Slime – Polyvinyl Alcohol with Borax

Description: This demonstration is typically performed as a hands-on activity for younger audiences but can also be used to discuss polymerization. Two clear colorless liquids are mixed and immediately form a gel with interesting physical properties.

Materials:

Polyvinyl alcohol
$Na_2B_4O_7 \bullet 10H_2O$ (borax)
Elmer's glue (optional)
Hot plate w/ thermometer
250 mL beaker w/ stir bar
Ziploc bags (optional)

Procedure:

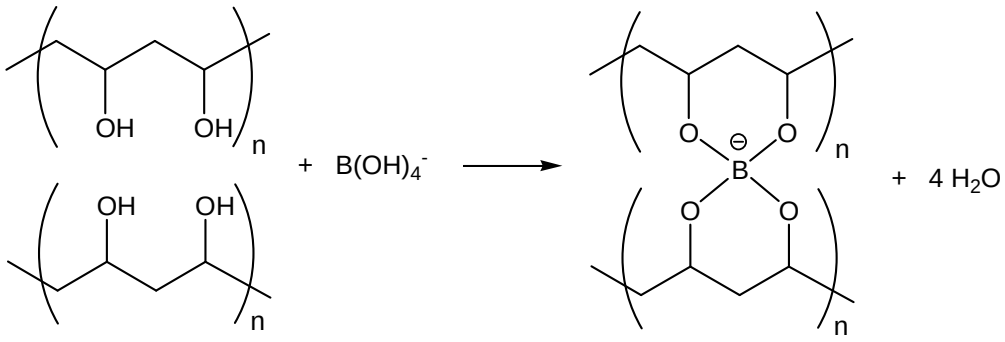
1. Separately prepare a 4% solution of PVA (4 g dissolved in 100 mL of hot water at 70 ^{o}C; do not boil) and a 4% solution of borax (4 g $Na_2B_4O_7 \bullet 10H_2O$ in 100 mL of water). Food coloring may be added to the borax solution. **Alternatively, Elmer's glue (diluted 1:1 with water) can be used in place of borax.**

2. The two solutions will be mixed in a 10:1 (PVA:borax) ratio. Add 50 mL of PVA solution to a 250 mL beaker. To this, add 5 mL of borax solution and mix vigorously with a wooden stirrer. A clear gel should form immediately. The viscosity of the gel can be altered by changing the ratio of PVA:borax.

3. The gel formed can be kneaded into a ball, slowly stretched but shears when quickly twisted.

4. For younger classrooms, the solutions can be mixed in the Ziploc bags and students can knead the gel in the bag to form the Slime.

Discussion: The borate ion in solution serves as a cross linking agent for PVA generating a new polymeric structure. $Na_2B_4O_7$ hydrolyzes in solution to generate $B(OH)_4^-$. This reacts with the –OH groups on PVA to generate a structure as shown below:



Safety: Be sure to inform younger audiences that materials are not to be ingested.

Disposal: Gel can be disposed of in normal waste.

References:

Shakhashiri, B. Z. In *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; The University of Wisconsin Press: 1989; Vol. 3, p 362-363.

Katz, D. A. *J. Chem. Educ.* **1994**, *71*, 891.

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JCE Editorial Staff *J. Chem. Educ.* **1998**, *75*, 1432A.

Video: http://www.youtube.com/watch?v=emlW5Jh-AHc (Gluep)