

Preparation of a biopolymer including the effect of a plasticiser

Introduction

In this practical you will make a plastic from potato starch and investigate the effect that adding a plasticiser has on the properties of the polymer that you make.

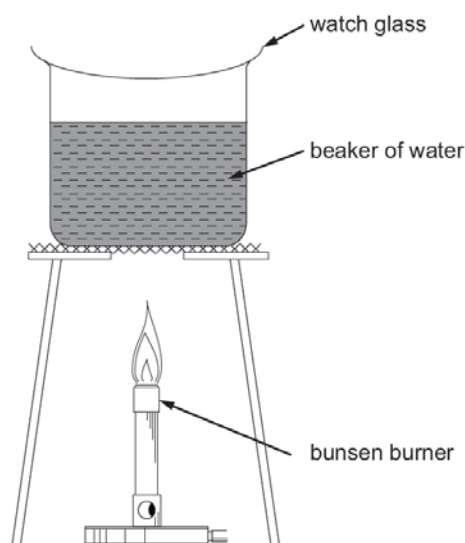
Apparatus

400 cm³ beaker
 250 cm³ beaker
 large watch glass
 Bunsen burner
 heat resistant mat
 tripod
 gauze
 stirring rod
 Petri dish or white tile
 universal indicator paper
 dropping pipette
 25 cm³ measuring cylinder
 dilute hydrochloric acid (0.1 mol/dm³)
 dilute sodium hydroxide (0.1 mol/dm³)
 distilled water (about 500 cm³)

Access to:

potato starch
 food colouring
 Propane-1,2,3-triol (glycerol), (2 cm³)

Diagram of Apparatus



Method

1. Put 22 cm³ of water into the beaker and add 4 g of potato starch, 3 cm³ of hydrochloric acid and 2 cm³ of propane-1,2,3-triol.
2. Put the watch glass on top of the beaker and heat the mixture using the Bunsen burner. Bring it carefully to the boil and then boil it gently for 15 minutes. Do not boil it dry.
3. Dip the stirring rod into the mixture and dot it onto the indicator paper to measure the pH. Add enough sodium hydroxide solution drop by drop to neutralise the mixture, testing after each addition with indicator paper. You will probably need to add about 3 cm³.
4. Add a drop of food colouring and mix thoroughly.
5. Pour the mixture onto a petri dish or white tile and push it around with the glass rod so that there is an even covering.
6. Repeat steps 1-6 but leave out the propane-1,2,3-triol.
7. Label the mixtures and leave them to dry out. It takes about one day on a radiator or sunny windowsill, or two days at room temperature. Alternatively, use a drying cabinet. It takes about 90 minutes at 100 °C.

Analysis

1. Compare the two films.

Risk Assessment

Hazard	Risk	Control measure
Dilute hydrochloric acid/ Dilute sodium hydroxide are irritants	Chemicals splashing onto hands or into eyes.	Wear eye protection.
Hot Bunsen burner / hot surfaces may cause burns	Moving the Bunsen burner may burn skin	Do not move Bunsen burner until cool

Technician notes

Reagents:

- Hydrochloric acid – Refer to CLEAPSS hazcard 47A
- Sodium hydroxide – Refer to CLEAPSS hazcard 31

If access to a balance is difficult, then starch can be pre-weighed.

If you have a drying cabinet, the mixture should dry in about 90 minutes at 100 °C.

While using food colouring is optional, it does enhance the product and the colour it gives makes the plastic film look more like plastic. Only one drop is needed or the film is too dark.

Care should be taken not to let the substances boil dry, as they can spit and have a tendency to jump out of the beaker.

If you wish, you can prepare your own potato starch using the following method, which produces enough for one group.

1. Grate about 100 g of potato. The potato does not need to be peeled, but it should be clean. Put the potato into the mortar.
2. Add about 100 cm³ of distilled water to the mortar, and grind the potato carefully.
3. Pour the liquid off through the tea strainer into the beaker, leaving the potato behind in the mortar.
4. Repeat steps 2 and 3 twice more.
5. Leave the mixture to settle in the beaker for 5 minutes.
6. Decant the water from the beaker, leaving behind the white starch which should have settled in the bottom. Put about 100 cm³ of distilled water in with the starch and stir gently. Leave to settle again and then decant the water, leaving the starch behind.

When students compare the two films, the one without the propane-1,2,3-triol is far more brittle, the one with it shows more plastic properties.

Working scientifically skills covered

1. Development of scientific thinking

Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications and make decisions based on the evaluation of evidence and arguments.

2. Experimental skills and strategies

Apply a knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to the experiment.

Carry out experiments appropriately having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.