

Counting Bonds in a Cool Reaction

Endothermic and Exothermic Reactions



Introduction

Many reactions produce heat, in fact when people think of chemical reactions, heat production is often expected. However, endothermic reactions, reactions which consume heat, can be just as exciting. One of the most striking examples of this is when the solids barium hydroxide and ammonium thiocyanate are mixed together in a beaker.

Concepts

- Endothermic reaction
- Chemical bonds

Materials

Ammonium thiocyanate, NH_4SCN , 10 g	Stopper, solid, size 6
Barium hydroxide octahydrate, $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$, 20 g	Thermometer graduated to at least $-30\text{ }^\circ\text{C}$
Cardboard, about 3" square	Tongs
Erlenmeyer flask, 250-mL	Water, tap

Safety Precautions

Barium salts are toxic by ingestion. Ammonium thiocyanate is also toxic by ingestion. Use caution when handling the beaker or flask. Use tongs if available. The temperatures involved are cold enough to freeze skin. Ammonia vapor is very irritating to eyes and the respiratory tract. Do not allow students to inhale the gas. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information before beginning this activity.

Procedure

1. Transfer 20 g of barium hydroxide and 10 g of ammonium thiocyanate to a 250-mL Erlenmeyer flask and stopper.
2. In less than two minutes the solids become liquid. A thermometer placed in the mixture shows the temperature falling far below freezing. An ammonia odor is evident to all who are near the flask.
3. Place the flask in a small puddle of water and your students will clearly see just how cool this reaction is; the water will freeze the flask to the counter top. Alternatively, spray the outside of the flask with water from a wash bottle.

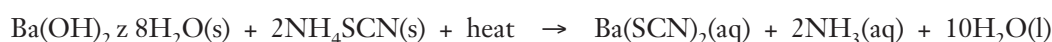
Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The barium thiocyanate product may be disposed of using Flinn Suggested Disposal Method #27h, conversion to barium sulfate compounds.

Discussion

This demonstration would be a great way to introduce the concept of heat as a reactant or product. In this reaction, heat is a reactant. It is absorbed from the surroundings as the reaction proceeds. The surroundings lose so much heat that water freezes!

The reaction between the solids is:



Counting Bonds in a Cool Reaction *continued*

This demonstration can be expanded into a lab on thermodynamics by using other ammonium salts. These include ammonium chloride (7 g) and ammonium nitrate (10 g). Have your energetic students (no pun intended) write the equations for these reactions.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

- Systems, order, and organization
- Evidence, models, and explanation

Content Standards: Grades 5–8

- Content Standard B: Physical Science, properties and changes of properties in matter, transfer of energy

Content Standards: Grades 9–12

- Content Standard B: Physical Science, structure and properties of matter, chemical reactions, interactions of energy and matter

References

Atkins, P. W. *General Chemistry*; W. H. Freeman: New York, 1989; p 188.

Shakhashiri, B. Z., *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; University of Wisconsin: Madison, WI, 1983; pp 10–12.

Summerlin, L. R., Ealy, J. L., *Chemical Demonstrations: A Sourcebook for Teachers*; American Chemical Society: Washington, DC, 1988; Vol. 1, p 66.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Counting Bonds in a Cool Reaction* activity, presented by DeWayne Leineman, is available in *Endothermic and Exothermic Reactions*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Counting Bonds in a Cool Reaction* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Cool Reaction—Chemical Demonstration Kit* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP8896	Cool Reaction—Chemical Demonstration Kit
B0155	Barium hydroxide octahydrate, 100 g
A0213	Ammonium thiocyanate, 100 g
GP3045	Erlenmeyer flask, 250-mL
AP2228	Stopper, Size 6

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.