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TOASTING A GUMMY CANDY

A photo taken at MIT 150th Celebration Open House Under the Dome April 30, 2011. Courtesy of Nathan Sanders. Used with permission.

Abstract

A gummy bear candy is oxidized using $KClO_3$ as the oxidizing agent in a dramatic reaction, which releases a large amount of energy and results in the formation of harmless products KCl, CO_2, and H_2O.

Materials

Gummy Bear Candy	25mm Heavy-Walled Borosilicate Test Tube
Potassium chlorate, $KClO_3$	Cast Iron Support Stand for Test Tube Clamp
Spatula	Test Tube Clamp
Explosion Shield	Portable Butane Burner or Lab Burner
Long laboratory tweezers	Face shield

Safety

Potassium chlorate is a strong oxidizer, which could ignite if placed into contact with other materials. It is a known skin, eye, and respiratory tract irritant. Potassium chlorate should always be fresh and weighed on a balance right before using it. It's a good idea to mass it directly into the test tube you are going to use in this experiment and cover the opening with paraffin wax paper to protect the contents from any contamination.

Procedure

Mass out approximately 5 grams of potassium chlorate into a 25 x 200 mm heavy walled borosilicate glass test tube. Place some paraffin wax on the open end of the test tube until you are ready to start. Clamp the test tube with a metal test tube clamp as close to the open end as possible. Angle the tube on the cast iron support stand so that it rests at about a 60-65 degree angle. Place the tube behind an explosion shield making sure that the open end is pointing away from any spectators. This reaction should be run in a vented laboratory hood if possible. When ready to begin, put on a face shield and remove the paraffin wax from the test tube. Begin to heat the closed end of the test tube containing the potassium chlorate. Rotate the burner gently with the flame touching the test tube until the potassium chlorate begins to melt around 350 ^{0}C. A molten mix of KCl and pure oxygen is released from the $KClO_3$. Continue to heat the $KClO_3$ until it melts and no crystals remain. This is important as leaving any solid $KClO_3$ in the test tube at the start of the reaction may cause it to eject violently from the tube. Once the $KClO_3$ is melted, shut off the burner and use a long pair of laboratory tweezers to pick up one gummy bear. In one quick motion push the gummy candy into the tube. The reaction starts instantly.

Discussion

The dramatic reaction produces fire and smoke. It almost smells like burnt marshmallows. The gummy bear is sucrose $C_{12}H_{22}O_{11}$, which is the source of fuel for the reaction. The first reaction produces the molten KCl and a rich oxygen environment. As soon as the gummy sugar is added, it ignites in the rich oxygen environment leading to the combustion reaction producing harmless CO_2, H_2O and lots of energy. The reaction feeds on itself producing more oxygen until the gummy sugar is consumed. The sequence of reactions is as follows:

Gummy Candy Combustion Reaction

Disposal

The test tube in this reaction is left completely charred and blackened with everything consumed in the reaction. The test tube can be safely disposed of into a laboratory broken glass waste container.

References

Bob Dayton, Tom Annacone, (1988) Lee Meriwether, Princeton Summer Institute Revised version by Mark Case, CHEM6 TORCH Binder, 1995.

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