

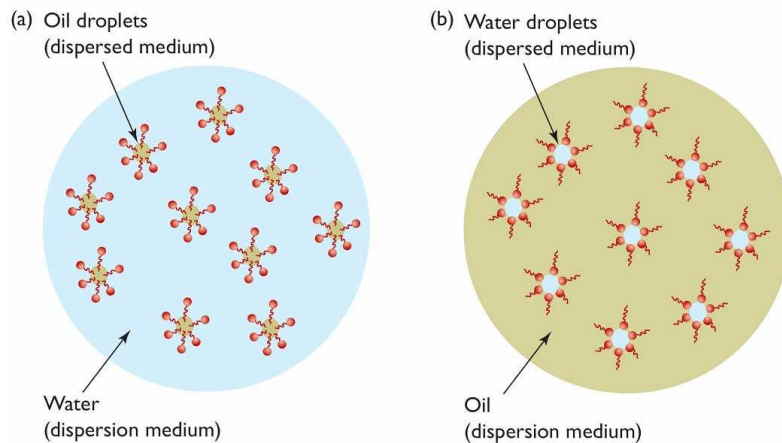
## EXPERIMENT #5

### EMULSIONS

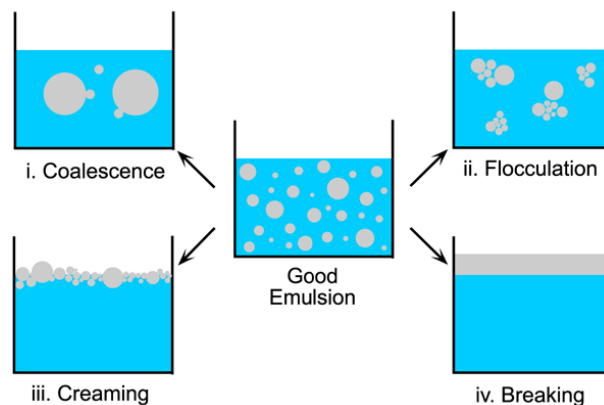
#### Introduction

An emulsion is a dispersed system in which the phases are immiscible or partially miscible liquids. In nearly all emulsions, one of the phases is aqueous and the other is an oil. If the oil is the dispersed phase, the emulsion is termed an oil-in-water (O/W) emulsion; if the aqueous medium is the dispersed phase, the emulsion is termed a water-in-oil (W/O) emulsion.

The practical application of emulsions and emulsion technology is considerable, and includes foodstuffs (milk, mayonnaise), pharmaceutical preparations, cosmetics, agricultural sprays and bituminous products.



In order to create an oil in water emulsion (one that remains stable for a long enough time), work must be done to overcome the interfacial tension between the two phases. This can be achieved by mixing; however mixing even at very high rates is not enough to provide long term *stability*. An *emulsifier* or combination of emulsifiers is needed to stabilize droplets of the dispersed phase. The materials which are most effective as emulsifying (and foaming) agents can be broadly classified as: 1. Surface-active materials 2. Naturally occurring materials. 3. Finely divided solids. The emulsifying agent forms an adsorbed film around the dispersed droplets which helps to prevent coagulation and coalescence.



All emulsifiers consist of a molecule that combines both hydrophilic and lipophilic groups. William C. Griffin developed a way to streamline the selection of surfactants by utilizing the ratio of the hydrophobic to the hydrophilic portion of the molecule. The HLB of an emulsifier is an expression of its Hydrophile-Lipophile Balance, i.e. the balance of the size and strength of the hydrophilic (water-loving or *polar*) and the lipophilic (oil loving or *non-polar*) groups of the emulsifier. Surfactants with high HLB values will be more water soluble and those with low HLB values are more oil soluble. The HLB for a nonionic surfactant can be calculated as follows:

$$\text{HLB} = \text{Weight \% Hydrophile} / 5$$

### **Materials:**

Diesel oil

Distilled water

Triton X-15 and Triton X-100 as emulsifiers (HLB values of these non-ionic surfactants are 4.9 & 13.4 respectively)

### **Experimental Procedure**

Pour 10 ml water and 10 ml diesel oil into both test-tubes, using a Pasteur pipette add a few drops of Triton X-15 to one of the test-tubes and a few drops of Triton X-100 to the other. Label the test-tubes. Shake the test-tubes just long enough until a stable emulsion forms. Using a pipette place a drop of emulsion on a slide and cover it with a cover glass. Look at both emulsions under the microscope.

### **Report:**

- Discuss whether an oil in water (O/W) or a water in oil (W/O) emulsion is formed upon your observations under the microscope. How does the HLB value of the emulsifier determine the type of emulsion.
- What is the chemical formula of Triton X type surfactants. Name the hydrophilic and hydrophobic parts. What are the molecular weights of these parts? Find the weight percentage of hydrophilic part of the Triton X-100 knowing that it has an average of 9.5 ethylene oxide units per molecule. Show that the HLB value of Triton X-100 is 13.4. Make the same calculation for Triton X-15 which has an average of 1.5 ethylene oxide units per molecule.
- What is the HLB value of 70/30 blend of these two emulsifiers?