Endothermic Reactions

«««« By James Palcik
James Palcik is the owner of Palcick Educational in Ancaster, Ontario. This activity is from the *Whiz, Bang, Boom Demos for Science* conference session, delivered by James at STAO 2012. Activity from Innovating Science TM by Aldon Corporation, copyright 2008. Used with permission of Palcick Educational.

Curriculum Connection: Grade 10 Chemistry, Academic and Applied; Grade 11 and 12U Chemistry.

Student Activity

This activity examines the concept of Energy Change in a Chemical Reaction.

Overview

A room-temperature white solid in a bag is exposed to water. Upon mixing, the material in the bag becomes cold to the touch. The reaction occurring in the bag is absorbing heat from the environment, causing the area around the reaction to become cold.

Contents

5 Bags containing Ammonium Nitrate and Vermiculite

Safety

Safety Goggles, Gloves, Lab Apron. Ammonium Nitrate may explode if contaminated and accidentally heated. Its dust is an irritant to eyes and lungs. Some boards recommend that Ammonium Nitrate be used by teachers only, and in small quantities, NOT by students. It is strongly recommended by STAO that this activity be done as a demonstration by the teacher, and not by the students.

Instructions

1. Put on your safety goggles and other safety equipment.
2. Obtain one bag containing ammonium nitrate and vermiculite.
3. Add 10 mL of distilled water to the bag and reseal it.
4. Squeeze and shake the bag to thoroughly mix the contents.
5. Observe any changes in the bag over time.

Real-world Chemistry

A cold pack can be as simple as a plastic bag full of ice cubes or liquid-filled plastic containers that are placed in a freezer until frozen solid. While effective, either ice cubes or frozen ice packs would have to be stored in a freezer.

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Endothermic reactions allow ice packs that can be stored at room temperature until "activated", at which point they become cold. However, since the reaction only lasts for a certain amount of time, there must be a way of preventing the reaction from occurring until necessary by keeping the reactants separate from each other.

Cold packs are actually constructed as a "pack within a pack". The outer pack contains water and the inner pack contains ammonium nitrate. When needed, the ice pack is hit sharply on the side, rupturing the inner pack. At this point, the reactants mix and within minutes the ice pack is ice cold.

Disposal

Dispose of ammonium nitrate in accordance to provincial and local regulations.

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Student Activity

This activity examines the concept of Energy Change in a Chemical Reaction.

Overview

Several components in a plastic bag are exposed to water. Upon mixing, a slow and steady evolution of heat occurs due to the oxidation of iron and reduction of oxygen in the presence of sodium chloride and calcium chloride catalysts.

Contents

5 Bags containing Iron Powder, Sodium Chloride, Calcium Chloride and Vermiculite

Safety

Safety Goggles, Gloves, Lab Apron

Instructions

1. Put on your safety goggles and other safety equipment.
2. Obtain one bag containing iron powder, sodium chloride, calcium chloride, and vermiculite.
3. Add 10mL of distilled water to the bag and reseal it.
4. Squeeze and shake the bag to thoroughly mix the contents.
5. Observe any changes in the bag over time.

Real-world Chemistry

Commercial heat packs take advantage of exothermic reactions. Though there are a couple of different reactions that heat packs may use, the most common is the oxidation of iron. Oxidation of iron is a slow reaction that generates a very small amount of heat. In order to increase the heat generated, a heat pack contains catalysts,

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usually some type of salt. A catalyst is something that speeds up a reaction. The oxidation of iron also requires oxygen. For this reason, heat packs are stored in sealed bags which do not allow oxygen to enter until opened.

When the heat pack is removed from the bag, it is squeezed and shaken to mix the ingredients. One more factor that enhances the reaction is water. The materials in the heat pack are moist. When removed, the iron, moisture, catalyst, and oxygen are all allowed to interact, starting an exothermic reaction that results in the noticeable production of heat in the area surrounding the heat pack.

Disposal

Dispose of iron powder in accordance to state and local regulations.