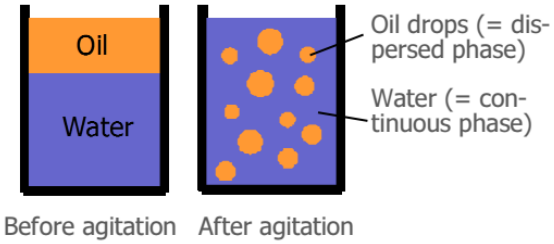
# Emulsifiers

MAKING COSMETICS

Emulsions are the most common type of delivery system used in cosmetics. They enable a wide variety of ingredients to be quickly and conveniently delivered to hair and skin. Creams and lotions are typical examples of emulsion-based cosmetics. Not only for the professional but also the amateur cosmetics maker there are large variety of techniques and methods to create different types of cosmetic emulsions. Some basic knowledge, however, is essential to make good and stable emulsions.

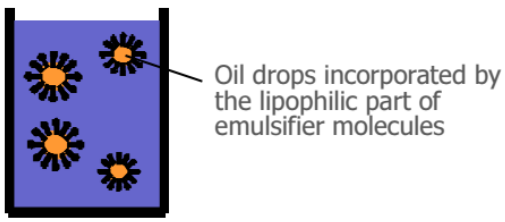
If two liquids such as water and alcohol are mixed together, a solution is formed. The droplets of both liquids mix and mingle with each other so that there is no boundary between one liquid and the other one. The two liquids are miscible. However, oil and water do not mix. They stay as two separate layers with a clear boundary between them, because the attraction forces between the droplets are very different preventing from mingling together. The forces between water particles are very strong, whereas oil particles are only weakly held together. Thus, the oil particles cannot stay between water particles as they cannot overcome the strong attractions between the water particles.

In an emulsion, however, oil and water can be forced to mix. Instead of forming two separate layers with a clear boundary between them, small droplets of one liquid (= dispersed phase) are spread throughout the other liquid (= continuous phase). Hence, an emulsion can be defined as a mixture consisting of an immiscible liquid dispersed in another liquid in the form of tiny droplets.




## Agitation

This incompatibility of water and oils can be overcome by agitating. Agitation disperses the molecules and generates an emulsion. The droplets formed by shaking are normally 0.1 to 0.5mm in size, and are visible to the bare eye. Using a special high-pressure homogenization process it is, however, also possible to achieve a much smaller droplet size of only 0.0001 mm (= nano-emulsions). The droplets in an emulsion scatter the light passing through it making the emulsion appear opaque grey or white (like milk as a natural emulsion). Emulsions made by simply agitating water and oil, however, will separate within a short time. Therefore, emulsifiers are needed.




## What Emulsifiers Do

Emulsifiers are compounds able to stabilize the dispersed droplets in the continuous phase. Emulsifiers are molecules consisting of a water-loving (hydrophilic) part and water-hating but oil-loving (lipophilic) part. With their lipophilic part emulsifiers wrap around and incorporate oil drops thereby preventing them from reunite again to form a separate oily phase. In this way, the oil particles are shielded from each other resulting in a stable emulsion.

## Emulsifier Function and HLB-Values

- HLB 1 - 3: Antifoaming Properties
- HLB 3 - 8: w/o-Emulsification
- HLB 7 - 9: Wetting Properties
- HLB 9 - 18: o/w-Emulsification
- HLB 15 - 20: Solubilizing Properties

## HLB of Widely Used Emulsifiers

| | |
|---|---|
| • Sorbitan Trioleate | HLB 1.8 |
| • Egg Yolk / Soy (Lecithin) | HLB 4.0 |
| • Sorbitan Monostearate | HLB 4.7 |
| • Triglyceryl Monooleate | HLB 5.0 |
| • PEG-7 Glyceryl Monococoate | HLB 11 |
| • Polysorbate 80 | HLB 15 |

## W/O Emulsions

- Usually contain more oils than water
- Are made with emulsifiers with a low HLB (4-6)
- Are ideal to dissolve oil-soluble active ingredients
- Provide excellent moisture and skin protection
- Tend to be greasy and are not absorbed very well
- Needs usually to be heated for stable emulsification
- Typically used for creams and ointments

## O/W Emulsions

- Are made with emulsifiers with a high HLB (8-10)
- Are stable in a wide pH range
- Are light, less greasy and easily absorbed
- Need usually to be heated for stable emulsification
- Can be diluted/dispersed further with water
- Can be thickened with water-soluble thickeners
- Typically used for lotions, creams

## HLB System

The usual method for choosing an emulsifier is known as the Hydrophilic-Lipophilic Balance (HLB) system which uses a scale of 0 to 20 based on their affinity for oil and water. Emulsifiers with low HLB-values are more lipophilic, while higher HLB compounds are hydrophilic. In general, emulsifiers with HLB-values of 3 – 8 give w/o-emulsions, whereas those with values of above 9 are more water-soluble and result in o/w-emulsions.

Sometimes several emulsifiers are mixed together before using them in formulas. Such emulsifying blends are commonly called emulsifying waxes. Typically, they contain 4-5 compounds such as polysorbate 60, cetearyl alcohol, PEG-150 stearate, and steareth-20.

## Types of Emulsions

The most typical emulsion is one in which an oil is dispersed in water. Understandably, this is called an oil-in-water (o/w) emulsion. If water droplets are dispersed in oil the resulting emulsion is called water-in-oil (w/o) emulsion. Generally, o/w-emulsions are typically chosen for applications requiring a relatively small amount of fatty material as hand, shaving or moisturizing creams.

On the other hand, w/o-emulsions are preferred when a large amount of oil is desired. This system has a greasier feel and leave a longer-lasting residue. Typical products are emollient creams and sunscreens. In addition to the simple two-phase emulsion it is possible to make also multiple emulsions as w/o/w-emulsions (w/o-emulsion in water).

## Destabilization of Emulsions

Although emulsifiers help stabilize the oil and water phase, emulsions are still inherently unstable and eventually will separate. The speed at which this occurs depends on the composition of the emulsion. There are 3 ways how an emulsion can destabilize:

- Creaming or sedimentation: a fatty cream appears due to the assembly of the large drops (example: unhomogenized milk). Creaming can be reversed by agitation.
- Flocculation: small flocci are formed. Flocculation is not a serious destabilization since it can be reversed also by agitation.
- Coalescence: the oily and watery phase are completely separated due to merging droplets to form large drops. Coalescence is irreversible.

By selecting the adequate emulsifier (w/o or o/w type) and using it at an appropriate concentration, everybody can make great emulsions without expert knowledge.