Name: _____ Class period: _____

Creating a Shape Memory Polymer from Silicone-1 Caulk Lab

Pre-Lab Question

1. What does it mean for a substance to have "shape memory"?

Materials for Part 1

- Safety Glasses or Goggles
- Gloves
- 3 Plastic Cups
- Spatula
- Silicone-1 Caulk
- Corn Starch
- MiraLAX
- Food Coloring
- 2-3 weigh papers

Procedure

1. Get 3 plastic cups and 2 weigh papers.

Batch 1: Corn Starch and Silicone ("Ooogoo")

2. Using 1 of the plastic cups, measure out ~1.2 grams of corn starch. Record the exact mass of the corn starch below:

   Mass of Corn Starch: _____ g

3. Take a 2nd cup to the fume hood to measure out ~3.0 grams of silicone-1 caulk. Record the exact mass of the silicone-1 below.

   Mass of Silicone-1 Caulk: _____ g

4. Before leaving the fume hood, add 1 drop of food coloring to the silicone-1 caulk. Record color here: _____
5. Using your spatula, stir the food coloring into the caulk until it's evenly mixed.
6. Pour the corn starch into the cup with the silicone-1 caulk, and mix until it has the same composition throughout.
7. Using your spatula, scrape the ball of material onto 1 of the weigh papers, and press into a flat sheet using the spatula or another weigh paper. Write your names and class period onto the weigh paper, and set aside to dry.
8. Throw out the cup that contained the silicone-1 caulk. Use a paper towel to wipe out the cup containing the corn starch, and use a paper towel to scrape off the material on the spatula.

Batch 2: MiraLAX and Silicone

9. Re-use the cup that contained the corn starch. Measure out ~1.2 grams of MiraLAX Record the exact mass of the MiraLAX below:

   Mass of MiraLAX: _____ g

   Take your 3rd cup to the fume hood and measure out ~3.0 grams of silicone-1 caulk. Record the exact mass of the silicone-1 below.

   Mass of Silicone-1 Caulk: _____ g

10. Add 1 drop of food coloring the silicone-1. Choose a different color than you used in the first batch. Record color here: _____
11. Stir in the food coloring to the silicone-1 until evenly distributed.
12. Pour the MiraLAX into the cup with the silicone, and mix until you have an even composition.
13. Use the spatula to scrape the ball out onto the 2nd weigh paper, and press flat. Write your names and class period on the weigh paper, and set aside to dry.
14. Clean up your lab area, throwing out the remaining cups and wiping down your spatula with a paper towel to remove the silicone.

Part 2: Testing the Shape Memory Properties

Materials

- Safety Glasses or Goggles
- Hot plate
- Scissors
- Thermometer
- 2 250 mL Beakers
- Stir rod (or spatula)
- 2 binder clips

Procedure

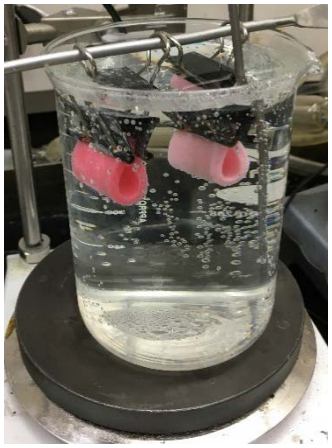
1. Fill each of the beakers with 250 mL of water.
2. Place 1 beaker full of water on the hot plate, and turn the hot plate on high. Place the thermometer in the water. Heat until the water reaches 60° C.
3. While you are waiting, find the two batches you prepared last class. Peel your sample off of the weigh paper. Using the scissors, trim the edges so that you have a rectangular shape.
4. To help you remember during testing, write down the color of each batch in the table below.

Batch	Color of samples
Corn Starch: Silicone	
MiraLAX: Silicone	

Name: _____ Class period: _____

5. Take each sample and bend it in half, so that the two ends meet. Then secure with a binder clip. See photo below.

6. Once the water is 60^{o} C, you are ready to begin testing. At this time, you can turn the hot plate down to a lower setting. (You don't want the water to boil, just to stay above 60^{o} C during the tests.)
7. Slide the 2 binder clips onto the stir rod, and use to suspend 1 sample from each batch (Corn starch & Silicone, and MiraLAX & Silicone) in the hot water. See photo below.



8. Keep in the hot water for 3 minutes.

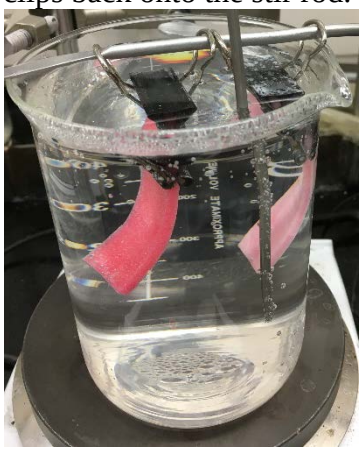
9. Immediately move the stir rod with the samples to the 2nd beaker of water, which should be at room temperature. Keep in the cold water for 3 minutes.

10. Remove the stir rod from hanging over the cold water beaker and place on a paper towel. Remove the binder clip from each of the 2 samples. Record your observations below.

Sample	Color of sample	Did the sample retain the C shape from being held in the binder clip? (Shape memory)	How did the texture change after being in the water?
Corn Starch: Silicone			
MiraLAX: Silicone			

Name: _____ Class period: _____

11. Now place one end of each sample back into the binder clip, and slide the binder clips back onto the stir rod. Suspend over the hot water beaker for 3 minutes.



Write your observations in the space below. What happens to each sample as they are heated back up above 60^{o} C?

12. Remove from the hot water, and gently dry both samples with a paper towel.
13. Then repeat the shape memory test. Place each sample in a binder clip, so that they both form a C shape. Hang over the hot water for 2 minutes, then place immediately into the cold water for 2 minutes. Remove from the cold water, and remove the binder clip. Record your observations in the table below.

Trial 2

Sample	Color of sample	Did the sample retain the C shape from being held in the binder clip? (Shape memory)	Was the result the same as the 1st time?
Corn Starch: Silicone			
MiraLAX: Silicone			

Post Lab Questions

1. The melting point of MiraLAX is ~55^{o} C. By heating the sample above 60^{o}C, what did that cause to happen inside the mixture of MiraLAX: Silicone?

2. Why was it necessary to cool the samples before removing the binder clip?

3. Draw pictures to represent what's happening at the molecular level in the MiraLAX: Silicone sample in the 3 phases of testing (at the start, after heated, after cooled down).