Supramolecular Chemistry-I

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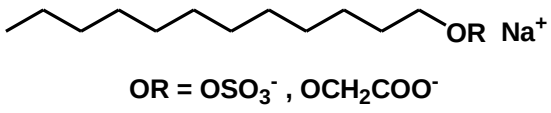
Week - 08

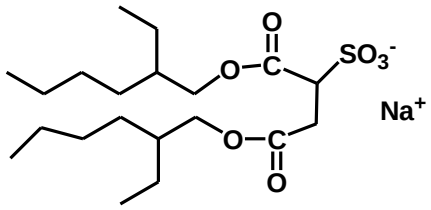
Lecture - 36

Good morning, so we have come to the last section of this supramolecular chemistry course. So, for this next about 3-5 lectures I will be talking about amphiphiles, which I introduced in my last class. So, a simplest amphiphile is a molecule where one side has a headgroup and another side tail. Another group of amphiphiles specially they are known as surfactants. As the name suggests, surfactants are surface active amphiphiles, what do they do? Suppose, there is a violent water body as in an ocean. Then if you drop oil on top of that then what happens? It makes the water calm because oil is a surfactant here and it will reduce the surface tension of water. So, usually the captain of the ship will tell his crew to throw oil, petrol. Because oil will make a layer and that will reduce the surface tension.

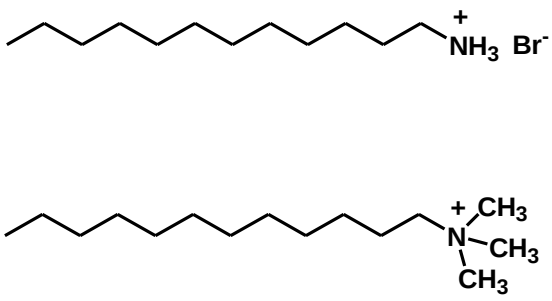
First let us see some structures of amphiphiles. We describe the simplest kind of amphiphile: one head group and a hydrophobic tail. I will tell you some of the examples as follows:



$OR = OSO_3^-, OCH_2COO^-$



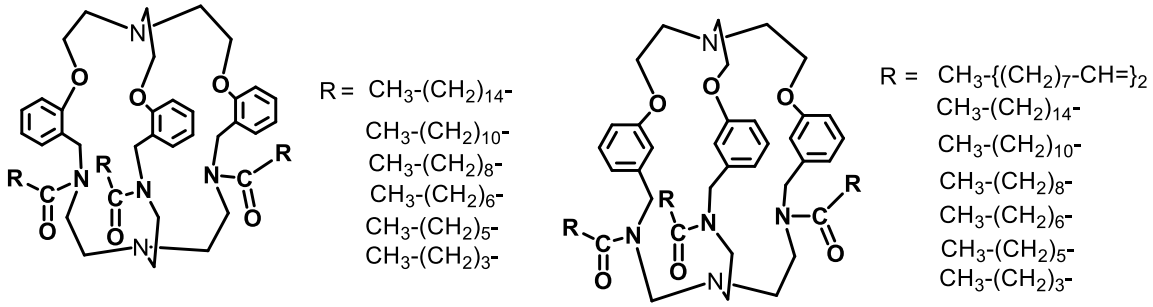
Anionic surfactants



Cationic surfactants

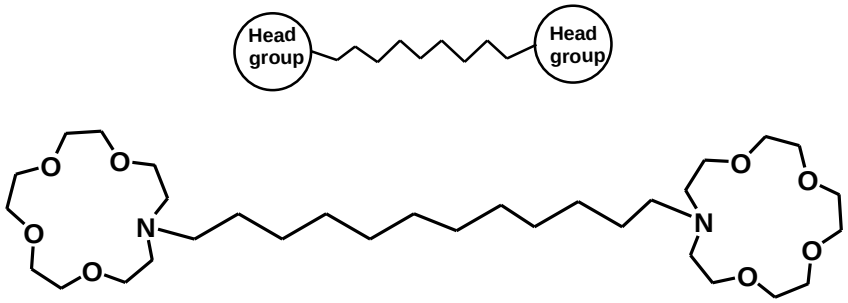
So, the first set is called anionic surfactants because the head group is negative although to neutralize sodium ion is present nearby. The second set of amphiphiles are similarly cationic amphiphiles.

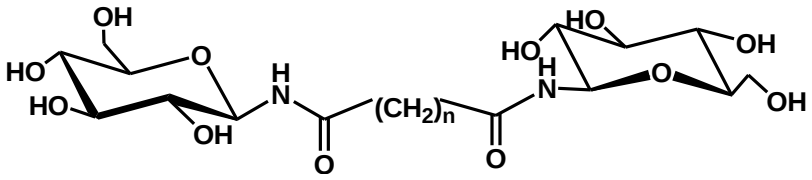
Again we can have neutral surfactants also.



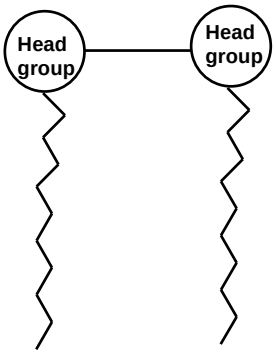
In the above set of amphiphiles, we have a neutral headgroup and three tails amphiphiles.

