
Gummy bear demonstration: Safety

Chemistry Class Explosion Injures Seven

By Deborah Medenbach

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Recordonline.com (Time-Herald Record)

A chemistry class gone awry resulted in an explosion and HAZMAT teams being dispatched to the Onteora High School, NY...

School officials said a teacher was demonstrating interactions between potassium chlorate and food items when the unexpectedly strong reaction occurred. Less than three grams of potassium chlorate was involved. The chemical is used in the manufacture of safety matches and explosives.

Nearby classes reported hearing a sound like a loud door slam and the school's Quick Response Team responded immediately.

Seven students and the teacher were transported to area hospitals for treatment. The teacher and two students were treated for minor cuts and burns. The remaining students were checked for minor injuries.

Parents were contacted by school staff immediately ... students and staff were transported out of the building. ... Police determined that HAZMAT response was not needed for cleanup after the explosion...

<http://www.recordonline.com/apps/pbcs.dll/article?AID=/20100120/NEWS/100119639>

[*Dailyfreeman.com*, another online newspaper, reported the "explosion that was strong enough to damage windows, according to police and school district officials."]

The above excerpt should make any teacher who has performed the Gummy Bear Demonstration pause for thought. The material in this case was not a gummy bear but a stick of gum. We cannot comment on this specific case as it is still under investigation but it is an opportunity for chemical educators to reflect on safety procedures for this type of demonstration in a classroom setting.

We have gathered some safety advice and stories concerning potassium chlorate and the gummy bear demonstration. Some of these are part of an ongoing online discussion at <http://www.freelists.org/neact/> (NEACT – New England Association of Chemistry Teachers).

- The consequences of this type of accident might have been avoided! This demonstration is quite common in many chemistry classes. Potassium chlorate, KClO_3 , is a white solid that decomposes (i.e., breaks up) when heated above its melting point. The products are potassium chloride, KCl (which can be found in "salt substitutes" and in some medicines) and oxygen gas. When a food (generally gummy bears are used) is introduced into the hot potassium chlorate, the sugar in the candy ignites from the heat and oxygen-rich environment and creates a "blow torch" effect out the end of the test tube.

IF the test tube diameter is too small or IF the test tube contained impurities (i.e., it was not thoroughly clean) then the test tube can EXPLODE sending glass and hot contents everywhere.

At minimum, a portable blast shield should be placed between the demonstration and the students. Preferably the demo should be done in a fume hood with the sash pulled down. This way everyone, including the demonstrator, is protected in the event of an explosion.

Investigation will look at ALL aspects of this incident. It will not be "covered up". Lawyers will see to that!!! [The above was written as an online comment to the *Dailyfreeman.com* web report on the incident.]

Harvey Gendreau, 35 years in the classroom, now with the Laboratory Safety Institute, www.labsafety.org

- This is a very popular demo with the students and I have done this many times with the gummy bear with no problems. You heat a pyrex test tube with a small amount of KClO_3 over a Bunsen burner. It liquefies and decomposes. You can see a white cloud of gas moving up the test tube. At this point I do the oxygen test to show the kids the identity of the gas and then to finish it off, I throw a gummy bear in. A light purple flame that looks like a blow torch comes shooting out as the sugar reacts – it's a great demo that can demonstrate and review the oxygen tests, types of reactions, and even review the electron movement in the potassium atom causing the violet color!

My colleague was doing this same demo in the hood in front of her class when the oxygen produced got trapped under some liquefied KClO_3 and caused it to splatter outward violently. The teacher was burned on her hand and wrist by the molten KCl . Since it was in a hood no kids were hurt, but we started using heavy gloves when doing the demo. My school had the hood in the middle of the room so the kids could be on one side looking through the glass, while I was on the other with the glass partly up to reach in. That made it even safer for the kids — but unfortunately few rooms are set up that way.

Jerusha Vogel

President, New England Association of Chemistry Teachers (NEACT), www.NEACT.org

● Years ago, we stopped using potassium chlorate to prepare oxygen in the classroom. It was not safe to assume that students had properly cleaned and dried their test tubes without using any paper towels or other material that could be easily oxidized. There were numerous reports of explosions, although I never experienced anything more than a small spark in the reaction test tube.

I have personally done the molten potassium chlorate experiment in the past, but I always used a small quantity of potassium chlorate, a small piece of a wood splint and a heavy wall ignition tube. The reaction was always performed behind a safety shield. Students were moved to at least 10 yards away. I did stop performing that experiment in the early 1980s, along with many fire, smoke, and small explosion-type reactions. The main reason was that I was doing a lot of outreach to schools and public groups and was concerned about students' and the public's perception of chemistry as always "blowing things up". I'm concerned that a report states that the teacher dropped a "stick of gum" into the test tube and that the district superintendent stated "it is a standard high school chemistry experiment and that teacher had executed each of its steps properly". I think an attorney will have a very different view of the matter.

