Physical Pharmacy
Lab - 3 -

Surfactants

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Surfactants (surface active agents SAA)

- **Surfactants** are molecules and ions that are adsorbed at the interfaces. Surfactants are materials that lower the surface tension(or interfacial tension) between two liquids or between a liquid and a solid.

- An alternative term is amphiphile, which suggests that the molecule or ion has a certain affinity for both polar and non-polar solvents.

- Surfactants may act as detergents, wetting agent, emulisifier, foaming agent , and dispersants.

Surfactants

When such molecule is placed in an air-water or oil- water system, the polar groups are attached or oriented toward the water, and the non-polar groups are oriented toward the air at the air-water interface, or oriented toward the oil at the oil-water interface (Figure 1).

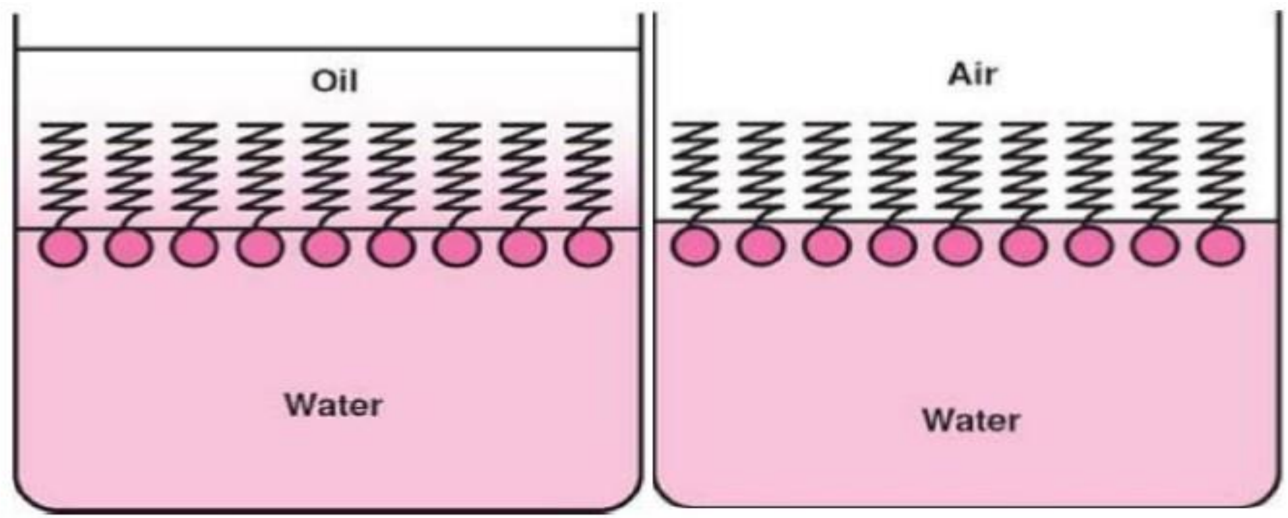
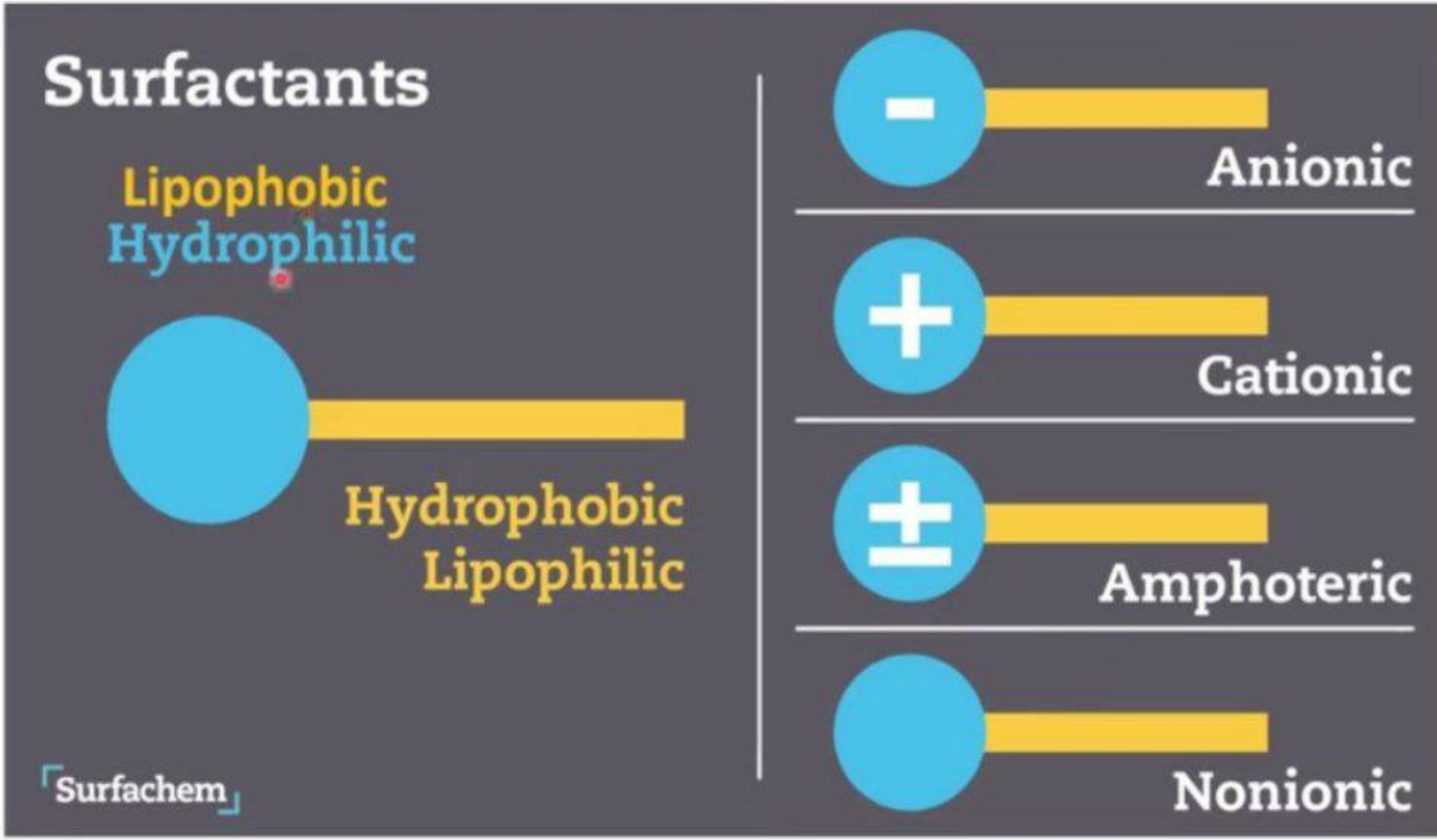


