

Thermoplastic Polymer

Contents:

Poly caprolactone 150 g



Thermoplastics are polymers that can be heated and reformed over and over. Poly caprolactone is a great example of a thermoplastic as it melts conveniently at 58 to 60 °C.

PROCEDURE

Required

Hot water above 75 °C

Glass beaker

Glass stirring rod

Tongs

Poly caprolactone granules

Procedure

- 1 Pour a number of poly caprolactone granules into the hot water in the glass beaker.
- 2 Stir the granules with the glass rod while observing the colour change that takes place. The granules will become pliable and sticky and cling to each other. When all of the polymer has turned translucent then the polymer has melted.
- 3 Lift the softened polymer from the hot water using tongs or the glass rod.
- 4 The polymer will remain pliable for 5 – 7 minutes and can be moulded into many different shapes. If students are not happy with their first attempt, they can put the polymer back in the hot water to soften.

WARNING: The melted polymer may be hot. Instruct students not to put the polymer into their mouths. It bonds to metal braces. Students should not make bracelets or rings as the polymer will harden and be difficult to remove.

WHAT IS HAPPENING?

A chocolate slab can be heated and shaped into an Easter egg. On a hot day the Easter egg, again, is transformed into a new shape. Some polymers can be melted, cooled and re-melted just as with chocolate.

Polymers that can be heated and reformed over and over again are known as **thermoplastics**. This group makes up the majority of man-made polymers. These polymers can be shaped into any form. After heating, it can be shaped by extrusion – that is forcing it through a die. The heated polymer can also be poured or pressed into a mould. This is called moulding.

On the other hand, when heat is applied to a raw egg, it solidifies as it is transformed into a solid boiled egg. After cooling, it can not be transformed into another shape by heating. A group of polymers behave similarly. This type of polymer is known as **thermoset polymers**. Their molecules form cross linkages when they are heated. This creates a rigid, permanent structure. Just as a boiled egg can't be un-boiled, thermoset plastics can't be softened again once it is heated and formed. We use thermosets in applications where durability, heat resistance and strength are determining factors, for example as pan handles, refrigerator insulation, in the car, electrical and space industries.

Our **Mushrooms in Minutes School Demo Pack** prepares polyurethane, a thermoset polymer.

The main differences in properties between the two types of polymers are:

THERMOPLASTIC POLYMERS

Can be heated and moulded over and over.

Have long, unconnected molecule chains with no or few crosslinks

Can ignite and burn when heated

THERMOSET POLYMERS

Once formed it cannot be softened by heat

Have many crosslinks between the polymer chains, forming a rigid structure

Usually resist burning but may char at high temperatures

Real life applications of Poly Caprolactone

Many applications take advantage of the material remaining workable for a period when cooled below the melting point. Applications are

- shoe soles, heels and toe stiffeners;
- hot melt glues;
- rigid and lightweight splints & casts replacing Plaster of Paris as orthopaedic support;
- orthodontic moulding systems, etc.

Disposal

Can be re-used many times. If there is a need to dispose of the polymer then do so in compliance with local/federal regulations. Product is not significantly hazardous for the environment.

Safety

Not classified as a hazardous chemical. See MSDS on our website.

References:

Fun with Chemistry Vol. 2, M & J Sarquis, University of Wisconsin-Madison, 1993

