Solubility, Separation, and Emulsions

Description: Four mixtures are described here to illustrate the concepts of solubility, separation and emulsification.

Materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Corn Oil</td>
<td>Separatory funnel</td>
</tr>
<tr>
<td>Water</td>
<td>Ring stand/clamp</td>
</tr>
<tr>
<td>Liquid soap</td>
<td>Food coloring</td>
</tr>
<tr>
<td>Chloroform</td>
<td>I$_2$</td>
</tr>
<tr>
<td>Hexanes</td>
<td>KI</td>
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</tbody>
</table>

Procedure:

For larger audiences, this demonstration is best performed using a document camera.

1. In a separatory funnel add 50 mL of colored water and 50 mL of corn oil. Shake vigorously and observe the two liquids form separate layers immediately.

2. To the mixture above, add a small amount of liquid detergent. Shake vigorously and set back in ring clamp. The liquid detergent forms emulsions in the mixture resulting in a much slower separation.

3. An alternative demonstration is outlined by Wagner (BCCE, 2006). In the following order, chloroform, water, and hexane are layered in a separatory funnel. A small amount of I$_2$ is added and dissolves in the bottom CHCl$_3$ layer as well as the hexanes layer. When mixed, two layers are generated as chloroform mixes with hexanes. I$_2$ is extracted from the organic layer by addition of KI which reacts at the interface of the phases to generate I$_3$ $^{1-}$, which is soluble in the aqueous phase.
4. To aid in visualizing viscosity and density, two separate display racks are available in Dabney 114 (below)

Discussion: The concept of like dissolves like is illustrated in this demonstration. As observed, hydrocarbons are not miscible with water. When liquid detergent is added, small micelles are formed in which some of the hydrocarbon liquid is trapped inside a small sphere of detergent molecules, thus impeding the ability of the two liquids to separate.

Safety: Wear proper protective equipment including gloves and safety glasses when preparing and performing this demonstration. ALWAYS release internal pressure built up from vigorous shaking by inverting the separatory funnel so that the tip is pointing away from audience members and opening the stopcock valve to release built up vapors. This is necessary when using hexanes. Care should be taken when handling chloroform as it is toxic and carcinogenic.

Disposal: Dispose of contents in an appropriate waste container.

References:

Summerlin, L. R.; Ealy, J. L. In Chemical Demonstrations: A Sourcebook for Teachers; American Chemical Society: 1985; Vol. 1, p 34. (variation)

Wagner, K. “Like dissolves like.” 19th Biennial Conference on Chemical Education, Purdue University, West Lafayette, IN, 2006.

Video:

http://www.youtube.com/watch?v=vcwfhdhLiQU (separation)