

MULTIPLE EMULSION
&
MICRO EMULSION

MICRO EMULSIONS

“ A micro emulsion is a system, of water ,oil and an amphiphile which is a single optically isotropic and thermodynamically stable liquid solution.”

In some aspects, micro emulsions can be considered as small scale versions of emulsions ,i.e , droplet type dispersions either of oil-in-water (o/w) or of water in oil (w/o) with a size range in the order of 5-50nm in drop radius.

TYPES OF MICROEMULSIONS

Three types of micro emulsions are most likely to be formed depending on the composition:

- Oil in water micro emulsions wherein oil droplets are dispersed in the continuous aqueous phase
- Water in oil micro emulsions wherein water droplets are dispersed in the continuous oil phase
- Bi-continuous micro emulsions where in micro domains of oil and water are inter dispersed within the system.

A micro emulsion is considered to be a thermodynamically or kinetically stable liquid dispersion of an oil phase and a water phase, in combination with a surfactant.

The key difference between emulsions and micro emulsions are that the former, whilst they may exhibit excellent kinetic stability, are fundamentally thermodynamically unstable and will eventually phase separate

Another important difference concerns their appearance; emulsions are cloudy while micro emulsions are clear or translucent

PREPARATION OF MICROEMULSION:

Microemulsions were prepared at 27°C by a titration method. The drug is dissolved in the lipophilic part of the microemulsion i.e. Oil and the water phases can be combined with surfactant and a cosurfactant is then added at slow rate with gradual stirring until the system is transparent.

The amount of surfactant and cosurfactant to be added and the percent of oil phase that can be incorporated shall be determined with the help of pseudo-ternary phase diagram.

Ultrasonicator can finally be used so to achieve the desired size range for dispersed globules. It is then allowed to equilibrate

Oil-in-water microemulsions were prepared by the titration method.

A mixture of fatty acid and oil was added to a caustic solution to produce a microemulsion, which was then titrated with a cosurfactant, an alcohol, until the system turned clear.

It was found that as the chain length of the surfactant increased, microemulsions with significant transmittances by visible spectrum could be formed with oils of longer chain lengths.

It was also found that different alcohols affected the formation of microemulsions in different ways.

The best results, in terms of the greatest percent transmittance coupled with the widest range of oil (dispersed in water) concentration, were obtained from short or branched alcohols.

Though it has been known that several factors determine whether a w/o or o/w system will be formed but in general it could be summarised that the most likely microemulsion would be that in which the phase with the smaller volume fraction forms the droplets i.e. internal phase.

The surfactants used to stabilise such systems may be:

(i) Non-ionic

(ii) Zwitterionic

(iii) Cationic

(iv) Anionic surfactants

Characterization Of Microemulsion :

The droplet size, viscosity, density, turbidity, refractive index, phase separation and pH measurements shall be performed to characterize the microemulsion.

The droplet size distribution of microemulsion vesicles can be determined by either light scattering technique or electron microscopy. This technique has been advocated as the best method for predicting microemulsion stability.

Advantages Of Microemulsion Over Other Dosage Forms :

- ✓ Increase the rate of absorption
- ✓ Eliminates variability in absorption
- ✓ Helps solublize lipophilic drug
- ✓ Provides a aqueous dosage form for water insoluble drugs
- ✓ Increases bioavailability
- ✓ Rapid and efficient penetration of the drug moiety
- ✓ Helpful in taste masking
- ✓ Liquid dosage form increases patient compliance.
- ✓ Less amount of energy requirement.

USES

Water-in-oil microemulsions for some dry cleaning processes Floor polishers and cleaners.

Personal care products Pesticide formulations Cutting oils.

Pharmaceutical applications of microemulsions Increase bioavailability of drugs poorly soluble in water.

