



## Metal Ion Decontamination of Soils by Complex Forming Agents

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As known, complex forming agents play an important role in the interactions of metal ions and soils because they influence the ratio and quantity of the chemical species of metal ions in the soil solution and on the soil. This effect of complex forming agents make possible the decontamination of soils from metal ions.

In this presentation we discuss the effect of complex forming agents by considering all processes in the solution, solid and soil-solution interface. As an example, the interactions in the system of calcium ion (metal ion), ethylene diamin tetraacetic acid (EDTA) (complex forming agent) and montmorillonite (soil clay mineral) are shown. An equation is derived for the calculation of the ratio of hydrated cation and the total concentration of cation (including complexes). For calcium ion:

$$[Ca^{2+}] / Ca_{tot} = \frac{1}{1 + \left( \frac{\beta_{CaEDTA}}{\alpha} + \frac{K_{CaHEDTA}[H^+]}{\alpha} \right) * EDTA_{tot}} \quad (1)$$

where [ ] means the concentration of hydrated ("free") cations,  $Ca_{tot}$  and  $EDTA_{tot}$  are the total concentration of Ca(II) ions and EDTA in the solution,  $\beta$  is the stability product of the complexes. In addition,

$$K_{CaHEDTA} = \frac{\beta_{CaHEDTA}}{\beta_{HEDTA}} \quad (2) \text{ and } \alpha = \frac{EDTA_{tot}}{[EDTA^{4-}]} \quad (3)$$

On the basis of Eq.1 the conditions (pH, the total concentration of complex forming agent and the stability products of the possible complexes) can be predicted when the cation can be dissolved, that is the clay mineral or soil can be decontaminated. Similarly, the conditions can also be predicted when in acidic soils hydrogen ions sorbed on the clay mineral/soil are exchanged to calcium ions, so the nutrient cycle of clay mineral is regenerated.

Eq. 1 is valid for the cations sorbed by cation exchange in the interlayer space of montmorillonite (outer sphere complexation). Cations sorbed by covalent bonds or precipitation on the deprotonated edge sites of silicates cannot be decontaminated in this way.

Of course, the method can be applied for polluting ions and for natural complex forming agents (e.g. hydroxy and glucuronic acids).