Le Chatelier’s Principle – CoCl\textsubscript{2} Thermosiphon

**Description:** Le Chatelier’s principle is demonstrated by a thermosiphon apparatus which heats and cools a solution of CoCl\textsubscript{2}. The equilibrium shift caused by the change in temperature is observed through the color change between the anhydrous (blue) and hexahydrate (pink) forms of CoCl\textsubscript{2}.

**Materials:**

- Thermosiphon apparatus
- Variac
- (Dabney 125)
- Ice

**Procedure:**

30 minutes prior to the demonstration, setup the thermosiphon by plugging in the variac to the apparatus and filling the plastic cup with ice as shown in the side figure. Set the power on the variac to 30%.

**Discussion:** This demonstration is unique in that both the anhydrous and hydrated forms of CoCl\textsubscript{2} are generated within the same reaction vessel. While the nature of the species in solution during the cobalt demonstration is not fully known, this experiment serves as an excellent demonstration of Le Chatelier’s principle. In dilute aqueous solutions the dominant cobalt species is Co(H\textsubscript{2}O)\textsubscript{6}\textsuperscript{2+}. Since the reaction shown below is endothermic the shift from Co(H\textsubscript{2}O)\textsubscript{6}\textsuperscript{2+} to CoCl\textsubscript{4}\textsuperscript{2-} is induced by an increase in temperature. The reverse reaction occurs when the solution is cooled. The chemical equation used to describe this equilibrium is commonly written as:

\[
[\text{Co(H}_2\text{O)}_6]^{2+}(\text{aq}) + 4 \text{Cl}^- (\text{aq}) \rightleftharpoons \text{CoCl}_4^{2-}(\text{aq}) + 6 \text{H}_2\text{O (l)}
\]
Equilibrium

Safety: Do not touch the heating wrap while the demonstration is in progress.

References:

Summerlin, L. R.; Ealy, J. L. In Chemical Demonstrations: A Sourcebook for Teachers; American Chemical Society: 1985; Vol. 1, p 53.