Factors Affecting Equilibria

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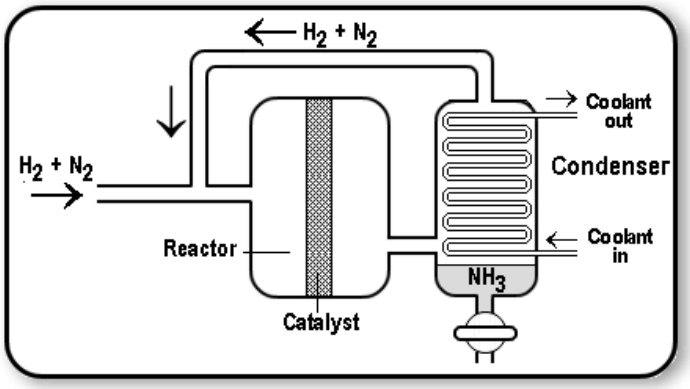
Introduction



Haber's Process of Manufacturing Ammonia

The main aim of the chemical synthesis is to achieve the efficient making of products from the reactants in cost effective manner.

So the reactions are carried under mild temperature and pressure conditions. For example, ammonia is produced all over the world at a large scale to meet the demand of fertilizers. The maximum yield of ammonia is obtained at low temperature.

But it takes long time to establish the equilibrium. Therefore, the reaction conditions are adjusted in a way to save time and make it economic.

Factors Affecting Equilibrium

Effect of Temperature

Effect of temperature

A system in equilibrium is affected by the following factors:

1. Change of concentration of any reactant or product
2. Change of temperature of the system
3. Change of pressure of the system
4. Addition of catalyst
5. Addition of some inert gas

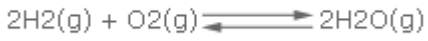
The effect of change of concentration, pressure and temperature is predicted with the help of Le Chatilier's principle. The effect of

adding a catalyst or an inert gas can be explained as follows:

Effect of Adding Catalyst on the Equilibrium

Addition of catalyst does not affect the equilibrium. It helps to attain the equilibrium quickly.

For example, in the following reaction equilibrium should exist in the manner



But equilibrium is never attained under ordinary conditions as hydrogen and oxygen do not combine to form water under ordinary condition. But in presence of platinised asbestos the reaction attains the equilibrium very quickly. Furthermore, the value of the equilibrium constant (1.2´1040) remains same irrespective of the increased speed of the reaction. Addition of catalyst increases the speed of reaction of forward and backward reaction to the equal extent.

Effect Of Addition Of Inert Gas To A Reaction Mixture At Equilibrium

Consider the reaction:

$PCl_5(g)$? $PCl_3(g) + Cl_2(g)$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

(a) If the reaction takes place at constant volume, addition of inert gas does not affect the equilibrium as molar concentration of the gases will remain the same.

(b) If the reaction takes place at constant pressure, addition of inert gas will increase the total volume. As a result the molar concentration of the gases will decrease. As the numerator has two concentration terms and the denominator has only one term, the value of Kc should decrease. But as Kc is constant at constant temperature, the dissociation of the PCl5 will increase on addition of inert gas.

Le Chatilier’s Principle

If a system in equilibrium is subjected to a change of concentration, temperature or pressure, the equilibrium shifts in a direction that tends to reduce the effect of change.

In general:
(i) If a reaction is in equilibrium:

The increase in concentration of the reactants shifts the equilibrium in the forward direction.

If the concentration of products is increased, the reaction shifts in the backward direction.

(ii)Exothermic reactions are favoured by low temperature whereasendothermic reactions are favoured by high temperature.

(iii) Low pressure favours those reactions which are accompanied by increase in total number of moles. However, pressure has no effect on an equilibrium reaction which proceeds with no change in total number of moles

How does temperature effect the equlibria?

Try to answer. Still need help? Want to know more about it?Click here to schedule live help from a certified tutor!

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Reference Links:

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