

15.1 Cobalt chloride equilibrium

Subject: Equilibrium, kinetics

Description: Test tubes containing a pink solution of cobalt and chloride ions are placed in hot water and cold water. The tube placed in hot water will turn blue. The tube placed in cold water will turn more pink.

Materials: (no bin-all items on shelf)

2 Pre-prepared test tubes with cobalt chloride and HCl (pink solutions)[‡] in beaker

2 Pre-prepared test tubes with aqueous cobalt chloride (purple solutions)[‡] in beaker

hot plate*

hot water bath

ice water bath (get ice from Gen chem labs prior to class)

Optional: heat gun*

[‡]Test tubes with pre-prepared solutions and beakers are located in the solutions cabinet.

*Shared items. Hot plate is located in the top drawer opposite the chemical storage cabinets or on the center bench. The heat gun is in the drawer below.

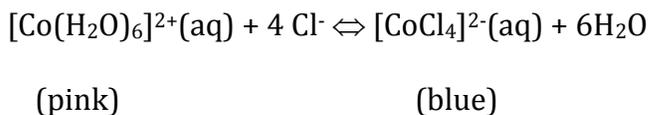
Procedure:

1. Prepare the hot water and ice baths.
2. Place one of each tube in the hot water.
3. Place one of each tube in the ice bath.
4. Observe the colors of the solutions after several minutes.

Alternatively you can use the heat gun to increase the temperature of the cobalt chloride solutions to shift the equilibrium.

Discussion:

An equilibrium exists between a hydrated cobalt species and anhydrous cobalt chloride, both have an oxidation state of 2⁺. See the equilibrium below:



A change in temperature or concentration of the ions will shift the equilibrium. If heat is added, the equilibrium will shift towards the cobalt chloride complex, which is blue in color. Cooling will shift the products towards the hydrated complex, which is more pink. If the chloride or cobalt concentrations increase, the equilibrium will also shift towards the blue anhydrous cobalt chloride. Add water, however, and the equilibrium will shift back towards the pink hydrated species.

Safety: Use caution working with acidic solutions. Wear proper protective equipment.

Disposal: None. Tubes can be reused.

References:

1. L. Summerlin, J. Ealy; *Chemical Demonstrations: A Sourcebook for Teachers*. Volume 1; 1985; p. 53
2. B.Z. Shakhashiri. *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; Wisconsin; 1983; Vol. 1; p 280-285