

Lab. 6

Bioplastic

Many materials that we use in our everyday life are made of plastics. But what are these plastics made of?

Plastics belong to a group of molecules called polymers, which are large molecules made of repeating units called monomers. Most plastics contain between 500 and 20,000 or more repeating units. Plastics can be produced by bonding together monomers in a reaction called polymerization.

Most plastics are made from crude oil. Molecules present in crude oil undergo chemical reactions that create monomers, which are assembled together to make polymers that can be processed into plastics.

This process is very common, but it:

1. Produces pollutants, such as carbon dioxide (CO₂), which contribute to climate change.
2. Crude oil is in great demand throughout the world. Scientists estimate that at today's consumption rate, the world's oil supply may dry up in less than 100 years.

To address these two problems, scientists have been looking for the past two decades for new ways of making plastics. One way involves the use of plants as the raw material, instead of crude oil. This type of plastic is called bioplastic.

Bioplastic

It is either biobased, biodegradable, or features both properties.

Biobased

This term means that the material or product is (partly) derived from biomass (plants). Biomass used for bioplastics stems from e.g. corn, sugarcane, or cellulose.

Biodegradable

Biodegradation is a chemical process during which microorganisms that are available in the environment convert materials into natural substances.

Procedure 1

1. Boil 500 ml of milk.
2. Add 3 spoons of vinegar, mix it.
3. Filter the mixture by piece of cloth.
4. While the plastic is still warm, shape it into any shape; let it for 24 h to dry.

Procedure 2

1. In a heat-proof container, add 12 g (4 teaspoons) unflavored gelatin to 240 mL (1 cup) of a 1% glycerol or glycerin solution, mix it well.
2. Heat the mixture to 95°C or to the first point of frothing, whichever comes first. Stir again. There should be no visible lumps.
3. Carefully empty the mixture into a nonstick brownie pan.
4. Let the pan sit undisturbed for as long as it takes for the mixture to dry, which may be several days, depending on room temperature and humidity.

Procedure 3

1. Place the cornstarch in the plastic bag.
2. Add corn oil. Add water. Seal the bag, and then mix the ingredients by rubbing outside the bag with your fingers.
3. Add two drops of any color food coloring to the mixture, seal the bag and mix again.
4. Open the zip seal just a tiny bit and put the bag in a microwave oven, on high 20–25 seconds. (Be careful removing your plastic, it will be hot!).
5. While the plastic is still warm, shape it into a ball. If you want to see your ball degrade, just immerse it in water.

How it works

Before heating, the starch and water molecules combine physically in a liquid mixture, but do not permanently attach. Heating causes the water molecules to move fast enough to penetrate and break up the starch granules, which then tangle together to form polymers. Because the polymers are weaker than commercial bioplastics, they readily break apart in water.