Whatever the reason for the explosion, this incident is an excellent reason that all science teachers must have adequate safety training as part of their college education, the correct safety equipment (such as safety shields, proper vessels suitable for demonstrations and experiments, etc.), and we should be considering restricting certain demonstrations rather than just listing chemicals that can be hazardous.

For those of you who do go out to schools or provide workshops to teach proper safety, thank you! Keep up the good work. Maybe we can stop more of these incidents from happening.

David Katz
Department of Chemistry
Pima Community College, Tucson AZ

● I think I have a possible cause for this high school chemistry class accident. I asked one of our researchers here who was a former food science chemist. She said that if the teacher used the SOUR flavor, they may have set up an incompatible reaction.

Tartaric acid has been used in the food industry to make the "sour" taste for gums and candy. The JT Baker MSDS for KClO_3 <http://www.jtbaker.com/msds/englishhtml/P5620.htm>, specifically lists tartaric acid as an incompatible material. The MSDS states "Incompatibilities: Iodides, tartaric acid, aluminum, sulfuric acid, hypophosphite, powdered metals, organic matter and many other oxidizable substances." It is also possible that all of the candy/gum wrapper was not removed and that caused a more vigorous reaction than anticipated.

This experiment, which appears to be common in high school chemistry classes, should have the following safety instructions included for all who demonstrate this reaction:

1. Read the MSDS for all chemicals before you use them. Make sure to read more than one manufacturer's MSDS — not all listed the specific chemical incompatibilities.
2. Do not use the SOUR flavor for the candy.
3. Check all glassware for any nicks, scratches, etc. Do not use if present. [New glassware is best.]
4. Use a plexiglass or lexan shield between the students and the demonstration. These shields can be purchased from Fisher, Flinn or other companies. They are expensive, but can be made relatively cheaply — buy a large sheet of lexan or plexiglass (5 to 20 mm thick) and ask the Tech teacher to cut it and mount it on a metal base. Remember that the OSHA Lab Standard (Occupational and Safety Health Administration) requires written protocols for all experiments. These protocols must include the safety requirements!

Kim Auletta
Lab Safety Specialist
Stony Brook University, Stony Brook NY

● One demonstrator remembered some undergraduate students practicing this exciting experiment for a chemistry show. These undergrads were using culture test tubes — these test tubes melted with the heat generated and became droopy. These students had found this demonstration online and did not realize that although it is exciting, it comes with risks. Luckily they were informed to use only new pyrex test tubes and to do it behind a safety shield. Even test tubes that have been cleaned can have invisible cracks.

Jean Hein, Editor
Chem 13 News

Remember: Potassium chlorate is a strong oxidizer. Use care when heating it. Wear insulated gloves, lab coat, and goggles. Be sure to set up a safety shield between the reaction and the audience. Be sure to put a fireproof tile below the reaction. Have a fire extinguisher handy.

Use only small amounts KClO_3 and read over all the safety instructions.

There are many examples of YouTube videos of the reaction of potassium chlorate with various candies. See this one using a candy cane. Sugar counts as organic matter and this is the result. http://www.youtube.com/watch?v=bbO-1C_BP_k

Serendipity played a role in this article. We had planned to have this “Gummy bear: Before and After” photo in the April issue. It was submitted by one of our 2009 photo contest winners, Katie Hodgkins. Katie was one of the few students who entered our contest. Her enthusiastic description reminds us why teachers continue to do these demonstrations in their classroom.



Katie Hodgkins, a sophomore at Scituate High School in Scituate, Massachusetts submitted the above photo with the following description:

In our Chemistry I Honors class, we did an experiment wherein Mrs. Ward melted some potassium chlorate and then lowered an innocent green gummy bear to its burning demise. (Our Assistant Principal had the privilege of lowering the gummy bear to the molten potassium chlorate, of which I captured the entire spectacle on film.) Immediately, the test tube was aflame and the sugar-based bear, now on fire, was sent spinning around the bottom of the test tube. Eventually, he was spun so fast that he was shot out of the test tube. This picture is what was left of the poor fellow.

Katie's chemistry teacher, Nancy Ward described her safety precautions:

It is done in the hood. I work from the back of the hood while wearing gloves, goggles and a lab coat. The hood is only open enough to allow my hand in. The students have to stand about ten feet from the front of the hood which is closed. They also must wear safety goggles. Once the potassium chlorate is ready, the hood shield is completely closed, and the gummy bear is lowered by a string that is threaded up through the top of the hood.

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