Precipitation reactions of lead nitrate – teacher notes

Many lead compounds are insoluble and some of them are brightly coloured. In this experiment students observe some precipitation reactions of lead ions, identifying which would make good pigments.

Topic

Lead compounds – precipitation reactions and pigments

Timing

20 minutes

Equipment

Apparatus

- Eye protection
- Student worksheet
- Clear plastic sheet (eg ohp sheet)

Chemicals

Solutions should be contained in plastic pipettes. See the accompanying guidance on apparatus and techniques for microscale chemistry (https://rsc.li/3qTrzNx), which includes instructions for preparing a variety of solutions.

- Sodium hydroxide, 1 mol dm^{-3}
- Lead nitrate, 0.5 mol dm^{-3}
- Potassium iodide, 0.2 mol dm^{-3}
- Sodium chloride, 0.5 mol dm^{-3}
- Potassium bromide, 0.2 mol dm^{-3}
- Sodium carbonate, 0.5 mol dm^{-3}
- Sodium sulfate, 0.5 mol dm^{-3}
- Potassium chromate, 0.2 mol dm^{-3}

Procedure

Part 1: adding different anions to lead nitrate solution

1. Cover the worksheet with a clear plastic sheet.
2. Put one drop of lead nitrate solution in each box of table 1.
3. Add one drop of each of the solutions containing the anions indicated to the appropriate box.

Part 2: adding deionised water and tap water to lead nitrate solution

1. With the worksheet still covered, put one drop of lead nitrate solution into each box of table 2.
2. Add one drop of deionised water and one drop of tap water to the appropriate boxes.

Health, safety and technical notes

- Read our standard health and safety guidance (https://rsc.li/3ynKtyK).
- Wear eye protection throughout (splash-resistant goggles to BS EN166 3).
- Sodium hydroxide solution, NaOH(aq), 1 mol dm^{-3} is CORROSIVE. See CLEAPSS Hazcard HC091a and CLEAPSS Recipe Book RB085.
- Lead nitrate, $Pb(NO_3)_2(aq)$, 0.5 mol dm^{-3} is a reproductive toxin and a specific target organ toxin. It also causes eye damage and is a probable carcinogen. See CLEAPSS Hazcard HC057a and CLEAPSS Recipe Book RB053.
- Potassium chromate, K_2CrO_4, 0.2 mol dm^{-3} is a carcinogen, mutagen and skin sensitiser. It is also toxic to aquatic life. Wear splash-proof eye-protection if transferring large amounts. Avoid skin contact. See CLEAPSS Hazcard HC078a and CLEAPSS Recipe Book RB069.
- The following chemicals are low hazard:
    - Potassium bromide, KBr(aq), 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC047b and CLEAPSS Recipe Book RB068.
    - Sodium sulfate, Na_2SO_3 (aq), 0.5 mol dm^{-3} – see CLEAPSS Hazcard HC098B and CLEAPSS Recipe Book RB107.
    - Sodium carbonate, 0.5 mol dm^{-3} – see CLEAPSS Hazcard HC095A and CLEAPSS Recipe Book RB080.
    - Potassium iodide, KI(aq), 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC047b and CLEAPSS Recipe Book RB072.

Questions for students

Part 1

1. Which of the lead compounds observed appear to be good pigments?
2. What is the main disadvantage of using these compounds as pigments?

Part 2

1. What explanations can you give for your observations?

Teaching notes and expected observations

Part 1

The addition of solutions of each of the anions produces precipitates, which indicates that in general lead compounds are insoluble. The iodide is an intense yellow colour, the chromate(VI) is also yellow and both could be used as pigments except for the fact that lead compounds are toxic.

Part 2

The fact that lead forms insoluble compounds is used as a basis for indicating the presence of anions in water. The addition of deionised water to lead nitrate gives no cloudiness. However, with tap water a cloudiness gradually develops if the water is from a hard water area since carbonates, sulphates or hydrogen carbonates may be present. If you live in a soft water area there will probably be no cloudiness. (One solution is to simulate hard water conditions.)