

Polymers and Toy Balls

Situation:

Your company has been contacted by a toy company. They have always specialized in toy balls made from vulcanized rubber. Recent environmental legislation has increased the cost of disposing of the sulfur and other chemical byproducts of the manufacturing process for this type of rubber. The toy company wants you to research some other materials.

Problem:

You need to do the following:

- synthesize each polymer
- make a ball from each polymer
- make observations about physical properties of each polymer
- measure the density of each ball
- measure how well each ball bounces
- calculate a production cost for each ball

Procedure:

- Ball 1:
1. Fill a tub about half-full of tap water.
 2. Using a clean graduated cylinder, measure 5 ml of liquid latex, and pour into a paper cup.
 3. Thoroughly clean the graduated cylinder and add 5 ml of distilled water to the latex in the cup.
 4. Measure 5 ml of 5% acetic acid solution, and pour it into the cup with the latex and water.
 5. Stir the mixture with a wooden stick immediately.
 6. As you stir, a "lump" will form around the stick. Pull the stick with the lump from the cup and immerse it into the tub of water
 7. While wearing gloves, gently pull the lump from the stick, keeping it under the water. Squeeze and roll the lump into a ball.
 8. Take the ball out of the water and allow it to dry.
- Ball 2:
1. In a clean graduated cylinder, measure 12 ml of sodium silicate solution, And pour it into a new paper cup.
 2. In a clean graduated cylinder, measure 3 ml of 50% ethanol. Pour it into the cup with the sodium silicate and stir with a new stick until a solid substance forms.
 3. While wearing gloves, remove the material from the cup. Squeeze and roll the material until a ball that does not crumble is formed. It may be helpful to moisten the ball with small amounts of water during formation

- Ball 3:
1. Measure 2.5 grams of borax and mix with 10 ml of water in a new cup until the borax is dissolved.
 2. Add Elmers Glue, approximately 5 ml, to the borax solution and stir and press the material until solid.
 3. With your hands, remove the material from the cup. Squeeze and roll the material until a ball is formed. *Wash.*

Observations and Measurements:

1. Observe as many physical properties as possible to be used in your recommendations.
2. Measure the diameter, in cm, of each ball and divide this by 2 to get the radius.
3. Calculate the volume of each ball using the formula: $\left(\frac{4}{3}\right) \times (\pi) \times (r^3)$
4. Measure the mass, in g, of each ball.
5. Calculate the density of each ball using the formula: $D = m/v$
6. Drop each ball from a height of 1 m, and record its bounce. Repeat 3 times.
7. Calculate an average bounce height.

Costs:

Using the given prices you will need to calculate the price of each ball.

Acetic acid solution	\$.0015/ml
Latex solution	\$.020/ml
Ethanol solution	\$.009/ml
Sodium silicate solution	\$.010/ml
Borax	\$.010/g
Elmers Glue	\$.020/ml

Report:

Use the attached form to make a report to the toy company.

Name: _____

The tables below show data collected and calculated in our study.

Density:

Ball	mass	volume	Density
Latex			
Sodium Silicate			
Glue & Borax			

Bounce:

Ball	Bounce #1	Bounce #2	Bounce #3	Average Bounce
Latex				
Sodium Silicate				
Glue & Borax				

Costs:

Latex Ball = \$ _____ /ball

Sodium Silicate = \$ _____ /ball

Glue/Borax = \$ _____ /ball

Recommendations: