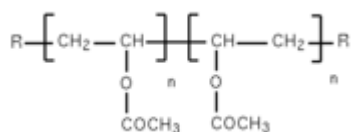


THE CHEMISTRY OF "SLIME" ACTIVITY

Background Information:

Slime is a fascinating substance that can be fun & educational. It is an example of how chemistry is used in everyday life. Slime is composed of Elmer's glue, water and sodium tetraborate (Borax).

Elmer's glue is composed primarily of the polymer polyvinyl acetate (see picture below). It has a greater viscosity (resistance to flow) than many liquids, but is not nearly as viscous as slime.



polyvinyl acetate formula

Polyvinyl acetate (PVA or PVAc) is a [rubbery synthetic polymer](#). It is prepared by polymerization of [vinyl acetate monomer](#), also referred to as VAM.

A **polymer** is a substance composed of [molecules](#) with large [molecular mass](#) composed of repeating [structural units](#), or [monomers](#), connected by [covalent chemical bonds](#). Well known examples of polymers include [plastics](#), [DNA](#) and [proteins](#).

Sodium tetraborate (Borax) also called **sodium borate**, or **disodium tetraborate**, is an important [boron compound](#), a [mineral](#), and a [salt](#) of [boric acid](#). It is usually a white powder consisting of soft colorless [crystals](#) that [dissolve](#) easily in [water](#).

Borax has a wide variety of uses. It is a component of many [detergents](#), [cosmetics](#), and [enamel](#) glazes. It is also used to make [buffer solutions](#) in [biochemistry](#), as a [fire retardant](#), as an [anti-fungal](#) compound for [fiberglass](#), as an [insecticide](#), as a [flux](#) in [metallurgy](#), and as a precursor for other boron compounds.

When a **saturated** solution (solution at the point at which the [solution](#) of a substance can dissolve no more of that substance and additional amounts of that substance will appear as a [precipitate](#)) of Borax is added to a mixture of water and Elmer's glue (mixed in a 1-1 ratio), the result is slime. The Borax solution causes the polyvinyl acetate molecules to become cross-linked. Cross-linking can be compared to the placement of wooden ties to hold the rails of a railroad track in place. The Borax molecules act like the ties, which hold the rails of the polyvinyl acetate molecules in place. This produces a much more viscous solution, since the polyvinyl acetate and Borax molecules are now linked firmly together.

Slime is an example of a non-**Newtonian fluid**. According to Isaac Newton, the viscosity of a liquid is dependent only on temperature and pressure. In simple terms, a Newtonian fluid is a fluid that continues to flow, regardless of the forces acting on it, temperature or pressure. However, the viscosity of a non-Newtonian fluid, such as slime, can be altered in several other ways besides changing its temperature.

Problem: (Carefully read the procedures for hints of the correct problem)

Variables:

Hypothesis:

Materials (At your table):

50 mL Elmer's Glue
50 mL Water
Saturated solution of water and Borax (pre-made)
1-2 drops Food Coloring (optional)
1-250ml plastic beaker
1-Stir stick
1-Dropper
1-Plastic storage bag
Paper towels
1-Newspaper

Procedures:

1. Pour water in the beaker to the 50mL line. Add the same amount of glue and mix.
2. Add food coloring (if desired). Stir.
3. Add 1 drop at a time of saturated Borax solution. Keep track of the # of drops you use.
4. Stir until most of the fluid has been absorbed. Do not add too much Borax at one time. Continue to stir constantly. (Slime will form on the stick).
5. When most of the liquid is gone, (but some is still present), remove the slime from the stick with your fingers.
6. Rinse off with water, and then work the slime with your hands.
7. Record observations about the quality of your slime.
8. Repeat this procedure two more times by varying your procedures to provide observations about how your independent variable affected the quality of your slime.
9. Put all supplies back and clean up your area.
10. Answer the "reflection" questions and write a lab/activity write-up

Observations: (Include all 3 trials)

Discussion: This won't be an official lab discussion paragraph but you must thoroughly explain the results using the background information and your knowledge of the results of the activity. This paragraph must be no less than 10 complete sentences. Include results from all 3 trials.

Slime Chemistry "Reflection" Questions:

1. What is Slime made of?
2. What is a polymer?
3. What are some polymer examples?
4. What is the chemical name for Borax?
5. What are some uses of Borax?
6. What is a saturated solution?
7. What is a Newtonian fluid?
8. When Slime is placed on newsprint, what happens?
9. Will Slime bounce?
10. If Slime is pulled apart slowly, what happens? Why?
11. If Slime is pulled apart quickly, what happens? Why?
12. What is Elmer's glue composed of?
13. Is slime an example of Non-Newtonian fluid or a Newtonian fluid?
14. What's the difference between the two fluids?
15. What color slime did you create?