Topical drug delivery systems

Applications of microemulsions

Microemulsions in enhanced oil recovery Microemulsions as fuels

Microemulsions as coatings and textile finishing

Microemulsions as lubricants, cutting oils and corrosion inhibitors

Microemulsions in detergency

Microemulsions in cosmetics Microemulsions in agrochemicals

Microemulsion in pharmaceuticals

MULTIPLE EMULSION

DEFINITION

Multiple emulsions are the emulsion system in which the dispersed phase contain smaller droplets that have the same composition as the external phase.

This is made possible by double emulsification hence the systems are also called as “double emulsion”.

Like simple emulsions, the multiple emulsions are also considered to be of two types:

- Oil-in-Water-in-Oil (O/W/O) emulsion system
- Water-in-Oil-in-Water (W/O/W) emulsion system

O/W/O EMULSION

In O/W/O systems an aqueous phase (hydrophilic) separates internal and external oil phase.

In other words, O/W/O is a system in which water droplets may be surrounded in oil phase, which in true encloses one or more oil droplets.

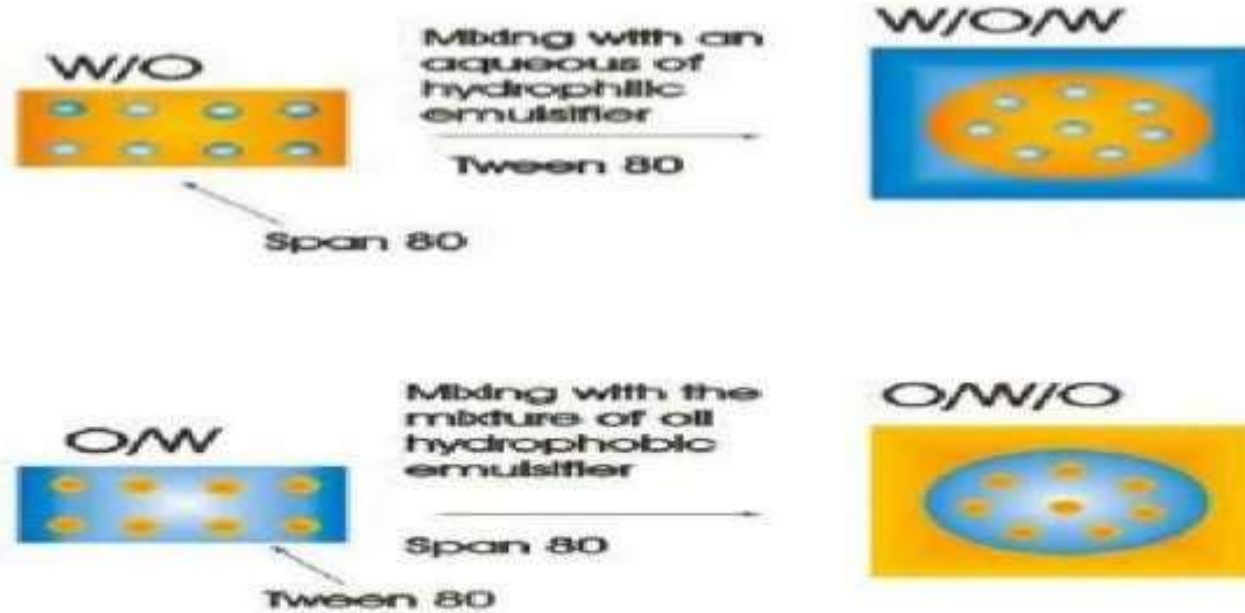
W/O/W EMULSION

In W/O/W systems, an organic phase (hydrophobic) separates internal and external aqueous phases.

In other words, W/O/W is a system in which oil droplets may be surrounded by an aqueous phase, which in turn encloses one or several water droplets

- ❑ These systems are the most studied among the multiple emulsions.
- ❑ The immiscible oil phase, which separates two miscible aqueous phases is known as “liquid membrane” and acts as a different barrier and semi-permeable membrane for the drugs or moieties entrapped in the internal aqueous phase.

Schematic Diagram of W/O/W & O/W/O



Methods of Preparation

Multiple emulsions are best prepared by re- emulsification of primary emulsion.

