Bouncing Around

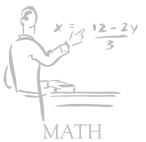
This is a lab activity I will definitely have my chemistry classes do again! There was much anticipation in the days that the bouncy-balls were curing. Which ratios would produce the best bounce?

10-12

GRADE LEVEL

ARTS

LANGUAGE



MATH

Misc

MISCELLANEOUS

SCIENCE

HISTORY

SOCIAL STUDIES

3

CLASS PERIODS

$580

TOTAL BUDGET

Curriculum/State Standard

Wyoming Science Content Standard
SCS#1: Students develop an understanding of scientific concepts using facts, theories, principles and models.

SCS#2: Students recognize patterns and processes, making connections in terms of systems and subsystems that explain the interrelationships of the natural and designed world.

SCS#3: Students demonstrate knowledge and skills necessary to perform scientific inquiry.

SCS#8: Students develop skills in using technology and recognizing the relationship between technology and science, including its potential and limits.

SCS#9: Students exercise care in scientific inquiry and recognize the importance of safety.

Overview

"Bouncing Around" was an effective way to introduce students to properties produced by polymer cross-linking. It was also my first time to e-mail lab write-ups back and forth to students. This took some additional time, but worked well. The chemistry class had a great time testing the bounciness of the balls they produced. It was a learning experience for both the students and myself. The students could hardly believe that I didn't know which ratio would produce the best bounce, and they could hardly wait to test their balls to find the answers.

Objectives

- Students will produce sample of elastomers and test its properties in the lab.
- Students will experience the role of the scientist by changing materials in experiments to create different elastomer properties.
- Students will discover the relationship between crosslinking and the properties of an elastomer.

Continued on the back...

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Kids In Need

THIS WINNING LESSON PLAN WAS SUBMITTED BY:

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"Bouncing Around" project continued...

Materials

Weigh boat, plastic wrap to cover equipment, aluminum foil, craft stick, hole-bored ping-pong ball, scissors, balance, RTV component kit

Readiness Activity

Students had previously studied natural polymers (carbohydrates, lipids, proteins, and nucleic acids) in biology, so only a review of polymer structure was necessary, along with introducing new cross-linking information.

Strategies/Activities

PART A: Making Samples With Different Amounts of Crosslinking

To determine what ratio of RTV base to curing agent will give you the most bounce you first need to know the base/catalyst mixing ratio by weight. Read the manufacturer's information sheet to see what ratios the 3110 RTV base should be mixed with the S-catalyst. Write them down.

Next, determine the ratio of the base to the curing agent that you will use. The math can be completed as follows:

Curing agent 1 x
____ = _____
base n 45g-x

1) First determine the whole number ratio you want (1:n). The curing agent should always be in amounts smaller than the base and n = any interger between 5 and 20. (example: n=11) Then calculate the x value.

2) Once the you have determined the amounts of base and curing agent, measure out the calculated quantities. Be careful! You will find both components very sticky. Measure out the base component first and then add the curing agent drop wise. Try to be as accurate as possible.

3) When you have obtained the appropriate amount of the two components, you must mix them completely or curing will not occur. This means AT LEAST 100 STROKES. When you have completed mixing set it aside for 5 minutes to allow the gas bubbles you have created to rise to the surface. Blowing gently across the surface will aid in removal of bubbles from the mixture.

4) While you are waiting you need to prepare a mold for your sample. It is a ping-pong ball that rests in a crumpled piece of Aluminum foil. Make sure you put your name on the ball!

5) When you are satisfied that the bubbles have been removed from the mixture, carefully pour the mixture to your mold. Again let the mixture sit for 5 minutes then give it to your teacher for curing.

Predictions and Questions:

1) Explain how the ratio of base to curing agent will effect the amount of crosslinking in the polymer.

2) Predict how the amounts of crosslinking will effect the physical properties of the polymer? Use your ratio and compared to two other ratios to discuss this difference.

3)Design a way to measure how well each of the different samples will bounce.

Testing Your "Super" Ball

1) To test the bounce of your ball you must first get it out of the mold. The shell can be cut away from the ball with a pair of sharp scissors. Be careful you don't slip and cut yourself. Excess polymer can be trimmed away with the scissors too.

2) To test the bounce of your ball, we will use a motion detector, LabPro and computer. Drop your ball from a height of one meter and record the height of the first bounce to the nearest centimeter. Record four trials and calculate the average.

My component ratio was _____.

Trial #1 _____ Trial #2 _____
Trial #3 _____ Trial #4 _____

Average Height _____

2) Collect results and compare with the rest of the class.

3) Make electronic graph(s) of your data and class data and attach to the lab questions.

Questions:

1) Do your results match your predictions? Why do you think so, or why not?

2) What ratio worked the best? Explain why this is so.

3) What is the relationship between the amount of crosslinking and the bounce of the ball?

4) Explain how the amount of crosslinking is responsible for the bounce?

EXTRA CREDIT=GOING FURTHER:

5) Compare your superball to a natural rubber ball. Which is better, natural or synthetic?

6) How are the polymer structures of the two balls (natural and synthetic) alike or different?

TEACHER NOTES for Activity Six: "Bouncing Around, the Sequel"

Students need to understand what a polymer is, how crosslinking is produced in the RTV system, and how stretching effects the entropy in a cross-linked polymer. I recommend completing other polymer activities that provide this knowledge prior to this lab.

Lab hints- I recommend the use of an electronic balance in this activity. You will want accuracy to 0.01 g. Because the components are messy, you should use plastic wrap to protect the surfaces of the balance and aid clean-up.

"Bouncing Around" project continued...

Where do I get RTV Silicone Rubber and S-Catalyst?

Ellsworth Adhesive Systems
N117 W18711 Fulton Drive
P.O. Box 1002
Germantown WI 53022-8202

Phone: 1-800-888-0698
Fax: 1-262-253-8619

Curing the PDMS- The samples that are produced by your students can be cured in two ways:

Oven Curing - heat samples for 20 minutes at 130 ° C.

Slow Curing - allow samples to sit for 2 days at room temperature.

The ratio samples are cured fastest using the oven method and would be available for the next day. We found that slow curing the balls minimizes the presence of bubbles in the finished product.