

H2O2 + baking soday yields?

September 8, 2010 2:52 PM [Subscribe](#)

Hydrogen peroxide + baking soda = ????

Following what appear to be standard instructions on how to clean the coffee stains from a stainless steel thermos, I mixed a cup of hydrogen peroxide and a few tblsp baking soda. Then screwed on the plastic cap, shook a few times and went away for half hour. Releasing the cap resulted in a pressurized spray.

This must be a pretty simple reaction, but my knowledge of chemistry is ancient.

What's causing the pressure ?

Thanks

posted by [Kevin S](#) to [Home & Garden](#) (22 answers total) 1 user marked this as a favorite

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Hydrogen peroxide is acidic. Any acid will react with baking soda to make carbon

dioxide.

posted by [Dr.Enormous](#) at **2:57 PM** on September 8, 2010

I barely remember my chemistry, but doesn't it also produce some kind of salt when you mix an acid with a base?

posted by [1000monkeys](#) at **3:07 PM** on September 8, 2010

It goes something like:

Peroxide + Baking Soda = Sodium Hydroxide, CO2 and water

$H_2O_2 + 2CHNaO_3 = 2NaOH, CO_2, H_2O.$

posted by [kuujjuarapik](#) at **3:18 PM** on September 8, 2010 [[1 favorite](#)]

Sorry, my equation is unbalanced. But I think those are the correct products.

posted by [kuujjuarapik](#) at **3:20 PM** on September 8, 2010

I would be surprised - possibly litigious - if the instructions specified that you should leave the cap on. This is meant to be a fizzing cleaner, similar to what I've seen recommended for stopped drains and the like.

(Also it's related to Oxyclean, but some more chemistry-minded person will have to clarify that if possible.)

posted by [ErikaB](#) at **3:20 PM** on September 8, 2010

Hydrogen peroxide is acidic. Any acid will react with baking soda to make carbon dioxide.

But hydrogen peroxide **isn't** an acid. It has a pKa around 12.

Hydrogen peroxide naturally decomposes into H2O and O2 and does so faster in alkaline solution (your baking soda).

$2H_2O_2 \rightarrow 2H_2O + O_2$

I'd guess that the gas in your container was O2 gas that had been produced. I know when you store stronger solutions of hydrogen peroxide, you need to keep it in a vented container because of O2 gas that builds up.

posted by [rancidchickn](#) at **3:25 PM** on September 8, 2010 [[1 favorite](#)]

Reaction of sodium bicarbonate with hydrogen peroxide and some properties of the compound $Na_2CO_3 \cdot 1.5 H_2O_2$

posted by [RichardP](#) at **3:43 PM** on September 8, 2010

It isn't acidic, its caustic (PH higher than 7) which cleans somethings really well, better than an acid. BTW this mixture is also the best for removing offensive odors-like skunk spray, especially if you also use a little dish soap to dissolve the oil. But it can bleach cloth so be careful.

posted by [bartonlong](#) at **3:58 PM** on September 8, 2010

Thanks everyone.

ErikaB, not in the instructions (i.e., web page) to leave cap on, just my dumbness.

posted by **Kevin S** at **4:03 PM** on September 8, 2010

Note: I finally spent my \$5 because after lurking here the answers to this question were driving me insane. Also, my numbers are not exact, but good enough for lazy ballpark science. IANAScientist by trade, just by experience.

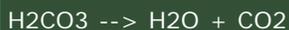
The problem is that your "cleaning experiment" did two reactions, not one. The hydrogen peroxide you used is likely purchased at a grocery, and hence 3% hydrogen peroxide, meaning the other 97% (roughly) was water. Even more water if the H2O2 was old as H2O2 degrades naturally in the following reaction:



So now you have two potential reactions, peroxide plus sodium bicarbonate, or water plus bicarbonate. The fastest reaction in this case will be water and sodium bicarbonate:



Carbonic acid degrades quite readily:

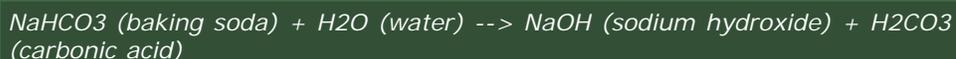


The gas release was mostly CO2. In fact, you had roughly 1/2 mol of CO2 (3 Tbsp of sodium bicarbonate is roughly 40g, which is roughly 1/2 mol) and 1/2 mol CO2 will generate nearly 11 liters of CO2 at standard temp/pressure. Not all of the CO2 will be generated as many of the reactions are incomplete reactions. Also, the vapor pressure caused by the cap on the bottle will have caused CO2 to dissolve in the water.