The following are the method of multiple emulsions:

- ✓ Two Steps Emulsification (Double Emulsification)
- ✓ Phase Inversion Technique (One Step Technique)

Two Steps Emulsification (Double emulsification)

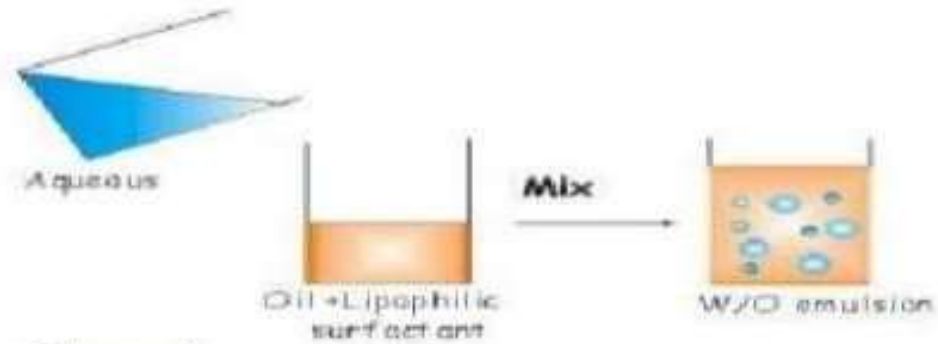
Two steps emulsification methods involve re-emulsification of primary W/O or O/W emulsion using a suitable emulsifier agent.

The first step involves, obtaining an ordinary W/O or O/W primary emulsion wherein an appropriate emulsifier system is utilized.

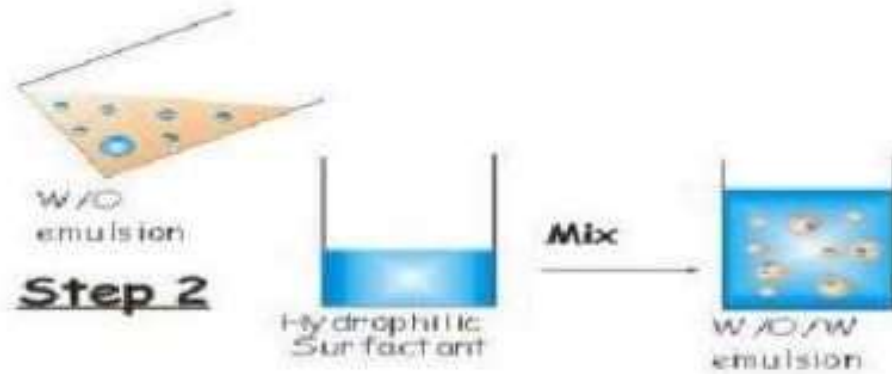
In the second step, the freshly prepared W/O or O/W primary emulsion is re-emulsified with an excess of aqueous phase or oil phase.

The finally prepared emulsion could be W/O /W or O/W/O respectively.

