

Preparation of pentaammine-chlorido-cobalt(III) chloride

Pentaammine-chlorido-cobalt(III) chloride is formed as one of the products in the oxidation of cobalt(II) salt solution containing ammonia. Because of its dark pink colour, he is sometimes called cobalt(III) roseochloride (Latin *roseus* = pink). It may be prepared by a heterogenous redox reaction



Úloha

Prepare pentaammine-chlorido-cobalt(III) chloride.

Chemikálie

- cobalt(II) chloride hexahydrate, $\text{CoCl}_2 \cdot 6 \text{H}_2\text{O}$, dark violet crystalline substance,
- ammonia, NH_3 , concentrated water solution, $w(\text{NH}_3) = 0,26$,
- ammonium chloride, NH_4Cl , white crystalline substance,
- hydrogen peroxide, H_2O_2 , concentrated, $w(\text{H}_2\text{O}_2) \approx 0,30$,
- hydrochloric acid, HCl , concentrated, $w(\text{HCl}) = 0,36$.

Postup

Pour $9,0 \text{ cm}^3$ of concentrated ammonia solution into an Erlenmeyer flask. Dissolve $1,0 \text{ g}$ of ammonium chloride in the ammonia solution. Under continuous stirring add $2,0 \text{ g}$ of finely powdered cobalt(II) chloride hexahydrate in small portions. A gold-pink precipitation of hexaammine-cobalt(II) chloride is formed.

Under continuous stirring add dropwise $2,0 \text{ cm}^3$ of 30 wt% hydrogen peroxide solution. Hexaammine-cobalt(II) chloride dissolves forming dark-red liquid aqua-pentaammine-cobalt(III) cation. Once the reaction mixture is quiet, add $6,0 \text{ cm}^3$ of concentrated hydrochloric acid in few portions. Heat and stir the solution after adding each portion of hydrochloric acid. It is recommended to perform this operation in a fume hood, because white fume of ammonium chloride could appear.

Heat the final reaction mixture around 30 minutes in a water bath (Fig. 1) at temperature $75 - 85 \text{ }^\circ\text{C}$. A dark-red precipitate in a green solution will be formed. Cool the flask under cool water stream. Filter out the product on a Büchner funnel, wash it with $4,0 \text{ cm}^3$ of ice-cooled water and finally, with the same amount of 20 wt% hydrochloric acid cooled to $10 \text{ }^\circ\text{C}$. Dry up the product in an oven at $105 \text{ }^\circ\text{C}$.

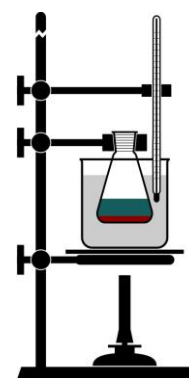


Fig. 1 Apparatus for the preparation of $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_2$

Cobalt(II) chloride hexahydrate – CoCl₂ · 6 H₂O

- R22** Harmful if swallowed.
R49 May cause cancer by inhalation.
R42/43 May cause sensitization by inhalation and skin contact.
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S22 Do not breathe dust
S45 In case of accident or if you feel unwell seek medical advice immediately (show the label where possible).
S53 Avoid exposure – Obtain special instructions before use.
S60 This material and its container must be disposed of as hazardous waste.
S61 Avoid release to the environment. Refer to special instructions/safety data sheet.

Ammonia – NH₃

- R10** Flammable.
R23 Toxic by inhalation.
S16 Keep away from sources of ignition – No smoking
S38 In case of insufficient ventilation wear suitable respiratory equipment
S7/9 Keep container tightly closed and in a well-ventilated place.

Ammonium chloride – NH₄Cl

- R22** Harmful if swallowed.
R36 Irritating to eyes.
S22 Do not breathe dust

Hydrogen peroxide – H₂O₂

- R34** Causes burns.
S3 Keep in a cool place.
S28 After contact with skin, wash immediately with plenty of (to be specified by the manufacturer).
S45 In case of accident or if you feel unwell seek medical advice immediately (show the label where possible).
S36/39 Wear suitable protective clothing and eye/face protection.

Hydrochloric acid – HCl

- R34** Causes burns.
R37 Irritating to respiratory system.
S2 Keep out of the reach of children
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice