Hydrogen Bonding in Slime

Purpose

To demonstrate the production of a polymer that flows and sheers, if twisted.

Materials

two 100 mL beakers

food coloring

two 50 mL graduated cylinders

poly(vinyl alcohol)

sodium tetraborate

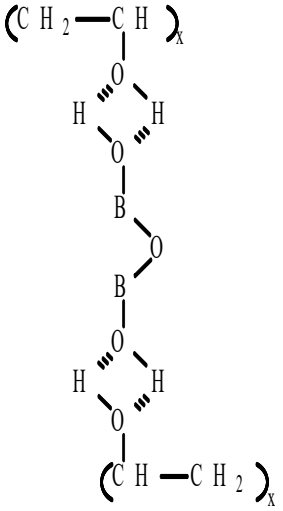
wooden stick

Procedure

1. Prepare the following two solutions:
   a. Poly(vinyl alcohol) is a 4% solution. Add 4.0 grams to 96 mL of water. Heat to 70 C until the solution clears. Do not boil.
   b. Sodium tetraborate is a 4% solution. Add 4.0 grams of sodium tetraborate ($Na_2B_4O_7 \bullet 10\ H_2O$) to 96 mL of water.
2. Measure out 50 mL of the poly(vinyl alcohol) solution and pour into a 100 mL beaker.
3. Measure out 10 mL of sodium tetraborate into another beaker and add one drop of food coloring.
4. Observe the characteristics of the two clear solutions before mixing.
5. Pour the sodium tetraborate into the poly(vinyl alcohol) while stirring vigorously with a wooden stick.
6. Examine the properties of the cross-linked polymer.

Additional Information

1. Poly(vinyl alcohol) is a polymer derived from the monomer vinyl alcohol.
2. The tetraborate forms a complex structure $B_4O_5(OH)_4^{-2}$, that links the poly(vinyl alcohol) polymer strands by hydrogen bonds.
3. Cross-linking can be compared with hydrogen bonding that links the DNA molecule or proteins into specific structures.
4. The polymer is nontoxic.



5. If pressed into a design written with a magic marker, the slime will pick up the design.

Disposal

The slim can be disposed of in the trash when it becomes boring.

Reference

Summerlin, L., Borgford, C., Ealy, J. Chemical Demonstrations, Volume II, 1987.