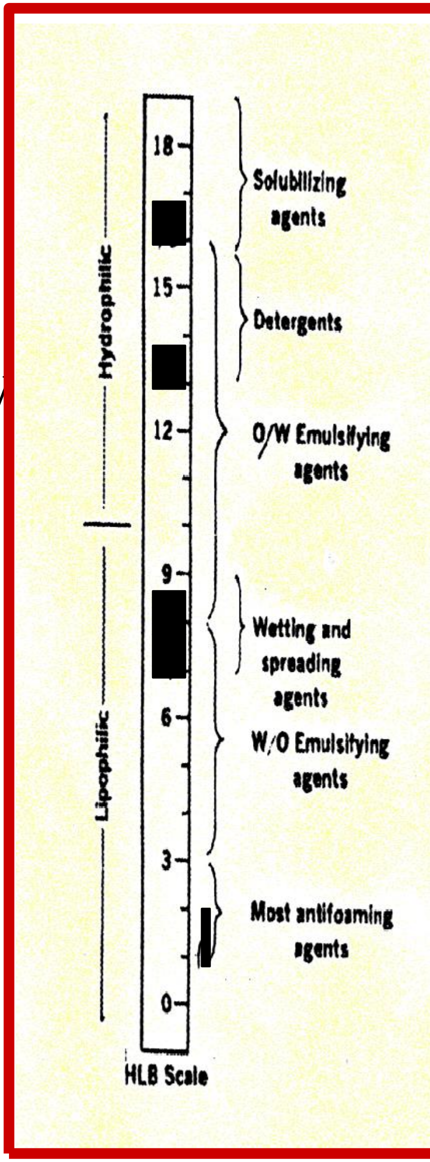
Figure 1: Adsorption of fatty acid molecule at a water-oil interface (left panel) and a water- air interface (right panel).

