The chemical properties of hydroxybenzene– teacher notes

Topic

Organic compounds, chemical properties.

Timing

20 minutes

Description

In this experiment students observe and interpret some of the chemical reactions of hydroxybenzene (phenol).

Apparatus

- Eye protection
- Clear plastic sheet (eg OHP sheet)
- Plastic Petri dish, 9 cm diameter

Chemicals

- Deionised water
- Full-range indicator solution – diluted 1:1 with deionised water
- Nitric acid,1 mol dm^{-3}
- Iron(III) nitrate, 0.1 mol dm^{-3}
- Sodium carbonate, 1 mol dm^{-3}
- Sodium hydroxide, 1 mol dm^{-3}
- Hydrochloric acid, 1 mol dm^{-3}
- Hydroxybenzene (phenol)
- The students should sample the bottle of hydroxybenzene (phenol) using the method in our standard health and safety guidance here https://rsc.li/3LNbkfo
- Solution should also be contained in plastic pipettes, instructions for preparing a variety of solutions are found at the above link.

Observations

- Hydroxybenzene (phenol) is partially soluble in water, and oily drops should be observed. An acidic solution is formed, and the indicator solution should turn red.
- The mixture turns dark as the hydroxybenzene (phenol) reacts with the nitric acid to give a mixture of nitrophenols.
- A violet colouration is seen, which is characteristic of the reaction between iron(III) and phenolic OH groups.
- No reaction is observed with sodium carbonate solution, indicating that hydroxybenzene (phenol), although acidic, is not a strong enough acid to liberate carbon dioxide from carbonates.
- Hydroxybenzene (phenol) dissolves readily in sodium hydroxide to form sodium phenoxide. The hydroxybenzene (phenol) is liberated and oily drops should be observed when this solution is acidified with hydrochloric acid.

Health, safety and technical notes

- Students must wear suitable eye protection (Splash resistant goggles to BS EN166 3).
- Hydroxybenzene (phenol) is hazardous and gloves should be worn (see CLEAPSS Hazcard HC070a).
- Nitric acid, 1 mol dm^{-3} HNO_3 (aq), is CORROSIVE (see CLEAPSS Hazcard HC067).
- Sodium hydroxide,1 mol dm^{-3} is corrosive, iron(III) nitrate, $Fe(NO_3)_3.9H_2O$ (aq),0.2 mol dm^{-3}, sodium carbonate 1 mol dm^{-3} and hydrochloric acid, HCl(aq), 1 mol dm^{-3}, are of low hazard (see CLEAPSS Hazcard HC091a, HC055c, HC095a, HC047a).
- Hydroxybenzene (phenol) is CORROSIVE, TOXIC by all routes and causes damage to organs on repeated or prolonged exposure (see CLEAPSS Hazcard HC070a). Dangerous if in contact with sodium nitrate (see CLEAPSS Hazcard HC093)
- Depending on the formulation of the Universal indicator, a 1:1 dilution with water might still be flammable. Keep away from sources of ignition.