**Emulsions: Mixing Immiscible Liquids**

AIChE at the University of California, Los Angeles

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1. **Overview**

“Emulsions” are a mixture of two liquids that do not normally mix. We can mix the liquids with the help of special chemicals called “surfactants” that allow the two liquids to act with each other. Emulsions are common in food such as mayonnaise, vinaigrette salad dressing, and butter.

1. **Objective**
   1. Describe what immiscible liquids are and why scientists might want to mix them
   2. Demonstrate how emulsions are formed by developing an understanding of how surfactants allow mixing
2. **Materials**
   1. Oil
   2. Water
   3. Clear container (glass jar, water bottle, etc.)
   4. Dishwashing detergent
   5. Waste bucket
      1. Necessary to dispose of oil-water waste. Never pour volumes of oil down drains because it can build up and solidify and clog pipes.
   6. Food coloring, optional
   7. Dispensing device, optional (Pipette, syringe, etc.)
3. **Procedure**
4. Ask students if they are familiar with oil and water, and what they might think occurs when you try to mix them.
5. Pour a mixture of about 1/3 oil and 2/3 water into the clear container. Mix them and let the solution settle, showing the students how the liquids separate.
6. Describe that the oil and water are “immiscible” meaning that they do not mix together. Ask the students if they can think of a way to mix the two.
   * 1. If food coloring is available, demonstrate that the adding a drop or two causes the liquid dye to mix with the water, but not the oil.
7. Add a few drops of detergent into the oil-water mixture after it separates. The detergent should fall through the oil and drag it into the water, mixing the two. Shake the container to suspend oil droplets in the water.
8. Dispose of the entire mixture in the waste container and throw away properly.
9. **Theory**
   1. Immiscible liquids:
      1. Not all liquids are able to mix and when they are not, they are called *immiscible*. Oil and water are an example of this.
      2. For higher level students (grades 7+), immiscible liquids often occur due to different polar and nonpolar interactions between the liquid molecules.
   2. Density:
      1. When the oil and water separate, the oil rises to the top. This is because oil is *less dense* than water. This means that the particles of water are heavier (per unit volume) than oil and sink. Just like how very dense rocks sink at the bottom of a lake, water sinks below oil.
   3. Emulsions and real-world examples:
      1. *Emulsions* are mixtures of immiscible liquids.
      2. Examples of emulsions used in every day food include: butter, mayonnaise, espresso cream, egg yolk, and salad dressing. Most of these are emulsions of fat particles in water.
   4. Surfactants/Emulsifiers:
      1. *Emulsifiers* are special molecules that allow immiscible liquids to be mixed.
      2. *Surfactants*, in particular, have one side that interacts with oil and one that interacts with water, allowing it to act like a bridge between the two and promoting the formation of an oil-water mixture.