

Scientific Method and Polymers

Purpose:

You will use the scientific method to determine the steps to prepare an organic polymer (Gak/slime) from reagents available in the home. You will examine the properties of the polymer.

Equipment and Materials:

10 mL Interior wood glue (a home liquid measuring cup should have mL)

Borax (Prepare by dissolving 1 tablespoon in 250 mL of warm distilled water. You will probably not use all of the borax solution in your sample of Gak/slime.)

Craft sticks/popsicle sticks or another stirring device

Glass cup

25 mL Distilled water

Device that will measure from approximately 10 mL – 80 mL (possible liquid measuring cup)

Safety:

Goggles are necessary to ensure eye safety.

Overview:

Scientific Method Overview:

1. Observe - Make observations
2. Question - Ask a question or identify a problem
3. Research - Search for existing answers or solutions
4. Hypothesis – Formulate hypothesis (educated guess)
5. Experiment – Design and perform an experiment
6. Test hypothesis – Accept or reject hypothesis
7. Draw conclusions – Make conclusions based on hypothesis
8. Report – Share your results

Experiments must be performed multiple times by more than one person to prevent bias.

Polymer Overview:

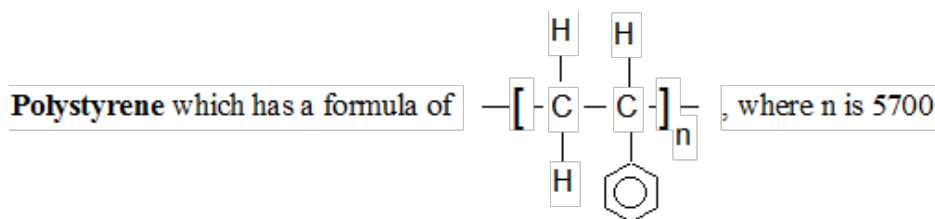
Polymers are chemicals having large molecular weights ranging from ten thousand to ten million. Close to 50 percent of all chemists work with polymers in some manner. Natural polymers include proteins such as wool and silk, wood and cotton cellulose, latex rubber and coal. Synthetic polymers such as polyethylene, nylon, and synthetic rubber are made from

monomers in a building process called polymerization. Such chain reactions, once initiated, tend to be very fast. The polymer strands may also be held together side-by-side in a cross-linked formation.

Physical and chemical properties of polymers depend on molecular weight, chemical structure, and intermolecular bonding forces. Polymers range from being soft and flexible to stiff and hard. Some, particularly the synthetic polymers, resist chemical action and are flame resistant. The general public frequently thinks of polymers as synonymous to plastics which, as can be seen from the examples given, is not always correct.

Some polymers like Silly Putty, Gak, etc. are viscous and elastic. Commercial Gak/slime will have similar but not identical properties of viscosity and elasticity.

As mentioned earlier, polymers are made by the polymerization of many monomers. Notice the monomer of polystyrene in the brackets below.



can be injected with air or pentane and molded into Styrofoam cups, coolers, and insulation. The acetone causes the polystyrene structure to partially collapse thus allowing the air or pentane to escape. The “n” indicates the number of monomers used to make polystyrene.

Procedures:

Use the equipment and materials given at the top of this lab document. The actual sequence of steps is not given to you for this lab. The purpose is for you to hypothesize the exact sequence while documenting, testing, and analyzing the resulting products.

You will produce Gak/slime by trial and error. If your first hypothesis doesn't work, try again until you get the correct sequence of steps and the correct amount of borax.

After you have produced Gak/slime, compare the following properties and record observations on report sheet.

1. Is it sticky?
2. Can it be molded? If so, roll into a ball between your hand using pressure. Does it bounce when dropped from a height of 2-3 feet? How high? (Include units)
3. Roll into a ball or pour onto a smooth, hard surface. Examine after 2-3 minutes. Does it retain its shape or flow into a puddle? Compare the size of the puddle to the original size, i.e., 2 x bigger, 3 x bigger, etc.
4. Move the puddle or emulsion to the edge of the desk so that a little hangs over the edge. Does it flow over the edge? If so, state slow or fast. Be prepared to catch the material.

5. Massage it into a ball and then roll it between your fingers until about 4 cm long. Pull apart slowly. Does it stretch? If so, state how far in inches or feet. The pieces can be massaged back into one piece.
6. Repeat Step 5 but pull apart abruptly. Compare results to Step 5. If it breaks, describe the broken ends.
7. Take a marble-size piece and hit it sharply with your finger. Does it mash or splatter?

Complete report sheet and make picture of yourself with the completed lab.

References

Shank, Lowell. Chemistry 101 Laboratory Manual.

PREPARATION OF POLYMERS FROM HOUSEHOLD REAGENTS

Report Sheet

Name _____ Date _____

Scientific Method Questions

1. How many hypotheses were proposed?
2. What is the correct sequence?
3. What 2 materials can change sequence?
4. What solidified the mixture?
5. Turn in the documentation of each trial.

Polymer Questions

6. Polymers are built from monomers by what process?
7. Name two natural polymers?
8. Is “Gak” a natural or synthetic polymer?
9. Is “Gak” a monomer or polymer?

	“Gak”
1. Sticky?	
2. Moldable? Bounce? How high? (Units required)	
3. Puddle after 2 min.? Size of puddle?	
4. Flow? (Slow, medium, fast)	
5. Slow stretch? How many inches or feet? (Units required)	
6. Describe ends when pulled apart abruptly.	
7. Mash or splatter? State which.	