Dry Ice and Limewater

**Description:** CO₂ is bubbled through a limewater solution forming a precipitate. As bubbling continues, the precipitate redissolves. A person blowing CO₂ through the solution can also cause precipitation but cannot redissolve the precipitate.

**Materials:**

- Saturated Ca(OH)_2 solution
- 2 beakers or large grad. cylinders
- Dry Ice
- Straw
- Bromothymol blue indicator
- Hot plate and stir bar

**Procedure:**

1. Pour 150-200 mL of limewater into each of two containers. Have a volunteer blow CO₂ into one of the beakers while dry ice is placed in the other beaker.

2. Over time, a precipitate will form in each container although the precipitate eventually dissolves in the container containing dry ice. The clear solution which contained dry ice can be heated and stirred to once again generate a precipitate. Further saturation of this solution with CO₂ will not dissolve the newly formed precipitate.

**Discussion:** CaCO₃ forms in each container (K_{sp} = 4.5 \times 10^9 for calcite). This precipitate dissolves in the container in which pure CO₂ is being bubbled due to the formation of calcium bicarbonate, Ca(HCO₃)₂, which is more soluble. Heating removes CO₂ from the solution, thus driving the equilibrium back to the formation of calcium carbonate. The net ionic equations relevant to this demonstration are shown below.

\[2 \text{OH}^{1-} (aq) + \text{CO}_2 (g) \rightarrow \text{H}_2\text{O} (l) + \text{CO}_3^{2-} (aq)\]
\[\text{Ca}^{2+} (aq) + \text{CO}_3^{2-} (aq) \rightarrow \text{CaCO}_3 (s)\]
\[\text{CO}_2 (g) + \text{H}_2\text{O} (l) + \text{CaCO}_3 (s) \rightleftharpoons \text{Ca}^{2+} (aq) + 2 \text{HCO}_3^{-} (aq)\]
Safety: Wear proper protective equipment while setting up and performing this demonstration. Saturated Ca(OH)$_2$ is a strong base and can irritate the skin and eyes. Dry ice has a temperature of -78 °C and can cause frostbite to exposed skin. Wear insulating gloves while handling dry ice.

Disposal: Solutions can be flushed down the drain with plenty of water.

References:


Video:

http://www.youtube.com/watch?v=4G0djU9y8LY