

Mixing Bleach and Ammonia – Here's What Happens

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Mixing bleach and ammonia produces toxic vapors that can incapacitate or kill you. (image: jeshoots.com)

Bleach and ammonia are two useful cleaners, but mixing them produces toxic vapors and could potentially kill you. Even if you don't intentionally mix bleach and ammonia, there are sneaky ways for the reaction to occur. For example, it can happen by mixing cleaners (never a good idea) or by adding bleach to a dirty swimming pool or [cat litter box](#).¹ Here's a look at the chemicals produced by the reaction, the symptoms to watch for, and what to do if you think you've been exposed.

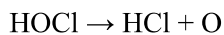
Chemicals Formed by Mixing Bleach and Ammonia

Mixing bleach and ammonia results in a solution containing the following compounds. Note all of the products are toxic except for salt and water.

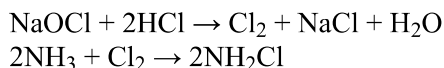
- NH_3 = ammonia
- HCl = hydrochloric acid
- NaOCl = sodium hypochlorite (bleach)
- Cl = [chlorine](#)
- Cl_2 = [chlorine gas](#)
- NH_2Cl = chloramine
- N_2H_4 = hydrazine
- NaCl = sodium chloride or salt
- H_2O = water

Here's how the chemical reactions may proceed. First, bleach (NaOCl) reacts with hydrogen from ammonia (NH_3) to form hydrochloric acid (HCl):





Bleach reacts with hydrochloric acid to produce chlorine gas, salt, and water. Ammonia reacts with chlorine to make chloramine (NH_2Cl), which is a gas.



Normally, chloramine is the main product from the mixture. However, if there is an excess of ammonia (which depends on the ratio of your mixture), liquid hydrazine (N_2H_4) may form.² Hydrazine is toxic, plus the reaction is exothermic. Under the right conditions, the mixture can boil and spray hot, toxic liquids.



If there is enough hydrazine, the mixture can explode. This is highly unlikely, although theoretically possible if enough gets produced and the temperature gets high enough.

Symptoms of Exposure

Bleach and ammonia are noxious on their own and irritate the eyes, mouth, skin, and lungs. Chlorine and chloramine are also respiratory irritants. Hydrazine causes respiratory irritation, nausea, headaches, edema, and seizures.³ Ultimately, the mixture damages the esophagus, bronchioles, and lungs. Mixing bleach with cleaning products [can cause unconsciousness](#) and death.⁴

What to Do If You're Exposed

- Immediately seek fresh air if you feel light-headed, nauseous, have trouble breathing, or feel irritation. Call 911, or if you feel your condition isn't that serious, dial Poison Control (1-800-222-1222) for advice on treatment and cleanup.
- If you find an unconscious victim, call 911 and then Poison Control (1-800-222-1222). Do not hang up on 911 until instructed to do so.
- After you call, you may be able to move the victim to a well-ventilated area, but if the fumes are too strong, try to ventilate the area and wait for help to arrive. If you do move the victim, be aware the person's hair, skin, and clothes may be covered in toxic chemicals.
- Usually, bleach and ammonia mixtures occur outdoors or in a kitchen or bathroom. Thoroughly ventilate the area before returning for cleanup.

References

1. Lawrence, Stephen A. (2004). *Amines: Synthesis, Properties and Applications*. Cambridge University Press. ISBN 9780521782845.
2. "[Toxicological Profile for Hydrazines](#)." Toxic Substances, Agency for Toxic Substances & Disease Registry. Center for Disease Control.
3. "[Protect Yourself: Cleaning Chemicals and Your Health](#)." OSHA Publication No. 3569-09, 2012.
4. "Accidental mix of bleach and acid kills Buffalo Wild Wings employee." *Chemical and Engineering News* 97:45, November 13, 2019.