

11.1A Solubility of iodine in water and Methylene Chloride (Intermolecular forces II)

Subjects: Properties of liquids, intermolecular forces

Materials:

Large test tube

H₂O wash bottle

Methylene chloride‡

Iodine‡

KI‡

Spatula and tweezers

1% starch solution‡

Disposable pipets

150 ml beaker (optional: for holding methylene chloride)

Test tube rack (Located on shelf above central bench)

‡Methylene chloride can be found in the flammables cabinet. Iodine and KI are located in the general chemical storage cabinets. The starch solution is located in the refrigerator.

Procedure:

Note: Use the demo camera to display the procedure.

1. Place the test tube in the rack and add dI water.
2. Using the tweezers, drop in a crystal of iodine. The iodine will not dissolve.
3. Add methylene chloride to the test tube, stopper and mix. The iodine will extract into the methylene chloride (bottom) layer, producing a dark pink color.
3. Add some KI to the test tube with the spatula. The KI will dissolve in the water layer. Agitate the test tube to mix again. The I⁻ ions in the aqueous layer will react with the I₂ in the organic layer to form triiodide (I₃⁻) ions, which are soluble in water. The layers will separate and some of the I₃⁻ will be extracted into the water layer, creating an amber color.
4. Optional: Add starch solution to produce the dark blue iodine-starch complex.

Discussion:

“Like dissolves like”. Methylene chloride is non-polar while water is polar and thus these two liquids do not mix. Methylene chloride is more dense than water and is the bottom layer. Iodine is non-polar and thus dissolves in methylene chloride by dispersion forces (induced dipole/induced dipole). A small amount of iodine may dissolve in the water initially due to dipole/induced-dipole interactions producing a slight brown color.

Safety: Use proper precautions when dealing with organic solvents. Avoid inhaling I₂ vapors.

Disposal: Dispose of methylene chloride/iodine mixture in appropriate chlorinated waste container.

References:

1. NCSU Chemistry Department Lecture demonstration website "Solubility, Separations, and Emulsions":

<http://www.ncsu.edu/project/chemistrydemos/DemoList.html>

2. L. Summerlin, J. Ealy; *Chemical Demonstrations: A Sourcebook for Teachers*; Volume 1; 1985; P. 34 (variation)