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Exploding Gummy Bears

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Introduction:

Gummy Bears on Fire!

In this experiment, a demonstration of a spontaneous exothermic reaction will take place between a gummy bear and molten potassium chlorate. Once the potassium chlorate has been melted in a test tube, a gummy bear will be dropped to his doom and flames will burst out of the tube as a result.

What's Really Going On...?

Gummy Bears are mostly made up of sugar. Sugar is also known as sucrose in organic chemistry. Sucrose is a disaccharide made up of two monosaccharide molecules known as glucose and fructose. Below is the structure for Sucrose.

On the left side of this molecule is the part of the structure that's made up by glucose. The right side is fructose. They are bonded in the middle by the oxygen. This bond is called a glycosidic bond, which just means that it is a covalent bond that bonds carbohydrates to another group. This other group can also be other carbohydrates, like we have seen above.

What are carbohydrates? They are organic molecules that only contain carbons, hydrogens and oxygen atoms. Carbohydrates are also known as sugars.

Okay, now that you know some background information, let's talk about what's going on. When the potassium chlorate is heated, it decomposes into potassium chloride and oxide, as seen below:

$$2KClO_3(s) \Longrightarrow 2KCl(s) + 3O_2(g)$$

When the gummy bear is dropped, the oxide from the decomposition of potassium chlorate reacts with the glucose molecule in sucrose. This reaction is a spontaneous combustion reaction:

$$C_6H_{12}O_6\,(s) + 6O_2\,(g) \Longrightarrow 6CO_2(g) + 6H_2O\,(g)$$

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The overall reaction is seen below:

$$C_{12}H_{22}O_{11}\,(s) + 8KClO_3\,(s) \longrightarrow 12CO_2\,(g) + 11H_2O\,(g) + 8KCl\,(s)$$

This reaction is an exothermic reaction because energy is released, in the form of heat, which can produce light, as seen by the purple hued flames. Hope you enjoyed this demonstration! Please answer the following questions and take note of any observations. **Turn in only the LAST page to your professor & Thank-you!**

Materials:

1. Safety first! Wear safety glasses
2. Plastic Shield
3. Gummy Bears
4. Potassium Chlorate (About 5-7 grams)
5. Pyrex Test Tube
6. Ring Stand with Clamp
7. Bunsen Burner
8. Matches
9. Tongs
10. Fume Hood or Snorkel

Safety:

WARNING! Do not stand near experiment, and always remain on the outside of the fume hood. Viewers must stay behind demonstrators at all times for safety precautions. Those who are sensitive to light should avoid this demonstration.

Procedure:

1. Weigh out 6.0 grams of potassium chlorate and put in the test tube.
2. Place test tube on ring stand under a fume hood or snorkel. Be sure that the test tube is pointed away from demonstrator and audience.
3. Set up the Bunsen burner under the test tube.
4. Heat the potassium chlorate until it is a complete liquid.
5. Drop the gummy bear in the test tube, stand back, and enjoy the show.

Data and Observations:

Potassium chlorate before heat and reaction	
Potassium Chlorate after heating	
Gummy bear before reaction	
Reaction: when gummy bear is dropped in the molten potassium chlorate	

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After reaction is complete	

Questions:

1. What type of reaction is this?(circle one)

   Endothermic Exothermic None

2. Is this a redox reaction?

   a. If yes what is oxidized and what is reduced?

   b. If no, why is it not a redox reaction?

3. What types of chemical reactions took place in the gummy bear experiment? (Check all that apply)

Combustion	
Synthesis	
Decomposition	
Single Displacement	
Double Displacement	
Acid-Base	
Oxidation-Reduction	

References:

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3. Rapid Oxidation of Sugar with Potassium Chlorate. http://www.dynamicscience.com.au/tester/solutions/chemistry/chemicaldemos/sugarandkclo.htm (April 10, 2013).

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