

Stability engaging
with the aqueous
continuous phase.



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stability of the emulsion. A charged surfactant monolayer through the addition of an ionic surfactant increases the repulsion energy between the particles, further improving the stability of the emulsion.

Most commonly non-ionic surfactants are employed in pharmaceutical emulsions as they are not adversely affected by additives and their low toxicity. In oil in water emulsions the hydrophobic hydrocarbon portions of the non-ionic surfactant adsorb into the oil emulsion droplet leaving the hydrophilic oxyethylene engaging with the aqueous continuous phase. This hydrophilic monolayer allows dispersion of the oil in the aqueous continuous phase (2). Surfactant molecules in water in oil emulsions follow the same mechanism to orientate the hydrophobic hydrocarbon chains with the oil continuous phase. The hydrophobic particles are in contact with the aqueous droplet. The protruding hydrocarbon chains of surfactant monolayer stabilise the dispersed system through three main mechanisms.

The first of which is enthalpic stabilisation, when the droplets come into close proximity (i. e. within twice the length of the coating hydrocarbon chains) the overlapping of the hydrocarbon chains displaces the continuous molecules that occupies the space between the chains, this is a positive enthalpy change and therefore thermodynamically unfavourable.

The second mechanism is the effect of the overlapping of the hydrocarbon chains restricting their conformational freedom; this is a negative change in entropy which is also unfavourable. Finally there is what is termed an 'osmotic effect' produced due to the high concentration of chains in one area this is unfavourable and the system will dilute the chains with the continuous

phase molecules (2). Selection of a particular surfactant for an emulsion system can be aided by the hydrophile-lipophile balance or HLB. This system is based on the fraction of hydrophilic to hydrophobic groups within a particular surfactant molecule. The system produces a figure that can be used to select the appropriate surfactant according to the requirements of the drug product.

General observations suggest that a mixture of surfactants produces a more stable emulsion. The mixture of a surfactant with a specifically selected co-surfactant can produce a more condensed rigid film improving the stability of the emulsion. The mixture of surfactant and co-surfactant can be altered to produce a suitable result (5).

A key factor in determining the dissolution of a solid dosage form is penetration of water in to the powder or tablet. The ease of interaction of the water with the solid is termed the wettability. The measurement of contact angle of a droplet of a certain liquid when placed on the surface of solid is an indication of the degree of how wettable a solid is.

The smaller the contact angle the receptive the solid is to being wetted, up to a completely wetted solid which would have a contact angle of 0°. For solids that cannot be satisfactorily wetted by a given liquid, a coating of surfactant can be employed on the surface of that solid dosage form reducing the contact angle and improving the wetting and thus the dissolution (5). Surfactants have been applied to inhalation products for a number of different applications.

In meter dose inhalers surfactants can be applied to the two main types of MDI formulation. The first of which are formulations intended to keep the drug molecules in solution, a surfactant can be employed following the principles previously discussed to improve the solubility of a specific drug compound. Suspended formulations may employ surfactants for any of the reasons previously discussed for all suspended formulations such as prevention of aggregation of particles, there are however other applications specific to MDI formulations. Surfactants maybe employed to lubricate the mechanical features of the device and prevent the build up of solids on the mechanical and other wetted parts of the device.

MDI dosage forms are designed to deliver a certain proportion of drug particles that are less than 5 μm in size; this is known as the fine particle mass. It is this critical parameter that determines the effectiveness of the drug, as the particles $<5 \mu\text{m}$ are most likely to be distributed in the lower regions of the lungs. Other than the suspended particle size, surfactant molecules are believed to decrease the electrostatic build up on the micronized plume of drug product produced on actuation of the device. Electrostatic build up has been linked to the aggregation of particles (6).

Non-ionic surfactants are commonly employed in MDI formulations such as oleic acid (7). Monolayers of surfactant molecules can be produced with select molecules that have very long hydrocarbon chains. The monolayers are produced through dissolving the surfactant in a suitable volatile solvent and carefully injecting it on to a surface of water. The surfactant molecules are anchored to the surface by their polar groups and the chains protruding into the air, forming a stable monolayer. As there is no interchange of <https://assignbuster.com/stability-engaging-with-the-aqueous-continuous-phase/>

surfactant molecule with the bulk of the liquid the number of surfactant molecule that makes up the film is known.

This has various applications in the study of drug products one of which is modelling of drug membrane interactions (2).