Types of surfactants



Hydrophilic-Lipophilic Balance (HLB) (How to determine if the surfactant is hydrophilic or lipophilic)

- Using Griffin's scale.
- It is an arbitrary scale from 0 to 18
- The higher the number, the greater the hydrophilicity vice versa .
- Low HLB surfactants are more oil soluble.
- High HLB represents good water solubility.
- Example: Spans with low HLB are lipophilic.
- Tweens with high HLB are hydrophilic.



Hydrophilic Lipophilic Balance

Determination of HLB

- Polyhydric Alcohol Fatty Acid Esters (Ex. Glyceryl monostearate)

$$HLB = 20 (1 – S / A)$$

S = Saponification number of the ester A = Acid number of the fatty acid which is measure of the number of the carboxylic acid group.

- Surfactants with no Saponification no (Ex. Bees wax and lanolin)

$$HLB = E + P / 5$$

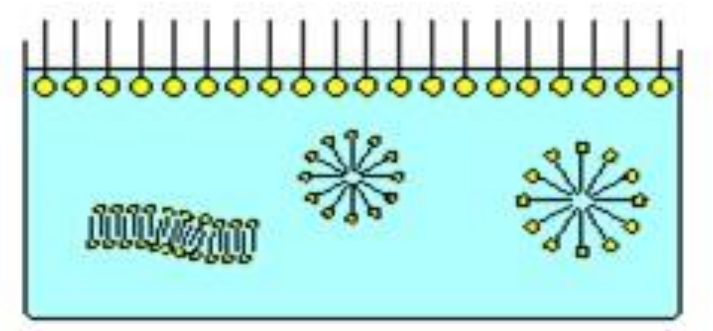
E = The percent by weight of ethylene oxide

P=The percent by weight of polyhydric alcohol group in the molecules

- Surfactants with hydrophilic portion have only oxyethylene groups

$$HLB = E / 5$$

Oriented adsorption of surfactant at interfaces



At low surfactant concentrations:

The hydrocarbon chains of surfactant molecules adsorbed in the interface lie nearly flat on the water surface.

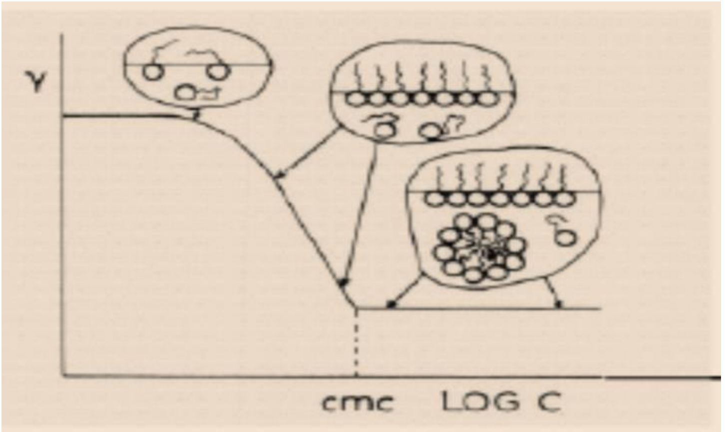
At higher concentrations:

They stand upright because this permits more surfactant molecules to pack into the interfacial monolayer.

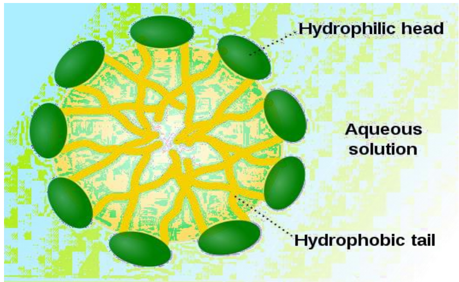
As the number of surfactant molecules adsorbed at the water-air interface increased, they tend to cover the water with a layer of hydrocarbon chains. Thus, the water-air interface is gradually transformed into an non polar-air interface. This results in a decrease in the surface tension of water.