You only had 3% H2O2 in what was approximately 8 ounces of water. Rough estimation puts that around 450g water, of which 3% or 15g was H2O2. This is roughly .3 mol of H2O2, and because of the reaction, you will only get .15 mol of O2 or two liters of oxygen if all of it reacted (again, incomplete reactions) and got out of solution.

Final result: Carbon dioxide in a reaction of NaHCO3 with water made most of the gas. Oxygen was a small (>10%) component at most. The reason they have you mix the two is that you have a weak solution of sodium hydroxide as well as the oxidizing power of H2O2 to kill off any nasties in your water container.

posted by **Mister Fabulous** at **4:09 PM** on September 8, 2010 [[13 favorites](#)]



If this were true, baking soda would release CO2 every time you dissolved it in water. This just isn't the case.

Also, pKa is not the same as pH. Something with a pKa of 11.6 (H2O2) is still perfectly capable of functioning as an acid, though not a very good one. While it is true that protonated carbonates have a lower pKa--which would normally disfavor their protonation by peroxide--the increase in entropy upon the release of CO2 will make the reaction irreversible, and the difference in pKas is not so much that it can't happen at all. Therefore, it will proceed quite nicely.

Peroxide protonated carbonate. It dissociated.

posted by [Dr.Enormous](#) at **5:07 PM** on September 8, 2010 [[2 favorites](#)]

And if you doubt me, just google hydrogen peroxide and pH. About a gazillion hits will tell you that it is a weak acid ([here's one](#))

posted by [Dr.Enormous](#) at **5:14 PM** on September 8, 2010

If you want to engage in a simple bit of kitchen science, there are easy tests for carbon dioxide and oxygen. So first, re-create your original conditions.

Carbon dioxide will extinguish a lit match stuck into it.

To test for oxygen (pure, or at least much higher concentration than what is in the atmosphere), light a match and blow it out, but leave it at the point where there is still an ember glowing. It will re-ignite in the presence of oxygen.

posted by [DevilsAdvocate](#) at **6:07 PM** on September 8, 2010

Funny, my dental hygienist just recommended brushing with baking soda and hydrogen peroxide for keeping my teeth white. Hope I don't get the same explosive result!

posted by [platinum](#) at **8:05 PM** on September 8, 2010

So is it the NaOH that dissolves/removes the crud from inside wall of the container? And presumably the NaOH is completely removed by rinsing a few times so not harmful (I know you are not my chemist)?

posted by [Kevin S](#) at **9:35 PM** on September 8, 2010

As kids we used to mix these two in a discarded camera film tube, pop the cap on, shake it vigorously, and then throw it up in the air: presto, instant chemical firework fun.

Of course, then we realized throwing it at each other was more fun.

posted by [allkindssoftime](#) at **4:22 AM** on September 9, 2010

Yes, the NaOH is the stuff that cleans up the crud. It also readily dissolves in water, so a few rinses should remove it all.

posted by [kuujjuarapik](#) at **5:02 AM** on September 9, 2010

Thanks very much everyone. Those calculations bring back memories - not all bad.

posted by [Kevin S](#) at **6:40 AM** on September 9, 2010

Whoops, nevermind, that was vinegar and baking soda, not hydrogen peroxide. Sorry bout that.

posted by [allkindssoftime](#) at **8:10 AM** on September 9, 2010

In my experience, you can clean the coffee residue out of a thermos by filling it with boiling water and 3-4 heaping spoonfuls of baking soda. It still fizzes (coffee is acidic) so leave the lid off. Let it sit for 15 minutes. Repeat as necessary. It's never taken me more than 3 iterations.

posted by [leapfrog](#) at **11:11 AM** on September 9, 2010

allkindsoftime, yes I can remember the same thing with baking soda and vinegar. IIRC, we first poured in the vinegar, then a cone shape folded piece of paper into which went the baking soda. So the two ingredients remained separate until thrown and mixed as the container tumbled in the air. With a little luck, the "explosion" wouldn't happen till near high point of the flight - at least that was the objective.

posted by [Kevin S](#) at **11:35 AM** on September 9, 2010

Can you use this mixture to clean the crud out of ears? Water and hydrogen peroxide is wonderful and fuzzy satisfying. Adding baking soda seems like it could be a dream come true. Will it explode and blow out my ears?

posted by [Pennyblack](#) at **8:58 PM** on September 9, 2010

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