**Cross-linking experiments**

**Polyurethane Foam**

**Purpose:**

To investigate the combination of cross-linking and gas-forming agents used to make a polyurethane foam. Polyurethane foam is the kind of foam in most chairs, couches, and car seats. It can also be used for water leaks in concrete walls, where the starting materials are injected directly into the wall and foam forms as it reacts with water. The reaction that occurs not only produces polyurethane polymers and cross-links, but also produces carbon dioxide gas. The gas creates little pockets of space in the mixture, making a stable foam.

In this exercise, each group will create foams of varying ratios of the starting components to test the effects of gas production and cross-linking on the properties of the foams.

**It is important to record all of your observations for this exercise!!!**

**Procedure:**

1. Get 3 paper cups, 3 stirring sticks, and enough paper towels to place under the cups. Label the cups 1, 2, and 3.
2. According to the following table, measure out the amounts of Components A and B into the three experiment cups using the plastic syringes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Component A (mL) [Crosslinking agent]** | **Component B (mL) [Gas-Producing agent]** | **Actual Component A (mL)** | **Actual Component B (mL)** |
| **Experiment 1** | **6** | **14** |  |  |
| **Experiment 2** | **8** | **12** |  |  |
| **Experiment 3** | **10** | **10** |  |  |

Observations of chemicals used:

1. Mix the components in each experiment until a foam begins to form. Discontinue mixing after you see it starting to foam!!! Try to mix the same amount for each mixture. If you mix too much, you will not get foam and you will not achieve the correct results.

**WARNING: Do not touch the foams with your hands, even with gloves, until their**

**outsides are no longer sticky. Sometimes the foams do not dry quickly, so you**

**cannot touch them at all.**

Record your observations of the reactions

**The foams need to dry before we touch them with the stir sticks. We will put the foams aside for now and move on to the slime experiment (next page). When you’re done with the slime experiment, come back to step 4.**

1. After the foams have dried, press on them with the stir stick to feel the rigidity. What is the effect of cross-linking on rigidity according to what you feel in the various foams?

Which foam would be good for a seat cushion?

Which foam would be good for a surfboard?

**Making SLIME!!!!!**

**Purpose:** We will mix polyvinylacetate solutions (glue) with different amounts of a cross linker (sodium borate solution). Yesterday we predicted that this would change the stiffness of the material. Today we will test that prediction.

**Procedure:**

1. Get 3 100mL beakers and fill each with 10 mL of polyvinylacetate solution (glue). Label them A, B, and C.

|  |  |
| --- | --- |
| **Description of substances before mixing** | |
| **Sodium borate solution** |  |
| **Polyvinylacetate solution** |  |

1. Using a syringe, add the solutions according to the following table:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **A** | **B** | **C** |
| **Sodium borate solution (mL)** | 2 | 3 | 5 |

1. Stir the mixtures for ~2 minutes.

|  |  |  |
| --- | --- | --- |
| **Description of material after mixing** | | |
| **A** | **B** | **C** |
|  |  |  |

* Rank the materials A, B, C in order form most to least cross-linking. How did you decide your order?

1. Spread the materials out so they make a thin film.

* Which material makes the best film?

When you’re done with the slimes, return to page 3 and complete step 4 of the foam experiment.