Repairing with redox

Background

Acidic wastewater often occurs in areas where wetlands have been disturbed. It can also be produced as a by-product of mine drainage and from deep drains in low-lying landscapes, such as the wheatbelt. Soil needs to be treated so that the pH is closer to 7 if it is to be used for crop production.

In this activity, a mixture of acidified seawater and glucose is used to simulate acidic water. Seawater is used, rather than fresh water, because typical acid sulfate soils contain high levels of dissolved ions. Glucose speeds up bacterial action by providing food for the bacteria.

Purpose

To demonstrate that organic materials can be used to treat solutions from acid soils, by a process of bioremediation.

Equipment

bioreactors – 250 mL glass containers with lids

100 mL beaker

test tube

Pasteur pipette

soil (potting mix is preferred)

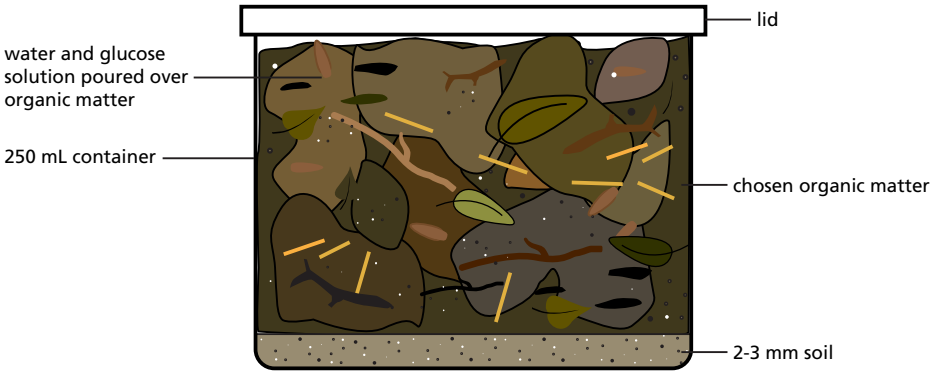
seawater

range of organic materials, such as chaff, leaves, straw, grass, hay, twigs, woodchips, sheep manure and ethanol (1 g L^{-1})

8.3 x 10^{-3} mol L^{-1} glucose solution

Procedure

Part A - Setting up the bioreactor



bioreactor

1. Cover the base of the bioreactor with 2 to 3 mm of soil, as shown in the diagram.
2. Loosely fill the container with your chosen organic matter. Record which organic material is being used and describe its appearance.
3. Add acidified seawater (about pH 4). Record the exact pH value: _____
4. Pour the solution over the top of the organic material.
5. Add 5 mL of glucose solution.
6. Seal the container and leave it in a secure place for about a week.

Part B - Measuring the success of the bioreactor

Warning: Do not touch or come into contact with material in the bioreactor.

1. After at least one week, observe and record the appearance of the organic material.

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2. Remove a small sample of the solution using a Pasteur pipette.
3. Measure the pH of the sample and record the value: _____

Questions

1. How has the appearance of the organic material changed during the experiment?

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2. How did the pH of the water change as a result of being in the 'bioreactor'?

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3. If there has been a change in the pH, explain what has brought about the change.

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4. Use oxidation numbers to explain if a redox reaction has taken place.

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5. Did you observe a deposit on the organic material? If you did, it is most likely a metal sulfide. Write a general equation for the formation of a metal sulfide. (Use the symbol 'M' to represent the metal).

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6. What are some advantages of using organic materials to reduce acidity, compared to the more traditional method of spreading lime over soil?

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