Fluorescent Slime

Properties of Polymers

Introduction

All students love slime! Now you can make slime with an interesting fluorescent twist.

Concepts

- Polymers
- Fluorescence

Materials

Fluorescein/bromphenol blue solution, 100 mL
Guar gum, 1.0 g
Sodium borate solution, 4%, 5 mL
Zipper-lock bag
Beaker, 250-mL
Graduated cylinder, 10-mL
Graduated cylinder, 100-mL
Stirring rod
Ultraviolet lamp (optional)

Safety Precautions

Slime is generally considered nonhazardous; however, it should not be ingested and should only be used in the manner intended. It is not recommended that students be allowed to take slime home. Slime will easily stain clothing, upholstery, and wood surfaces. With food coloring added, it will stain these surfaces and skin even more readily. The fluorescein/bromphenol blue solution may be irritating to the skin. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

Prepare the fluorescein/bromphenol blue solution by dissolving 0.04 g fluorescein and 0.01 g bromphenol blue in 100 mL of distilled or deionized water.

Procedure

1. Add 100 mL of the fluorescein/bromphenol blue solution to a 250-mL beaker.
2. Stirring constantly, slowly sprinkle, a pinch at a time, 1.0 g of guar gum to the beaker. *Note:* If the guar gum is added too quickly, it will form large, undesirable clumps.
3. Add 5 mL of the 4% sodium borate solution to the beaker. Stir the resulting slime until it is of the desired consistency.
4. Place the slime in a zipper-lock bag.
5. View the slime at varying angles. If an ultraviolet light source is available, view the slime under its light also.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Dispose of the slime in an approved landfill site according to Flinn Suggested Disposal Method #26a.

Discussion

Guar gum, a natural polymer with a molecular weight of about 220,000 g/mole, is made from the ground endosperms of *Cyamopsis tetragonolobus*, a legume cultivated in India as livestock feed. Guar gum has 5–8 times the thickening power of starch and is commonly used as a binding or thickening agent in foods and cosmetics.

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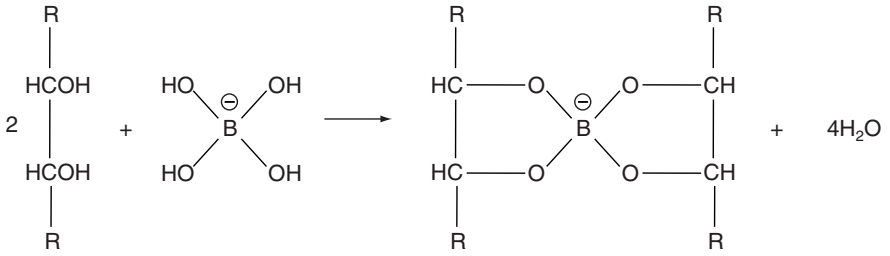
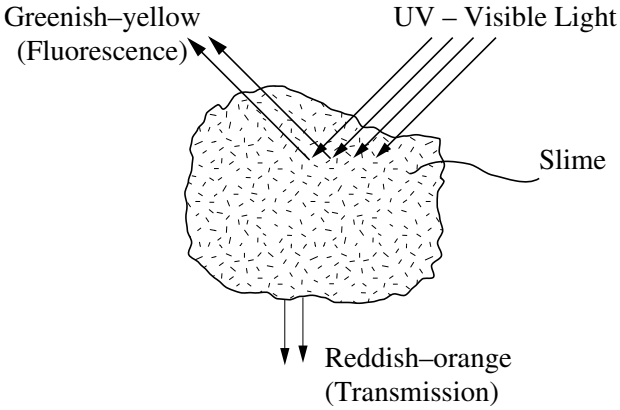
Guar gum is a long-chain polyalcohol with 1,2-diol groupings capable of complexation with the borate ion, $B(OH)_4^-$. The structures given below are oversimplified, but may help to visualize the network complex as it extends in three dimensions.



In addition to forming complexes with the borate ion, the interaction of long-chain polyalcohols, such as guar gum, with the borate ion leads to cross-linking of different polymer chains, or sometimes part of the same chain, in such a way that a three-dimensional network of connected chains is formed. When the concentration of cross-linked chains is high, solvent is immobilized within the network and a semisolid gel results. Because the borate ion can bond with four alcohol groups it is particularly effective in creating three-dimensional gel networks from gums such as guar gum. Other examples of networks and gels are rubber cement, gelatin, fruit jellies, agar, and yogurt.

Fluorescence is due to an atom or molecule emitting visible light when one of its electrons passes from a higher to a lower energy level. In this demonstration, fluorescein absorbs light in the ultraviolet and violet range of the electromagnetic spectrum and emits light of longer wavelengths. Fluorescein emits intense greenish-yellow light by fluorescence, while it appears reddish-orange by transmitted light.



Fluorescein fluoresces in the green region of the spectrum. In other words, the blue-violet end of the visible spectrum (and ultraviolet light) is converted to green so green is seen on the light incident side. The bromphenol blue absorbs all visible colors except red so that only red light is allowed to pass through the slime.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation

Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter, transfer of energy

Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, interactions of energy and matter

Answers to Worksheet Questions

1. Describe any observations you made about the slime, such as its color, texture, movement, etc.

The slime has a rather sticky texture and a gel-like appearance. It stretches when you pull it slowly, but when you pull it suddenly then it breaks. Generally it can be shaped into a different form quite easily. It is green under normal light, but if you place it under a ultraviolet light source, it appears reddish-orange.

2. Would you classify the slime as a solid or a liquid? Explain.

The slime seems to be something in between a solid and a liquid. It is firmer and easier to handle than most liquids. However, it will take the shape of the container its in, so it is probably a liquid.

3. What is a polymer?

A polymer is a large molecule, usually in the shape of a chain, composed of many smaller molecules called monomers.

4. Fluorescence occurs when a substance absorbs a photon from a light source. The energy from that photon causes an electron to move to an "excited" state (higher energy level). As that electron returns to its ground state, it releases another photon with a particular wavelength. Explain how this relates to the "colorful glow" you see when a substance fluoresces.

The glow is caused by the energy that is released by the electron relaxing from a high energy level to a low energy level. If the photon that is released at this time has a wavelength that is within the visible spectrum, then we can see the colorful glow it causes.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Fluorescent Slime* activity, presented by Irene Cesa, is available in *Properties of Polymers* and in *Fluorescence*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Fluorescent Slime* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Slime with a Twist—Chemical Demonstration Kit* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP9081	Slime with a Twist—Fluorescent Slime Demonstration Kit
AP9030	Ultraviolet Lamp, 180
G0038	Guar Gum, 25 g
S0363	Sodium Borate Solution, 4%, 500 mL
F0043	Fluorescein, 25 g
B0043	Bromphenol Blue, 1 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Fluorescent Slime Demonstration Worksheet

Discussion Questions

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2. Would you classify the slime as a solid or a liquid? Explain.

3. What is a polymer?

4. Fluorescence occurs when a substance absorbs a photon from a light source. The energy from that photon causes an electron to move to an "excited" state (higher energy level). As that electron returns to its ground state, it releases another photon with a particular wavelength. Explain how this relates to the "colorful glow" you see when a substance fluoresces.