Investigating sulfides

This procedure investigates the chemistry of metal sulfides, and their role in the formation of acid sulfate soils.

Safety note: All parts of this procedure should be completed in a fume cupboard.

Part A: Production of insoluble sulfides

Equipment

sodium sulfide solution
iron II nitrate solution
copper II nitrate solution
zinc nitrate solution
potassium nitrate solution
lead II nitrate solution
large test tubes or small beakers (5)
test tube rack

Method

In separate test tubes, mix sodium sulfide solution with each of the other solutions. Record your observations in the table below.

Save the contents of each test tube for part B of the investigation.

	zinc nitrate	copper II nitrate	iron II nitrate	potassium nitrate	lead II nitrate
sodium sulfide					

Questions

1. Did a chemical reaction take place when each combination of solutions was mixed? Explain your observations.

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2. The metals in this experiment (Zn, Cu, Fe, K, Pb) existed as elements before being converted to ions in the nitrate compounds. Write half equations to show how each elemental metal loses electrons to form an ion.

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3. Write a half equation to show how sulfur accepts electrons to form an ion.

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4. Write ionic equations for each of the observed chemical reactions.

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5. Do the equations in question 4 represent redox reactions? Explain your answer.

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Part B: Testing the pH of oxidised sulfides

Equipment

test tubes with sulfide solutions/precipitates, from part A

test tube rack

universal indicator

hydrogen peroxide (30% water)

filter stand, filter papers, filter funnel

100 mL beakers (5)

distilled water

stirring rod

Method

1. Add a few drops of universal indicator to each of the test tubes saved from part A.
2. Observe the colour of the solution and record your observations.
3. Set up filter apparatus and filter the contents of each test tube, using a new filter paper for each.
4. Transfer the contents of each filter paper to separate 100 mL beakers.
5. Add distilled water and a few drops of indicator to each beaker and stir well.
6. Observe and record the colour of the solution.
7. Add about 30 mL of hydrogen peroxide to each beaker.
8. Observe and record any changes in colour of the solution.

Questions

6. Comment on any changes in pH of the solutions, as indicated by the colour changes, throughout the procedure.

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7. What are likely common products from the reactions with hydrogen peroxide?

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8. Write a general equation that represents hydrogen peroxide reacting with a sulfide.

Hint: First write half equations for the oxidation of sulfide, and the reduction of hydrogen peroxide.

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9. Are these reactions redox reactions? Explain your answer.

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Part C: Testing the pH of oxidised pyrite soils

Background

Pyrite (FeS_2) is one form of iron sulfide. Because of its crystalline structure it can have a lustrous appearance that resembles gold. For this reason it is often referred to as 'fool's gold'. In this form, sulfur has an oxidation number of -1. Pyrite is present in many types of soils found in the Perth metropolitan area.

Equipment

sample of soil containing pyrite

conical flask

hydrogen peroxide (30% water)

universal indicator

Bunsen burner or hotplate

barium sulfate powder

Method

1. Place about 100 g of soil in the flask.
2. Add distilled water and several drops of universal indicator.
3. Shake the flask vigorously and allow the soil to settle.
4. Observe and record the colour of the solution.
5. Add a few centimetres of hydrogen peroxide to the flask and carefully heat the flask.
6. When cool, observe and record the colour of the solution.

Questions

10. Pyrite (FeS_2) is a common sulfide found in some soils. It can undergo a redox reaction when exposed to the atmosphere, or when treated with an oxidising agent. In this experiment sulfides are oxidised by hydrogen peroxide. How would the pH of soil containing pyrite change if pyrite is oxidised?

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11. After oxidation would soils be more or less suitable for plants that require an approximately neutral pH for their successful growth? Explain your answer.

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Part D: Atmospheric oxidation of pyrite soil

Equipment

samples of soil containing pyrite

conical flasks (2)

large petri dish

Method

1. Record the colour, odour and any other characteristics of the soil sample.
2. Divide the soil sample into two equal volumes.
3. Place one sample in the conical flask and spread the other sample on the petri dish.
4. Cover the soil in the conical flask with about 5 cm of distilled water, add a few drops of indicator and shake vigorously.
5. When the soil has settled, observe and record the colour of the solution.
6. Expose the dish containing the soil to the air, in a secure place, for several weeks.
7. After the elapsed time record the colour and odour of the soil sample.
8. Transfer the soil in the petri dish to a conical flask.
9. Add distilled water and a few drops of indicator to the flask and shake vigorously.
10. Observe and record the colour of the solution.

Questions

12. Is there any difference in pH of the two samples? Explain how any difference might arise.

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13. Describe what a farmer may do to decrease soil acidity so that plants may be grown successfully.

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14. How could you test a soil sample for presence of pyrite?

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