Soil Chemistry

Soil Colloids

Consisting of clay and humified organic matter, inorganic (clay) colloids, organic colloids (humus). They are negatively charged. They attract (hold) positive charged particle called cation.

The colloidal state refers to a two phase system in which one material (or materials) in a very finely divided state is dispersed through a second Ex. Colloidal state milk and cheese, clouds and fog; starch, gelatin, rubber, proteins, blood, and soil etc.

Solid in liquid : Clay in water (dispersion of clay in water)

Liquid in gas : Fog or clouds – in atmosphere

The rapidly diffusing substances, mostly of crystalline nature in the solid state, are called crystalloids while starch and proteins are called colloids. But this distinction is not always true, because of crystalline substance like NaCl can be obtained in colloidal condition while albumin may be obtained by crystalline form. It is therefore be more appropriate to speak of a colloidal state of a substance than of a colloidal substance.

The size of the particles in true solution and in colloidal suspensions are $= 0.2 - 1 \text{ m}\mu$ and 1-200 m μ (micrometers) respectively. Colloidal particles – Float in a medium and – do not tend to settle. Therefore colloids are referred to as dispersed systems.

The substance in solution is called the dispersed phase while the medium in which the particles are dispersed is called the dispersion medium. Soil particles less than 0.001 mm size possess colloidal properties and are known as soil colloids. and non-agricultural purposes.

Type of Soil Colloids : Except Sand fraction, all soils contain particles of colloidal size. Soil colloids are chemically active portion of the soil.

Inorganic Colloids — Iron and aluminum hydrousoxide (occurs in tropical and subtropical region soils) Silicate clays (dominant in temperatre regions).

Organic Colloids — Humus (dominant in temperatre region soils).

The individual crystalline particle is called "micelle" or "micro cell". Colloidal clay particles are considered as ocupying an intermediate position being neither truely lyophilic (liquid loving) or hydrophillic (water loving) nor lyophobic (liquid hating) or hydrophobic (water repleelent). Clay colloids posses the properties of hydrophilic because of its hydration. Its sensitivity to electrolytes is a hydrophobic nature.

Lyophobic Colloids — The surface tension and viscosity of this colloidal system is similar to that of the dispersion medium. Small quantities of electrolytes cause precipitation. The particles are easily detected in the ultramicroscope and they migrate in one direction in an electronic field.

Lyophilic Colloids — The surface tension is usually lower and the viscosity is much higher than that of the dispersion medium. Large quantities of hte electrolytes cause prelipitation. The particles cannot be easily detected in Ultra microscope and they migrate in different directions or not at all in an electric field.

Among all kinds of soil colloids, the silitcate clays are the most dominant and important in the field of agriculture.

tetrahedral positions by Aluminumions, Al⁺⁺⁺⁺. Hence, the K⁺ ions occur in the hexagonal cavity between the two units of illite and bind the illite units tightly. Illites for this are non-expanding when 2/3 of the octahedral positions are occupied by Alions & 1/3 is empty, then it is called dioctahedral illite fig. 7 (ii). When all octahedral positions are occupied by Mg⁺⁺ & Fe⁺⁺ ions, then it is called trioctahedral illite fig. 7(iii). The cation exchange capacity of illite is 15-40 m e/100 g. Total external and internal surface areas are 120+170, 50+70 & 70 to 100 m²/100 gm respectively.

(3) Vermiculites : are also 2:1 type minerals in that an octahedral sheet occurs between two tetrahedral sheets.



 $Mg_2(Si_6Al_2)(Mg_2Fe_2)O_{20}(OH)_4 n H_2O$

Fig. 8(i): Streuture of dioethedral Vermiculite

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exposed crystal surfaces (as a result of ionizable hydrogen ions) and isomorphous substitution respectively.

i) Exposed Crystal edges : The negative charge on the silicate clays develops due to unsatisfied valences at the broken edges of silica and aluminium sheet. Besides, the flat external surfaces of silicate clay minerals also serve as the source of negative charge. Ionizable hydrogen ions are hydrogen from hydroxyl ions on clay surfaces. The Al-OH or Si-OH portion of the clay ionizes the H and leaves a temporary negative charge on the oxygen (- AI - O or -Si - O). The machanism is shown below (Fig. 10) reaction are as follows :



Fig. 10: Development of negative charge at the exposed crystal edges