Two Steps Emulsification

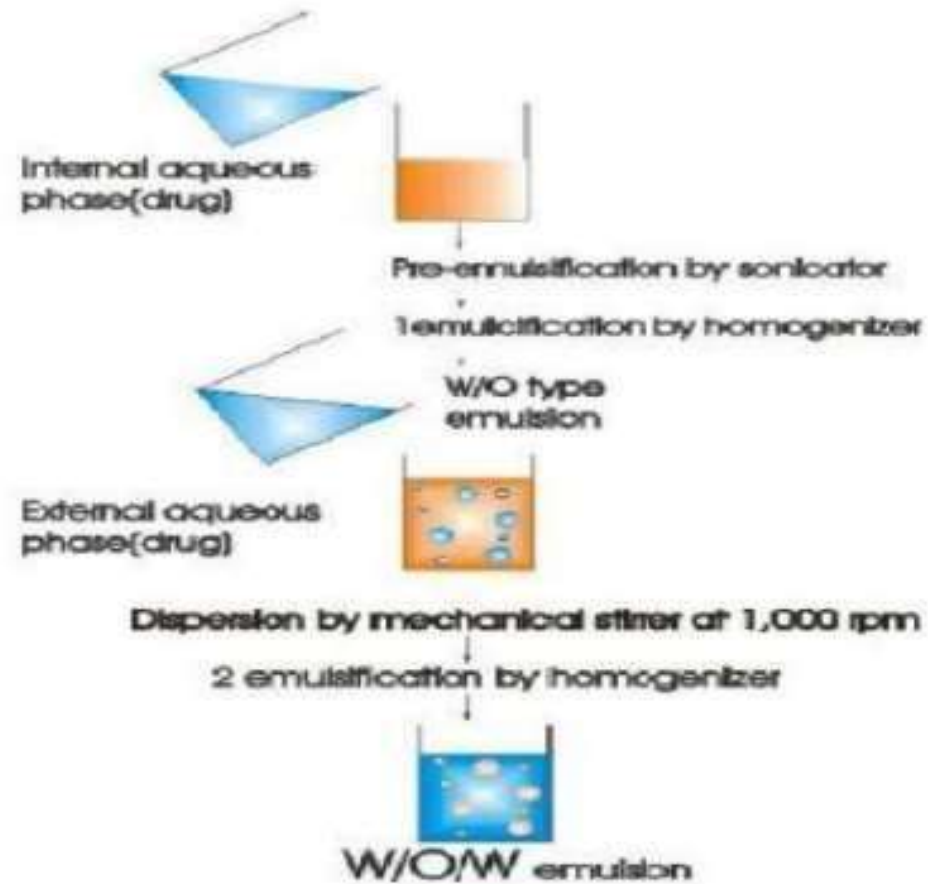


Step 1



Step 2

Modified Two Steps Emulsification



Phase Inversion Technique (One Step Technique)

An increase in volume concentration of dispersed phase may cause an increase in the phase volume ratio, which subsequently leads the formation of multiple emulsions.

The method typically involves the addition of an aqueous phase contains the hydrophilic emulsifier

[Tween 80/sodiumdodecylsulphate (SDS) or Cetyl trimethyl ammonium salt CTAB)] to an oil phase consisted of liquid paraffin and containg lipophilic emulsifier (Span80).

Phase Inversion Technique



Aqueous phase
containing
hydrophilic
emulsifier



Oil + lipophilic
surfactant



W/O/W
emulsion

1-

Volume fraction of the aqueous phase should be higher than 0.7

2-

Molar ratio of the hydrophobic and hydrophilic emulsifier should be optimized

APPLICATIONS

- ✓ Applications in Therapeutics & Cosmetics:

Multiple emulsion systems are finding unlimited uses because of their vesicular structure with innermost phase closely similar to that of liposomal vesicles and the selective permeability characteristic of liquid membrane.

- ✓ In cancer therapy.
- ✓ In herbal drugs.
- ✓ In taste masking.
- ✓ In food industry.
- ✓ In drug over dosage treatment.
- ✓ In inverse targeting

CONCLUSION

- ❑ Micro emulsion properties are extremely varied. The extreme diversity of their practical applications is one consequence.
- ❑ One of their disadvantages is the large amount of surfactant required to stabilize them because of the small dispersion size.
- ❑ Although micro emulsion properties are beginning to be satisfactorily understood, especially the droplet structure, large research domains remain to be clarified.
- ❑ With evaluation of newer techniques of preparation, stabilization, rheological properties can serve as potential carrier for drugs
,cosmetics ,pharmaceutical agents

- ❑ Multiple emulsions are complex polydispersed systems where both oil in water and water in oil emulsion exists simultaneously which are stabilized by lipophilic and hydrophilic surfactants respectively.
- ❑ The ratio of these surfactants is important in achieving stable multiple emulsions. Among water-in-oil-in-water (w/o/w) and oil-in-water-in-oil (o/w/o) type multiple emulsions; the former has wider areas of applications.