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(Study Notes on Colloids and Surfaces)

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Colloids and Catalyst

Colloids

Between suspension and solution extremes, a large group of systems exists which is known as colloidal dispersion or colloids. A colloidal is generally a heterogeneous system in which two mediums are present: dispersed and dispersion. Colloidal differs from solution in particle size. In solution, very fine particles are present while in colloidal, particles have a range of diameter between 1 and 1000 nm (10^{-9} to 10^{-6}m).

Classification of colloids

(a) Physical state of the dispersed phase and the dispersion medium.

(b) Nature of interaction between two phases.

(c) Type of particles of the dispersed phase.

Important properties of colloidal sols:

(i) Colligative properties: Colloidal solutions tend to show colligative properties which are:

(a)Relative lowering in vapour pressure

(b)Elevation in boiling point

(c) Depression in freezing point

(d) Osmotic pressure

(ii) Tyndall effect: When a strong beam of light is passed through colloidal sol, the path of the beam gets deviated.

(iii) Mechanical properties

Brownian movement

The motion of colloidal particles has been observed as zig-zag which is known as Brownian movement. This phenomenon arises due to the impact of dispersion medium molecules with colloidal particles. This movement becomes slow when the size of the particle increases.

(iv) Electrical properties (Electrophoresis):

Colloid particles are electrically charged. In the dispersion medium, due to the presence of an equal and opposite charge, the system is neutral. Due to the presence of similar nature of charge carried by particles, they repel each other due to which no formation of bigger particles takes place. Due to this reason, the solution becomes stable. As there exists an electric charge, phenomena of electrophoresis arise.

(iv) Coagulation of colloids: For the stability of colloids, it is necessary that appropriate electrolytes in small amounts should be present. But when these electrolytes are present in large amounts, the particles of sol will be taken up by ions that contain an opposite charge. Due to this, neutralization will occur. The process by which colloidal particles get aggregated into insoluble precipitate is known as coagulation. At a lower concentration of electrolytes, the aggregation of particles is called flocculation.

Catalysis

A catalyst is used to change the speed of a reaction, but it does not get used in the reaction. An increase in speed of reaction indicates the presence of a positive catalyst while a decrease in speed of the reaction indicates a negative catalyst is present. A catalyst also lowers the activation energy for both backward and forward reactions by providing an alternate path. The rate of both forward and backward reactions accelerated to the same extent due to which the equilibrium constant remains the same.

Types of Catalysis

1. **Homogeneous catalysis:** If the phases of both catalyst and reactants are the same, it is known as a homogeneous catalyst. One example is:

(a) Oxidation of SO_2 to SO_3 in which NO acts as a catalyst.

2. **Heterogeneous catalysis:** If phases of both catalyst and reactants are different, it is known as heterogeneous catalyst. One example is:

(a) Manufacture of ammonia from N_2 and H_2 by Haber's process using iron as catalyst.

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