

Materials Testing - Adhesives: Technical Notes

Introduction

In this activity student investigate stickiness and the forces involved. Some of the substances used are just sticky such as honey but others would be classified as glues and adhesives. The students begin by investigating the adhesive properties of Blu Tack. Blu Tack has been chosen because there is no drying time. See notes on Blu Tack below. Activity A1 is initially to demonstrate to the students a systematic way of testing adhesiveness. The technique used for measuring resistance to shear force is consistent with the way adhesives are tested in materials science and engineering. Students then compare Blu Tack's adhesion to plastic with that of wood. In Activity A2, the students are required to compare the adhesive properties of Blu Tack with those of Tuff Tack (or another generic putty-like adhesive). Activity A2 is a more open ended investigation, although it is expected students will use the materials and equipment from Activity A1.

In Activity B1 the students make a selection of homemade glues and in Activity B2 compare the glues for their adhesive properties. Alternatively, the glues could be prepared by the lab tech and supplied to the students who would focus on devising fair tests. Because some of the glues are quite strong it may be necessary for students to compare the adhesion using torsion forces using the multiplying effect of a lever. See diagram below.

Equipment and Materials

Per student group

Part A1

- A small piece of Blu Tack about 6 mm in diameter. [Footnote ¹⁰]
- 2 icy pole sticks (one with a hole in one end) [Footnote ¹¹]
- 2 plastic strips (one with a hole in the end) You will need to test the plastic for the degree to which the Blu Tack adheres. You need to choose a plastic to which the Blu Tack does not adhere strongly. See notes below
- Slotted brass weights – about 500 g
- Sand paper
- Retort stand with boss and clamp

Part A2

- The materials used in Part A1, *plus*
- 6 mm sphere of Tuff Tack or a similar generic putty like adhesive

Part B1

- Strips of paper and cardboard.
- Icy pole sticks.
- Ingredients for making the glues.
- Heat source.
- Stirring rods or spoons.
- Beakers or glass jars or cups.

PLUS

Materials described in the recipes for four different 'homemade' glues. In some schools the Lab Tech may be requested to make the glues.

¹⁰ Blu Tack is the commercial name of a "reusable" adhesive made by Bostik. Other similar products can be used.

¹¹ Icy pole stick, paddle pop stick, and popsicle stick are alternate names for flat pieces of wood about 12 cm long, 1 cm wide, and 2 mm thick. Any similar product can be used.

Corn syrup glue

- Corn syrup
 - White vinegar
 - Corn-starch.
1. In a small saucepan, mix 180 mL water with 35 mL corn syrup and 15 mL tablespoon white vinegar.
 2. Bring the mixture to a rolling boil.
 3. In bowl, mix 20g corn-starch with 180 mL cold water.
 4. Slowly add the cold mixture into the hot mixture. Stir constantly for one minute.
 5. Remove from heat

Once it has cooled, pour the mixture into a labelled glass jar or beaker or cup.

(Let it stand overnight at room temperature before using.)

Casein glue

- gelatine [Footnote ¹²]
 - skim milk
 - clove oil (optional)
1. Pour two tablespoons of cold water into a small bowl.
 2. Sprinkle 2 packets of unflavoured gelatine over the water and set aside for about an hour.
 3. Heat 40 g skim milk to just below boiling and pour it into the gelatine and water.
 4. Stir the mixture until the gelatine is completely dissolved.

Optionally, add a few drops of clove oil as preservative if you're not going to use all the glue immediately. (With clove oil, the glue will keep for a day or so – when it starts smelling like spoiled milk, throw it out.)

¹² Glycerol, glycerin, glycerine, 1,2,3-propanetriol, propan-1,2,3-triol and propane-1,2,3-triol are all alternate names and spellings for the same chemical substance. Glycerol is the official IUPAC (International Union of Pure and Applied Chemistry) name. Propan-1,2,3-triol is the systematic IUPAC name. Glycerin is a commonly used commercial name.

Gum Arabic glue

- 45 mL gum arabic
- 15 mL glycerol [Footnote ¹³]
- 8 mL water

1. Mix 45 mL gum arabic, 15 mL glycerol and 8 mL water thoroughly in a bowl or beaker.
2. To use this glue, apply a thin coat to each surface and hold the pieces firmly together until the glue dries. (up to an hour).

Gelatine glue

- 1 packet gelatine (10 g)
- 15 mL glycerol [Footnote ¹⁴]
- 15 mL white vinegar
- 15 mL water

1. Add the gelatine to 15 mL cold water in a beaker, stir gently, let stand until it ‘blooms’.
2. Mix 45 mL boiling water, the white vinegar, and glycerol to the gelatine and stir until it all dissolves.

he resultant glue may become solid and will need to be warmed to soften before each use.

Notes on Blu Tack

Blu Tack is a very interesting and unusual material with variable adhesive properties. It sticks to most materials and surfaces firmly but there are some plastics to which it doesn't stick as well. The adhesion on these plastics improves when the surface is roughened.

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Blu Tack becomes stickier when it is warmer, when it is worked (repeatedly squeezed and folded) between the fingers and sometimes when it is very old. The degree to which it sticks to surfaces is altered by the degree to which it is 'worked' and the way it is applied to a surface. It appears that a sphere of Blu Tack pushed onto a surface sticks more firmly than when the surface is applied to a piece of Blu Tack that has been flattened. This means that there are many variables that need to be managed for a fair test.

Risk management

- In this activity students are applying force to glued joints. In some cases, the joints can give away unexpectedly and so care needs to be taken to avoid eye damage. Safety glasses should be worn.
- The brass weights are expensive. When the joints give way, the weights may fall and there is a risk that the spindle will break off. To reduce impact and therefore damage a folded cloth or box filled with something soft is needed under the suspended weights.
- A number of the glues made in Part B require heating. Care must be taken to avoid burns. Preparations for burns first aid needs to be in place.
- Glass containers are likely to be used. Risks of glass breakage therefore exist. Teachers and students need to be aware of broken glass clean-up procedures. Broken glass disposal bins need to be in place.
- Students must wear safety glasses/goggles. The use of personal protective equipment (lab coats) is recommended.

Suppliers

Blu –Tack can be bought from most stationery suppliers.

Tuff Tack can be bought from Officeworks.

Storage suggestions

- Corn syrup glue can be stored at room temperature without spoiling.
- Casein glue should be refrigerated and clove oil used as a preservative if it to be kept.
- Gum Arabic glue lasts well at room temperature
- Gelatin glue lasts well at room temperature and needs to be warmed for use
- Flour paste will only last few weeks and will last longer if clove oil is used as a preservative

Clean-up suggestions

Large bins of warm water in the lab can be provided for students to place all materials used to make and experiment with these glues. This should make the cleaning of the equipment and potential permanent gluing easier to control.

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