁰ Skin sensitization is an allergic reaction after repeated contact

with a substance. Researchers found that PHMB can act as a skin sensitizer.⁸ Some animal testing showed halohydantoins to be skin sensitizers while others did not.¹⁰

The risk of exposure is highest when mixing and applying. Consider taking the precautions listed above and **always follow the label** to reduce risk of exposure. If anyone is exposed, follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222.

Table 1: Acute toxicity of active ingredients commonly found in pool chemicals

	Sodium and Calcium Hypochlorite salts ^{6,11}	*Chlorinated isocyanurates ⁷	**Halohydantoins ¹⁰	Polyhexamethylene biguanide (PHMB) ⁸	Sodium bromide ⁹
Acute Oral	Low to very low toxicity	Low toxicity	Moderate to very low toxicity	Low toxicity	Low toxicity
Acute Inhalation	Calcium hypochlorite - Low toxicity	Testing not required	Moderate toxicity	Low toxicity	Study not available
Acute Dermal	Moderate toxicity	Low toxicity	Low to very low toxicity	Low to very low toxicity	Low toxicity
Primary Eye	Corrosive	Corrosive	Corrosive	Moderate to corrosive irritant	Mild irritant
Primary Skin	Corrosive	Mild irritant	Corrosive	Slight to moderate irritant	Low toxicity

*Chlorinated isocyanurates include five chemicals: dichloro-s-triazinetrione, potassium dichloro-s-triazinetrione, sodium dichloro-s-triazinetrione, trichloro-s-triazinetrione, and sodium dichloro-s-triazinetrione dihydrate. These chemicals react to form isocyanuric and cyanuric acid, which slow the breakdown of chlorine in sunlight.⁷

**Halohydantoins include the active ingredients dichlorodimethylhydantoin, bromochlorodimethylhydantoin, dichloroethylmethylhydantoin, dibromodimethylhydantoin, and bromochlorodimethylhydantoin. After applying to water, these chemicals break down and release chlorine and/or bromine which react with water to form hypochlorous acid or hypobromous acid. These are the chemicals that function as antimicrobials.¹⁰

What about the health effects of chlorine?

Chlorine is a gas used to make disinfectants like bleach (sodium hypochlorite) and other swimming pool chemicals. Pool chemicals do not always release chlorine gas. However, they can do so, especially if they are used improperly. When inhaled, chlorine is irritating to the eyes, nose, and throat. Inhaling chlorine gas can cause coughing and lung damage.¹²

Chlorine can lead to the development of chloramines. Chloramines can cause health effects in swimmers such as skin and eye irritation. They can also cause coughing, wheezing, and asthma attacks in sensitive individuals.¹³ They form because of the reaction between chlorine and other substances, including



Photo credit: 12019, Pixabay

water. When pool chemicals containing chlorine are added to water, the chlorine dissolves to form hypochlorous acid and hypochlorite anion, which disinfect the water.¹⁴ The hypochlorous acid and hypochlorite ions can combine with organic waste products such as dirt, cosmetics, urine, feces, and sweat to form chloramines.¹⁵ Chloramines off-gas from the water. They are heavier than air and tend to build up in the air above and surrounding pool water. This could expose swimmers and others in the area. Chloramines may build up to high levels in indoor pools without good ventilation.¹³

Consider following the tips below to reduce buildup of chloramines:¹⁶

- Shower, or require others to shower, before entering the pool.
- Closely supervise children to keep urine and feces out of the water.
- Don't swim or allow others to swim if sick with diarrhea.
- Monitor total chlorine and free chlorine levels closely.
- Reduce exposure to chloramines by bringing outside air into the swimming area, or swimming in well ventilated areas.¹³

Are common pool chemicals likely to contribute to the development of cancer?

Like any chemical, pool chemicals have different risks of contributing to cancer, depending on the specific chemical. See our fact sheet "[Can pesticides cause cancer?](#)" for more information about cancer classifications and determining cancer risk.

Table 2: Carcinogenicity of pool chemicals

Active Ingredient	Cancer Classification
Hypochlorite salts (includes sodium and calcium hypochlorite)	*Not classifiable ¹⁷ Can form trihalomethanes which are possible carcinogens ¹⁸
Chlorinated isocyanurates	*No carcinogenic effects or not classifiable ^{7,19}
Halohydantoins	No evidence of carcinogenicity ¹⁰
Polyhexamethylene biguanide (PHMB)	*Not classifiable ⁸
Sodium bromide	Can form bromate, a known carcinogen ^{9,20}

*When scientists don't have enough data to determine if certain chemicals can cause cancer the chemicals are classified by authoritative bodies as "not classifiable."

- **Hypochlorite Salts (includes sodium and calcium hypochlorite):** The International Agency for Research on Cancer (IARC) determined that hypochlorite salts are "not classifiable as to their carcinogenicity to humans."¹⁷ However, hypochlorite salts form byproducts called trihalomethanes. IARC classifies some of these byproducts as possible human carcinogens.¹⁸ The EPA has set maximum contaminant levels for trihalomethanes in drinking water to mitigate this risk.⁶
- **Chlorinated isocyanurates:** Scientists fed rats large amounts (up to the limit of solubility in water) of the active ingredient for two years. They did not find carcinogenic effects at any of the doses tested.⁷ The EPA considers chlorine as "not classifiable as to human carcinogenicity." They also did not find evidence that hypochlorous acid or hypochlorite ions are carcinogenic. Chlorinated isocyanurates generate hypochlorous acid in water.¹⁹
- **Halohydantoins:** Laboratory studies found no evidence of carcinogenicity or gene mutations. The EPA considers the breakdown product 5,5-dimethylhydantoin "not likely" to be a carcinogen.¹⁰
- **Polyhexamethylene biguanide (PHMB):** The EPA has classified PHMB as having "suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential." Studies indicate that PHMB does not cause gene mutations.⁸

- **Sodium bromide:** Sodium bromide may form bromate when exposed to UV light. Bromate is a known human carcinogen.^{9,20}

How do I store and dispose of pool chemicals?

