**Biodegradable Plastics**

In 2017, over one trillion plastic bags were produced worldwide. (1) Landfills contain millions of plastic objects. Only a tiny fraction of the plastic used in Canada is recycled. The rest ends up in landfills. And let’s not forget that we also wrap our garbage in plastic bags. Plastic bags are so airtight that the waste inside has a hard time breaking down.

Determined to solve the solid waste problem, researchers are trying to develop plastics that are both biodegradable and strong. A first avenue of study is to combine polyethylene, a non-biodegradable plastic derived from petroleum, with various plant materials. These new plastics are composed of a minimum of 6% organic matter.

The new bioplastics must also meet the quality criteria of conventional plastics, i.e., **resistance, flexibility, lightness and impermeability**.

In this lab, you will use two different raw materials to make a bioplastic in order to compare the characteristics of each.

**Objective:**

Create a bioplastic and determine the raw material that best meets the characteristics of a bioplastic and compare the decaying rates of different plastics.

**Part 1 — Create a starch-based polymer**

**Material**

|  |  |
| --- | --- |
| – Potato starch  – HCl 0.1 M  – NaOH 0.1 M  – 50% glycerol solution in water  – 1% solution of cochineal red  – Erlenmeyer flask 100 mL  – Magnetic heating plate + magnet bar | – Petri dish  – Test tube 25 mL  – Test tube 10 mL (2)  – Spatula  – Small beaker 50 mL (6)  – Temperature probe |

**Method**

1. Cut a sheet of paper to cover the bottom of 2 Petri dishes.
2. Weigh 5 g of starch.
3. Measure out:
   * 5 mL glycerol
   * 2 mL dye solution (cochineal red)
   * 3 mL hydrochloric acid at 0.1 mol.L-1
   * 50 mL water
4. Place the reagents in an Erlenmeyer flask.
5. Add the magnet bar.
6. Heat while stirring to reach 100 °C.
7. Maintain the temperature and continue stirring for about 15 minutes until a homogeneous mixture is formed.
8. Add 6 mL of NaOH solution at 0.1 mol.L-1. The solution will change colour from red to purplish blue.
9. Pour the viscous mixture obtained into a Petri dish covered with a sheet of paper.
10. Divide the mixture obtained into the two Petri dishes. Spread the mixture evenly and slowly on the paper. Tilt your Petri dish in all directions to get an even distribution. Avoid reaching the edge of the paper to prevent the mixture from going under the paper.
11. Let dry for 24 hours or in the oven at 100 °C for 1 hour and 30 minutes.
12. Gently peel off the paper sheet.

**Part 2 — Create a casein-based polymer**

**Material**

|  |  |
| --- | --- |
| * 500 mL milk * 1 beaker of 1 L * 60 mL acetic acid * Graduated cylinder * Erlenmeyer flask 1000 mL   - Magnetic heating plate + magnet bar | * Filter * Filter paper * Funnel * Petri dish * Pliers |

**Method**

1. Measure out 500 mL of milk.
2. Put the milk in an Erlenmeyer flask.
3. Add the magnet bar.
4. Heat while stirring to reach 80 °C.
5. Add 60 mL acetic acid.
6. Allow to cool to 40 °C.
7. Filter the product to separate the curd (solid) from the whey (liquid).
8. Collect the curd and gently rinse with water.
9. Squeeze the curd several times between sheets of paper towel to remove the water.
10. Squeeze the curd into a Petri dish to form a shape similar to the bioplastic in section 1.

**Part 3 — Test the characteristics of the plastic**

You and your team must determine how to determine the characteristics of plastics

Have your teacher approve your method.

* Flexibility
* Resistance
* Impermeability
* Lightness

**Analysis:**

1. Compare the two bioplastics in terms of appearance, flexibility, heat resistance, impermeability, mechanical strength, and lightness.
2. Is the production of bioplastic from consumable material a necessity? Explain your answer.