Chilling effects

Education in Chemistry
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Technicians notes

This demonstration is an example of a spontaneous solid-solid endothermic reaction.

Kit

Hazcard and recipe book references are to CLEAPSS resources

- Eye protection
- Two 100 cm^3 beakers
- Stirring rod
- Barium hydroxide-8-water, c.32 g (corrosive) (*Hazcard 10B*)
- Either ammonium thiocyanate, c.15 g (harmful) (*Hazcard 9B*) or ammonium chloride, c.11 g (irritant) (*Hazcard 9A*)
- Universal indicator (or red litmus) paper, 1 strip
- Watch glass or small wooden block with one side of similar size to the base of the beaker
- Thermometer that reads to –30°C or lower

Safety and disposal

Wear eye protection. All waste can be disposed of down the sink with plenty of water.

Preparation

Weigh out the solids in separate beakers. Stand the beaker containing the barium hydroxide in a watch glass containing a few drops of water, or on a wooden block with a few drops of water on top. You want good contact between the base of the beaker and the water.

In front of the audience

Work in a well-ventilated room or a fume cupboard. Take an initial reading of the temperatures of the two beakers and point out the liquid water on which the barium hydroxide beaker is standing. A digital thermometer that can be connected to a display or digital infrared thermometer can be useful here.

Add the ammonium salt and mix the powders with the stirring rod. The temperature will rapidly drop to approximately –20°C, the water on the base freezes causing the watch glass or wooden block to freeze to the flask. In the case of the thiocyanate reaction, the solids dissolve in barium hydroxide's water of crystallsation. Damp red litmus held over the top of the flask turns blue to reveal the presence of ammonia vapour – take care not to inhale the toxic vapour.

Once the production of ammonia has stopped, the beaker can be passed around the class, taking care to ensure the watch glass is removed first or that it is supported from underneath.