Many pool products are very reactive chemicals. Use care to **store** and **dispose** of them properly. Always follow any storage instructions on the product label, along with these tips:⁵

- Keep all products tightly sealed to avoid any contact with water. Consider storing products with waterproof covers on packaging.
- Store products elevated off the ground away from doors and windows to avoid potential contact with wet floors, and open or leaky windows.
- Carefully inspect product containers and lids for damage after use.
- Never allow pool chemicals to mix. The most common pool chemicals are incompatible with each other. Mixing can cause dangerous chemical reactions that cause fires or release toxic gasses.
- Always store products in their original packaging.
- Take care to keep products separate during disposal.
- Consult your **local household hazardous waste** collection center for more information on proper disposal.



photo credit: Pexels

How do pool chemicals behave in the environment?

Sodium hypochlorite and calcium hypochlorite break down very quickly. When exposed to oxygen they react with organic matter and convert into sodium chloride (table salt) and calcium chloride (road salt).⁶

Pool chemicals and treated pool water often contain high levels of chlorine, or other antimicrobial ingredients. The treated water can harm fish and other aquatic life if discharged in a way that allows it to reach surface water. Discharging pool water onto the ground may damage plants and animals and may drain to streams or ponds.²¹

Before discharging, consider contacting your local wastewater service provider, water authority, city government, or state environmental agency for guidance. Precautions may be required. These can include holding the water to reduce product concentration, ensuring the water stays on your property, and taking care to prevent the creation of odors or potential mosquito breeding grounds.²¹ Best practices for discharging your pool water can vary depending on your community. If you have questions, contact your **state environmental agency**.

Where can I get more information?

For more detailed information about pool chemicals please see the list of referenced resources below, call NPIC Monday - Friday, between 8:00am - 12:00pm Pacific Time (11:00am - 3:00pm Eastern Time) at 800-858-7378, or visit us on the web at <http://npic.orst.edu>. NPIC provides objective, science-based information about pesticides.

Please cite as: Foss, C.; Gervais, J.; Cross, A.; Cocks, M.; Mermer, S. 2024. Pool Chemicals; Oregon State University Extension, National Pesticide Information Center, Oregon State University Extension Services. <http://npic.orst.edu/factsheets/pool-chemicals.html>

Date Reviewed: January 2024

References

1. *Pool Chemical Safety*; Centers for Disease Control and Prevention: Atlanta, GA, 2023.
2. *Recreational Water Illnesses*; Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health: Atlanta, GA, 2020.
3. *Use of the Term "Shock" in Swimming Pool, Hot Tubs, and Spa Products*; U.S. Environmental Protection Agency, Antimicrobials Division, U.S. Government Printing Office: Washington, DC, 2023.
4. *NPIC Product Research Online (NPRO): Zinc Sulfate Monohydrate*; National Pesticide Information Center, Corvallis, OR, 2023.
5. *Safe Storage and Handling of Swimming Pool Chemicals*; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 2001.
6. *RED Facts for Sodium and Calcium Hypochlorite Salts*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 1991.
7. *Reregistration Eligibility Document (RED) for Chlorinated Isocyanurates*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 1992.
8. *Reregistration Eligibility Decision (RED) for PHMB*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 2004.
9. Leighton, T.; Shamim, N.; Walls, C. *Sodium Bromide: Residential and Dietary Antimicrobial Uses (Pools, Spas, Sugar Beets, and Fruit & Vegetable Wash)*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 2005.
10. *Reregistration Eligibility Decision (RED) for Halohydrantoin*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 2007.
11. *Reregistration Eligibility Document (RED) for Sodium and Calcium Hypochlorite Salts*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 1992.
12. *Chlorine - ToxFAQs*; Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry: Atlanta, GA 2007.
13. *Chloramines and Pool Operation*; Centers for Disease Control and Prevention: Atlanta, GA, 2022.
14. *Toxicological Profile for Chlorine*; Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry: Atlanta, GA, 2010.
15. Manasfi, T.; Coulomb, B.; Boudenne, J.-L. Occurrence, Origin, and Toxicity of Disinfection Byproducts in Chlorinated Swimming Pools: An Overview. *Int J Hyg Envir Heal* 2017, 220, 591–603.

POOL & SPA CHEMICALS

TOPIC FACT SHEET

16. *Chemical Irritation of the Eyes and Lungs*; Centers for Disease Control and Prevention: Atlanta, GA, 2019.
17. *Summaries & Evaluations: Hypochlorite Salts (Group 3)*; International Agency for Research on Cancer (IARC): Lyon, France, 1997.
18. *Some Chemicals Present in Industrial and Consumer Products, Food and Drinking-Water*; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 101; International Agency for Research on Cancer (IARC): Lyon, France, 2011.
19. *Reregistration Eligibility Decision (RED) for Chlorine Gas*; U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, U.S. Government Printing Office: Washington, DC, 1999.
20. DeAngelo, A. B.; George, M. H.; Kilburn, S. R.; Moore, T. M.; Wolf, D. C. Carcinogenicity of Potassium Bromate Administered in the Drinking Water to Male B6C3F1 Mice and F344/N Rats. *Toxicol Pathol* 1998, 26 (5), 587–594.
21. *Disposing Chlorinated Water from Swimming Pools and Hot Tubs*; State of Oregon, Department of Environmental Quality: Portland, OR 2017.

