CHEMICAL EQUILIBRIUM

Did you ever try to balance a half filled cold drink bottle horizontally on your finger? Its a difficult task because when you try to balance it, the liquid shifts to one side and the bottle gets imbalanced. But at a point when the amount of liquid on both sides becomes equal, the bottle gets balanced on your finger. This situation is known as equilibrium.

Reaction is a very common term which we use frequently in our daily life. We will learn about it in chemistry also. When something named A reacts to B and produce a completely different thing C, this all process is known as a chemical reaction.

$A + B \rightarrow C$

Here A and B are reactants and C is the product. In this reaction a number of molecules react with each other and a number of product molecules are formed. If you visualize it, you will see there is a pool of molecules which are moving from reactant to product side just like the liquid moves in the bottle. Bottle is the vessel in which this reaction is carried out.

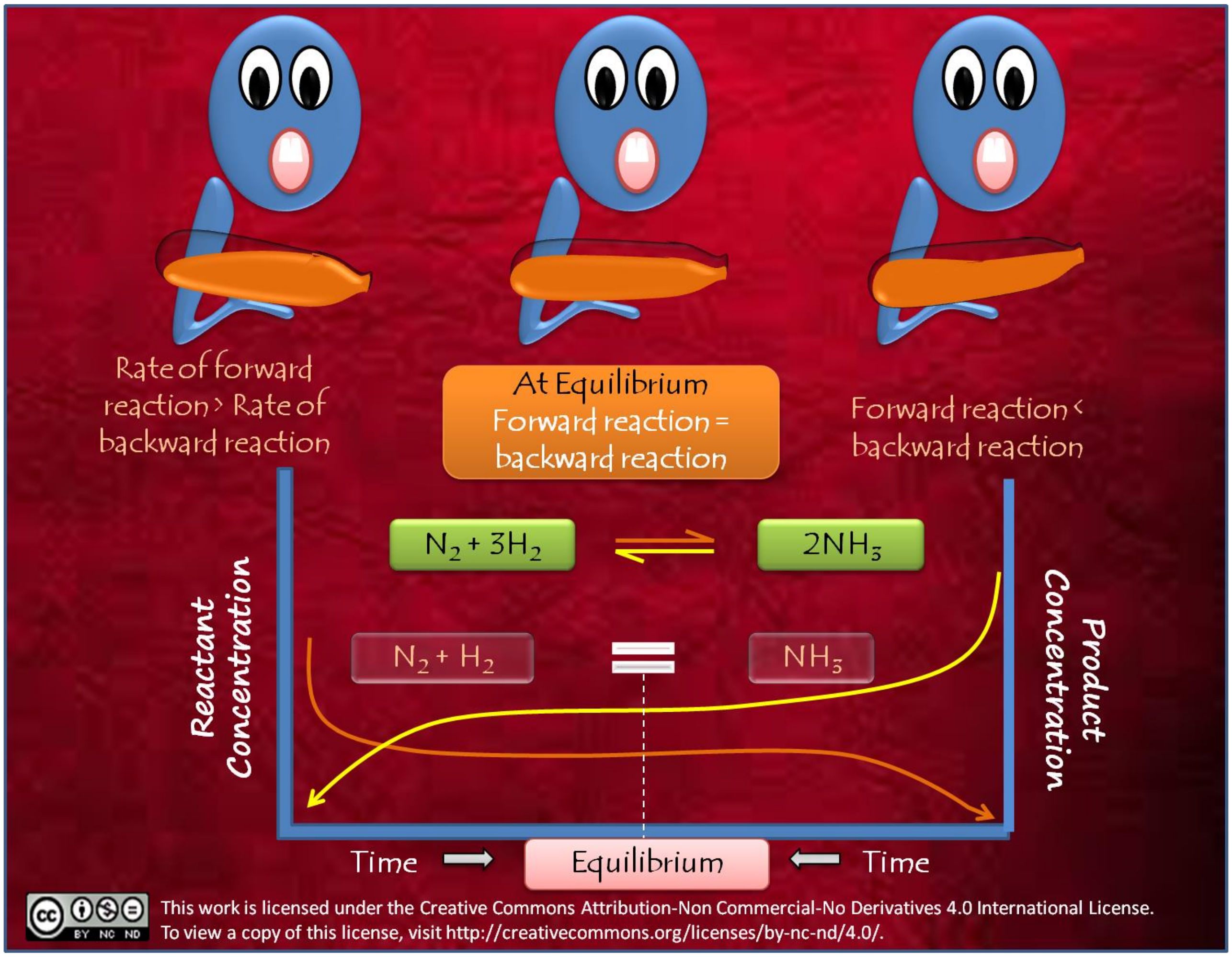
Equilibrium is that balance point at which the number of reactant molecules are equal to the number of product molecules. But it doesn't mean that equilibrium is a static condition at which reaction gets seized. Actually at equilibrium the rate of formation of product molecules is equal to the rate of break down of product molecules changing them back to reactant molecules again. That's why number of reactant molecules remain equal to the number of product molecules and it seems that reaction has been seized.

When two people of equal strength arm wrestle, there comes a stage when no one could defeat the other, this is the equilibrium stage. At arm wrestling equilibrium the forces applied by both contestants are equal and opposite. Similarly, when in a chemical reaction the rate of forward reaction (forward arrow→) becomes equal to the rate of backward reaction (backward arrow ←), it attains the equilibrium stage which is depicted by two half arrows pointing in the opposite directions.

In the last post of liquification of gases, we have observed a plateau region in the graph, where liquid CO_2 and gas CO_2 both coexist. At the middle of the plateau we get the equilibrium point. That was an example of gas-liquid equilibrium.

Similarly, you have seen solid-water equilibrium when you place ice in water and keep them at constant temperature above zero degree. At this condition you will see there is no change in the amount of ice and water because freezing and melting both are going on at equal rate.

You may wonder why I took the example of bottle to explain equilibrium. Because it is one of the characteristics of equilibrium. Bottle is the vessel in which reaction is carried out, in the language of chemistry bottle is the system. Equilibrium is possible only in the closed system and as the bottle is capped it becomes the closed system. When I talk about the bottle of cold drink, can you guess which equilibrium I am talking about? Here the equilibrium is set between gas dissolved in the liquid and undissolved gas. Closed system is that system which doesn't allow molecules or heat to escape. Another characteristic of equilibrium is fixed parameters like temperature and pressure.



Let's take an example of real chemical reaction. When we take N_2 and H_2 we get NH_3. Initially N_2 and H_2 get combined to form NH_3 in forward reaction. After some time the NH_3 formed by this reaction starts to decompose to N_2 and H_2 in backward reaction. And after some time the system reaches the equilibrium, when both reactions occur in the same rate and concentrations of product and reactants become equal. If we plot a graph between concentration and time, we can visualize it happening. In one side we take reactant concentration and on the other side we take the product concentration. Reactant vs time curve represents forward reaction, while product vs time curve represents backward reaction. You can see in the graph that we can reach at equilibrium stage by any of the curve. That means either we took N_2 and H_2 or NH_3 alone, we would reach the equilibrium by same time.

What happens if we take out some of the product from the system or we change the temperature or pressure of the system? How will it affect the equilibrium? You can answer all these questions but for that you'll have to learn some laws of equilibrium. In the next post we will discuss these laws and learn how to use them to find answers of these questions.

Source : http://chemistrynotmystery.blogspot.in/2014/11/chemical-equilibrium.html