Critical micelle concentrationcan (CMC) be defined as

- 1-The concentration of surfactant at which the micelles are formed.
- 2- The concentration of surfactant after which the surfactant added has no effect on surface tension.
- 3-The concentration at which the surface of solution becomes completely saturated with SAA

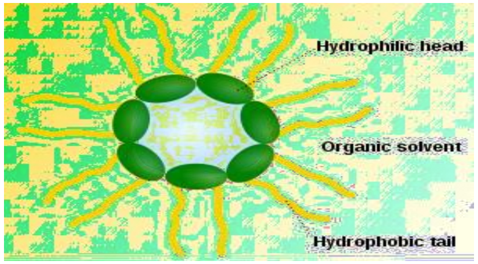


Shape of micelles



- Normal spherical micelles

In dilute aqueous solutions micelles are approximately spherical. The polar groups of the surfactants are in the periphery and the hydrocarbon chains are oriented toward the center, forming the core of the micelles

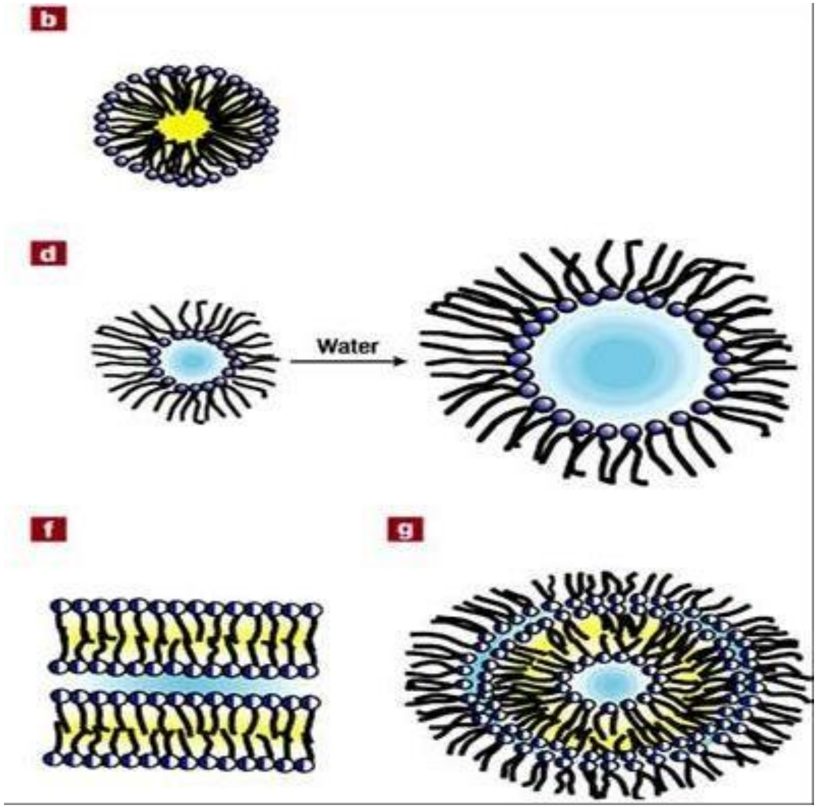


- Inverted spherical micelles

In solvents of low polarity or oils micelles are inverted. The polar groups face inward to form the core of the micelle while the hydrocarbon chains are oriented outward

Shape of micelles

- Inverted micelles



- Cylindrical and lamellar micelles

In more concentrated solutions of surfactants, micelles change from spherical either to cylindrical or lamellar phase.

Micelle can increase the solubility of slightly soluble drugs by incorporating them into the hydrophobic core of the micelle solubilization

Experimental Work

- Glassware and Equipment : volumetric flask (50ml), conical flask (50ml), graduated pipettes, burette, filter paper, funnel, and a balance.

- Chemicals: bring Salicylic acid powder, Tween60, distilled water, phenol red indicator and NaOH Solution (0.05N).

