

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 cm³ pipette
- 1 cm³ 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 cm³)
- Hydrochloric acid, 0.1 mol dm⁻³ (1.0 cm³)
- Sodium hydroxide solution, 0.1 mol dm⁻³ (1.0 cm³)
- 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 cm³ of a solution of zinc sulfate (containing 10 ppm Zn^{2+}) to both boiling tubes, followed by 1.0 cm³ of deionised water.
3. Using a pipette, add 1.0 cm³ of 0.1 mol dm⁻³ hydrochloric acid to the boiling tube labelled 'acid' and 1.0 cm³ 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 cm³ 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.