

Edta titrations essay sample



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Complexation Reaction: A reaction between two species having a well-defined stoichiometry. The resulting bond is not permanent from a covalent standpoint. Complex: The resulting structure formed during a complexation reaction. Coordination Center: Metal ion in a complex (Lewis acid) Ligand: The species that complexes the metal center. A single species can form one or more bonds with a single coordination center (Lewis base) Coordination Number: Number of ligand bonds formed around the coordination center. Chelate: Ligands that form multiple bonds (multidentate; bi, tri, tetra, penta) Ethylenediaminetetraacetic acid EDTA CO_2

$\text{CO}_2\text{NH}^+ \text{CO}_2^-$

$\text{NH}^+ \text{CO}_2^-$

Ethylenediamine

NH_2^+

NH_2^+

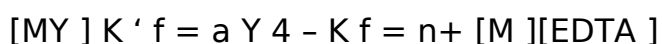
- EDTA is the most commonly used chelating agents as it can form complexes with a wide range of metals.
- The ability of EDTA to complex is dependent on its form. The most desirable state is the Y^{4-} form.
- As the pH increases, more EDTA becomes Y^{4-} . $[\text{Y}^{4-}] = [\text{H}_6\text{Y}^{2+}] + [\text{H}_5\text{Y}^+] + [\text{H}_4\text{Y}] + [\text{H}_3\text{Y}^-] + [\text{H}_2\text{Y}^{2-}] + [\text{HY}^{3-}] + [\text{Y}^{4-}]$ a $\text{Y}^{4-}[\text{Y}^{4-}] = [\text{EDTA}]$

Equil. Concentrations

- The formation constant for metal-EDTA complexes is:



- It is important to note the requirement for the charge state of EDTA. Leads to a conditional (effective) formation constant



n -4

Equilibrium Concentrations

- Again we must consider equilibrium reactions and concentrations in analysis using complexation.
- Equilibrium constants are referred to as formation constants, K_f .
- For simple complexes (1: 1) we can make some similar assumptions and generate similar equations as we did for monoprotic acids
- For more complex systems we must deal with step-wise formations and step-wise formation constants.

EDTA titrations

1. Before the equivalence point there is excess M in solution At the equivalence point, treated as dissolving pure MY complex. After equivalence there is excess EDTA

Indicators

- The most common indicator is the metal ion indicator
- To be useful must bind less strongly than EDTA
- The most common indicator is Eriochrome black T. EBT binds to metal ions to give a red color. Upon release of the metal to EDTA, it becomes blue

- Can use ion specific electrodes and/or mercury electrodes. Both of these are more expensive and time consuming.

Sometimes there is not a strong reaction between EBT and the metal. This can be overcome by a displacement titration. The solution begins with the Mg^{2+} complexed with EDTA. The analyte is added (assuming higher binding constant and lower concentration) and the Mg^{2+} is displaced. The Mg^{2+} is titrated with EBT. A second way to overcome titrations with weak end points is to do a back titration. In a back titration, excess EDTA is added to the sample solution. The excess is then titrated with a standard Mg or Zn solution.

EDTA is a widely applicable complexing agent as it will complex with almost any metal. This can be a problem if selectivity is desired however. Selectivity can be controlled through pH.

A second method for adding selectivity is to add a competing reagent called a masking agent. A masking reagent reacts with one of the species and allows titration of the second. This can be applied to a simple binary mixture or to a more complex mixture. For example, if NH_3 is used as a buffer, Cd^{2+} can be titrated in the presence of Zn^{2+} .