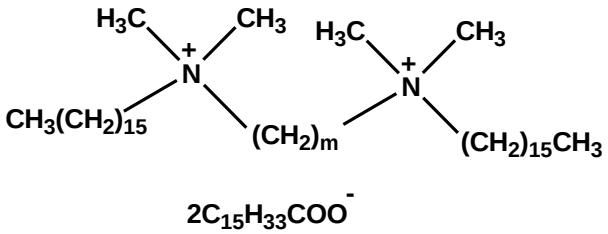
Similarly, we can take a macrocycle, or a calixarene as the neutral headgroup. Now the following compound written as a cartoon is called a bola amphiphile and below it a bola amphiphile.

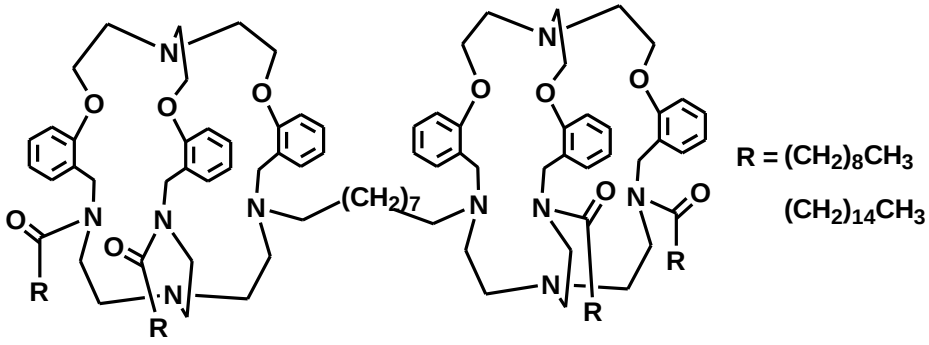




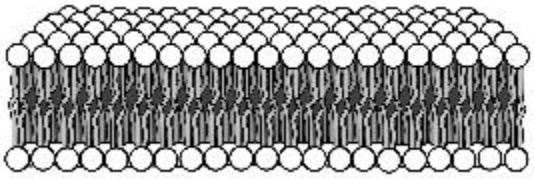
The name, Bola comes from the South American slingshot normally used to incapacitate a cow as its legs will be completely surrounded and it cannot move. Then, I will put another one. Gemini amphiphiles. What are Gemini amplifiers? First a cartoon and then a compound:



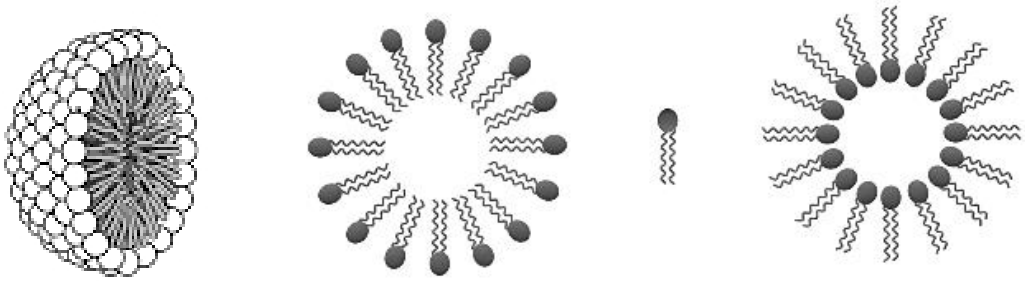




Gemini means twin. So, these are some of the structural variations of amphiphilic molecules that I have drawn here. These amphiphilic molecules are very important in biology. Now I shall describe a bilayer membrane. Bilayer membrane is a membrane that is present in our cell. The bilayer membrane looks something like as follows:



In human body all genetic materials like DNA, mitochondria, etc. reside inside the cell. The bilayer membrane protects the genetic materials from coming out of the cell. It is like when you make a building, you protect your building by a fence around it. Another important thing is amphiphilic molecules can make micelle. The structure of micelle is shown below:



Micelles section of a micelle section of a reverse micelle

So, if you can imagine a ball, then the surface of the ball is hydrophilic and inside is hydrophobic in character. Inside the micelle we can store hydrophobic molecules. This is called a micelle. Then another structure is called reverse micelle. So, as the name suggests, reverse micelle will have a ball-like structure where outside surface is hydrophobic but inside is hydrophilic. A section of a micelle and a reverse micelle are also shown. Now, when an amphiphile will form a micelle? Micelle will form at a critical mass of amphiphiles at a critical concentration. The critical concentration of amphiphiles that forms miceller structure is called the critical micellar concentration (CMC). The critical micellar concentration that depends upon the structure of the amphiphile and the solvent systems. Hydrophobic cannot easily penetrate an ion. So, there must be some ion channels and they are hydrophobic outside, but inside the metal is sitting. This way, essential ions penetrate the cell wall in a biosystem. Thank you very much.