- Aim of the experiment : is to show the effect of increasing the concentration of Tween on the solubility of salicylic acid.

procedure

1. Prepare different concentration of tween60 (0%, 0.05%, 0.5%, 1%, 2%, 3%), prepare 50 mL of each solution (use volumetric flask and pipette) from stock solution 5% (C1V1=C2V2).
2. Place 25ml of each concentration in a conical flask of (50mL) then add 0.25g salicylic acid to each flask.
3. Shake the flasks for 10 minutes.
4. Set to settle for another 10 minutes to permit the undissolved salicylic acid to settle down (filter if necessary).
5. Withdraw 10mL of filtrate solution and titrate with standardized NaOH solution (0.05N) using phenol red as indicator. The end point is a point when the colour changes from yellow to pink. Measure the end points.
6. Plot the total solubility (mg/mL) or (g/100ml) of salicylic acid against a concentration of tween 60.

procedure

To prepare 50 ml of 0% tween 60 that mean we will not use tween 60 ,just add 50 ml D.W in the volumetric flask

To prepare 50 ml of 0.05% tween60 from 5%stock solution by using dilution

$$C1 \quad V1 = C2 \quad V2$$

$$5\%*V1 = 0.05\%*50$$

V1= 0.5ml take from stock solution 5%tween 60 (using pipette) put it in the volumetric flask then complete the volume to 50 ml by adding D.W

*The same procedure and calculation for preparation of the other concentration

Steps of experiment

prepare 50 mL of different concentration of tween 60 from stock solution 5%tween 60 ($C_1V_1=C_2V_2$).

Place 25ml of each concentration in a conical flask

add 0.25g salicylic acid to each flask.

Shake the flask for 10 min. set to settle for another 10 min (filter if necessary).

Withdraw 10mL of filtrate solution and titrate with standardized (0.05N) NaOH solution using phenol red as indicator. Measure the end points.

Calculation

If the end point for 0%tween 60 was 2.6ml The calculation will be

End point *chemical factor = g of salicylic acid in 10ml (filtrate)
2.6 ml * 0.0069 = 0.0179 g of salicylic acid in10 ml

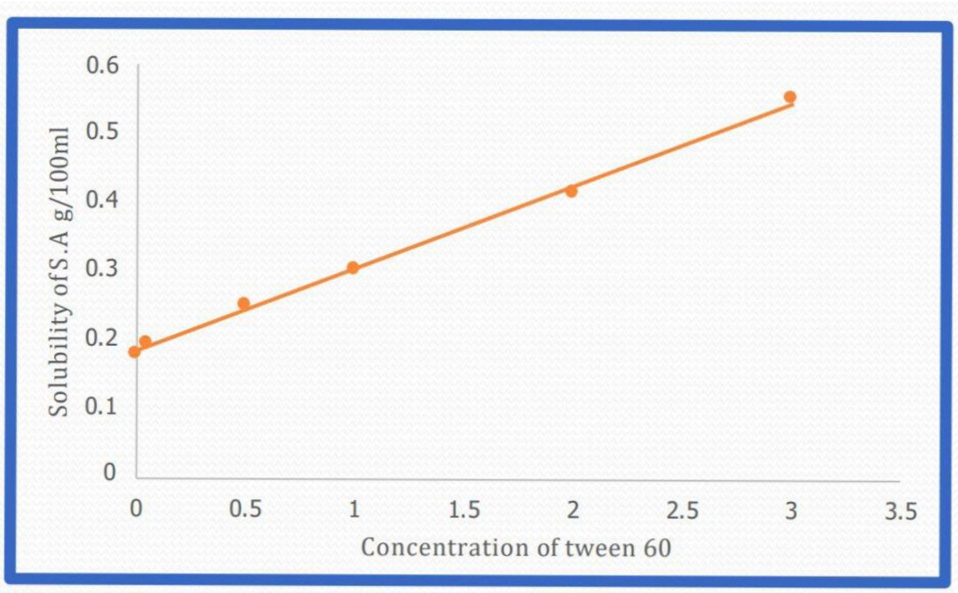
The solubility of salicylic acid in (g\100ml)

0.0179g	10ml
X	100ml

X= 0.179 g\100ml of salicylic acid

*The same calculation for other end points

Conc.Of Tween60	E.P (mls of NaOH)	Grams of S.A in 10ml	Grams of S.A in 100 ml
0%			
0.05%			
0.5%			
%1			
2%			
3%			



THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS ?