

Activity 5.2: Guar Gum Slime

Guar gum is a natural substance produced by the guar plant. When guar gum is heated in water, it forms polymers that cause the solution to become more solid. Many processed foods include guar gum as a thickener, much like soluble cornstarch that thickens gravy.

Oil drillers also mix guar gum into the slurry that they pump into oil wells.

Sodium borate (borax) is a cleaning agent often used for laundry. It is a hydrated ionic compound made up of sodium and polyatomic borate ions: $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O}(\text{s})$. In solution the borate ions react with certain organic compounds to form cross-linked polymers. In this investigation, the borate ions link with $-\text{OH}$ groups in the guar gum molecules to form a cross-linked substance with interesting physical properties.

Equipment and Materials: lab apron; chemical safety goggles; 250 mL beaker; wooden stir stick; 100 mL measuring cylinder; electronic balance; 100 mL beaker; aluminum pie plate; 110 mL warm distilled water; food colouring (optional); 1.0 g guar gum powder; 0.4 g sodium borate, $\text{Na}_2\text{B}_4\text{O}_7(\text{s})$

Sodium borate is an irritant. Avoid skin and eye contact. If the solution splashes onto your skin or into your eyes, wash the affected area for 15 min with plenty of cool water and inform your teacher. Wash your hands at the end of the investigation.

Do not consume anything in the laboratory or remove anything from the laboratory to consume later.

1. Put on your lab apron and chemical safety goggles.
2. Add 100 mL of warm water to the 250 mL beaker. Add food colouring (optional). Slowly add the guar gum powder, stirring constantly with the stir stick to dissolve the powder.
3. Add 10 mL of warm water to the 100 mL beaker. Add the sodium borate crystals to the water.
4. Add the sodium borate solution to the guar gum solution. Immediately begin stirring the mixture with the stir stick. Within a couple of minutes, a slimy substance will form.
5. Lift some of the "slime" out with the stir stick and place it on the aluminum pie plate. The mixture is safe to touch. Use your hands to manipulate the slime. Try stretching, poking, and slapping it. Move it quickly and slowly. Record your observations.

- A. What happened when you first started stirring the mixture?
- B. What happened after stirring for a few minutes?
- C. Describe the appearance and properties of the slime. Are the properties constant, or do they vary?
- D. Describe how cross-linking gives this mixture its properties.
- E. How might the use of guar gum by the oil-drilling industry affect the price of food? Comment on the implications of this.