Effect of pH on distribution coefficient for Zn$^{2+}$

Student worksheet

Principle

Acidic, alkaline and neutral solutions of zinc sulfate are left in contact with soil for a few days. They are filtered and the concentration of Zn$^{2+}$ ions in each filtrate determined using a zincon assay. The analytical data are used to determine the soil-water distribution coefficient for Zn$^{2+}$ in each case.

Equipment and materials

- Soil (0.1 g)
- Electronic balance
- Boiling tube x 2
- 5 cm$^3$ pipette
- 1 cm$^3$ pipette x 2
- −10 – 110°C thermometer
- Filter funnel and filter paper
- Narrow range pH indicator paper
- Zinc sulfate solution containing 0.01 g dm$^{-3}$ Zn$^{2+}$ (10 ppm), (10 cm$^3$)
- Hydrochloric acid, 0.1 mol dm$^{-3}$ (1.0 cm$^3$)
- Sodium hydroxide solution, 0.1 mol dm$^{-3}$ (1.0 cm$^3$)
- Equipment and materials for zincon assay (see Zinc by zincon assay)

Method

Care: Wear eye protection. 0.1 mol dm$^{-3}$ sodium hydroxide solution is an irritant.

1. Weigh 0.1 g samples of solid growing medium into two boiling tubes labelled ‘acid’ and alkali’. Note: Growing medium should be homogeneous soils so remove pieces of vermiculite, larger pebbles or pieces of organic materials.

2. Using pipettes add 5.0 cm$^3$ of a solution of zinc sulfate (containing 10 ppm Zn$^{2+}$) to both boiling tubes, followed by 1.0 cm$^3$ of deionised water.

3. Using a pipette, add 1.0 cm$^3$ of 0.1 mol dm$^{-3}$ hydrochloric acid to the boiling tube labelled ‘acid’ and 1.0 cm$^3$ of 0.1 mol dm$^{-3}$ sodium hydroxide solution to the boiling tube labelled ‘alkali’.

4. Leave the tubes for 3-4 days, occasionally shaking them. Record the temperature each day and calculate the average value.

5. Filter the contents of the tubes through folded paper in a funnel (then pass the filtrate through a 0.2 μm syringe filter if available).

6. Measure the pH of the filtrates using a narrow range indicator.

7. Use a zincon assay to determine the concentration of zinc ions in the filtered solutions (see Zinc by zincon assay).

Calculations

1. Calculate the mass (in mg) of zinc ions in 5 cm$^3$ of both filtrate.
2. Calculate the mass (in mg) of zinc ions bound to the growing medium in both samples.
3. Calculate $K_d$ for zinc and soil in acidic and alkaline conditions.