

ION ADSORPTION ON CLAYS: A REVIEW

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ABSTRACT

The following ion-adsorption processes may occur on a solid surface, in contact with an ionic solution. An electric double layer is created by:

1. Specific adsorption of certain ions (the "potential determining ions") which give the surface a positive or a negative charge, unless, as in the case of the layer surface of a clay, the charge originates from interior crystal lattice imperfections.
2. Accumulation of "counter ions" ("gegenions") close to the charged surface in the liquid.

In an established double layer there may occur:

1. Exchange of counter ions for other species of the same sign available in solution (exchange adsorption).
2. Chemisorption of ions on the surface, which may lead to destruction of the double layer or to the creation of a new double layer, possibly of opposite sign.
3. Exchange of exposed lattice ions at the surface by ions in solution (lattice exchange).

Therefore, in a single double layer several possibilities must be considered when interpreting adsorption data. In the case of clays, an additional complication arises in that two different double layers are involved simultaneously—the layer surface double layer and the edge double layer.

The layer surface double layer originates from interior lattice substitutions; the edge double layer originates from the adsorption of potential determining ions on the broken-bond surface. The layer surface double layer is negatively charged; the edge surface double layer probably is amphoteric and may be either positive or negative depending on the composition of the solution.

Technically, the two most important adsorption phenomena in clays are the cation exchange adsorption on the layer surfaces and chemisorption of anions at the edge surfaces. Our present knowledge on these two topics will be reviewed from the point of view of the electric double layer theory.