

Difference Between Complexing Agent and Chelating Agent

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Key Difference - Complexing Agent vs Chelating Agent

Chelation is the formation of a chelate. A chelate is a cyclic compound which has a central metal [atom](#) bonded to at least two other atoms. Normally, a metal [ion](#) in a solution does not remain isolated. Metal ions can link with other metal ions and form chain structures. If not, metal ions make complexes with non-metal ions or molecules. These complexes are called coordination compounds. The molecules or ions which are involved in these complex formations can be categorized into two types as complexing agents and chelating agents. The key difference between complexing agent and chelating agent is that **complexing agent is an ion, molecule or a functional group that can bind with a metal ion through one or several atoms to form a large complex** whereas **chelating agent is a compound that can bind with a metal ion to produce a chelate through several atoms in the same molecule.**

What is a Complexing Agent?

A complexing agent is also called a **ligand**. A complexing agent is a chemical species capable of binding with metal ions or other chemical entities in a system through its single or multiple sites. These sites have lone pairs of [electrons](#) which can be donated to the d orbitals of a metal ion, forming coordination bonds. This results in a coordination compound. Ligands may surround a metal ion or can act as a bridge between two metal ions. A complexing agent can be an ion, molecule or a functional group of a molecule. A complexing agent can have either one binding site or several binding sites.

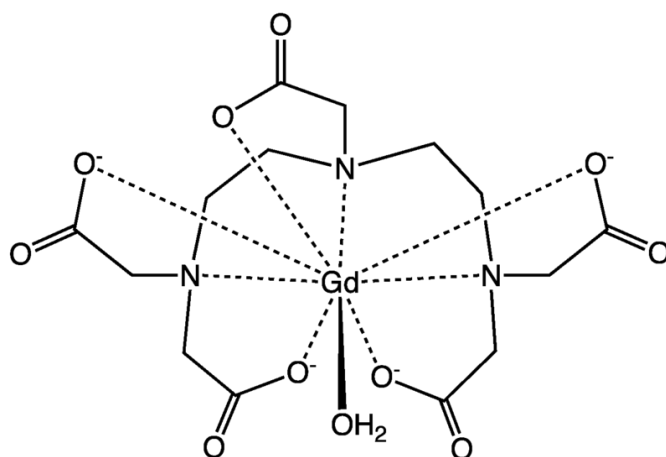


Figure 01: DTPA Complex

What is a Chelating Agent?

A chelating agent is also a type of ligand, but unlike the other ligands, chelating agents can bind to a metal ion with several atoms in the same molecule. A chelating agent is a chemical compound that can bind to a single metal ion through several atoms present in the molecule. These atoms have lone pairs which can donate to the empty d orbitals of a metal atom. Which means, unlike other ligands, chelating agents are multidentate ligands, and there are no monodentate chelating agents. For example, a single ethylenediamine molecule can form two coordination bonds with Nickel(II) atom. Since Nickel (II) atom can form six such bonds, three ethylenediamine molecules will bind with a single Nickel (II) atom.

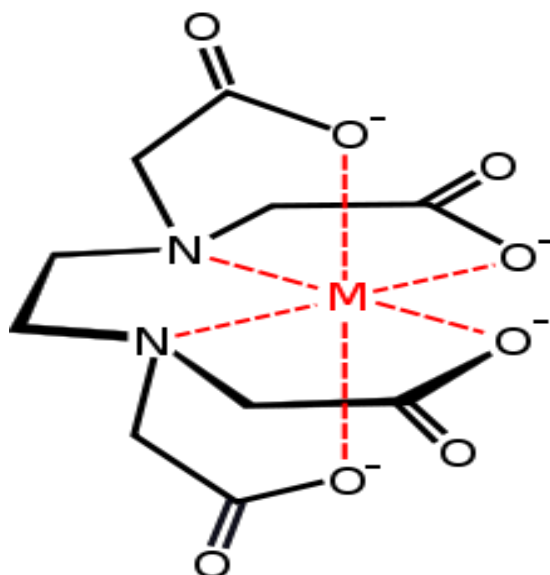


Figure 02: Coordination bonds of DOTA chelate with a Metal ("M")

What are the similarities between Complexing Agent and Chelating Agent?

- Both complexing agent and chelating agent are ligands which can bind with certain chemical substituents.
- Both these compounds form coordination bonds with metal ions by donating lone pairs of electrons to the d orbitals of a metal.

What is the difference between Complexing Agent and Chelating Agent?

Complexing Agent vs Chelating Agent	
A complexing agent is an ion, molecule or a functional group which can bind with metal ion through one or several coordination bonds.	A chelating agent is a chemical compound which can bind with metal ions through multiple coordination bonds to form stable, water-soluble complexes.
Binding Sites	
A complexing agent may have single or multiple bonding sites.	A chelating agent has multiple binding sites but not a single binding site per molecule.
Number of Atoms Involved	
A complexing agent can bind with a metal ion through a single atom or multiple atoms.	A chelating agent binds with a metal ion with at least two atoms, but not with a single atom.
Nature of Agent	
A complexing agent can be an ion, molecule or a functional group.	A chelating agent is always an organic molecule.

Nature of Binding

A complexing agent can bind with a metal ion by surrounding it or as a bridge that connects two metal ions.

A chelating agent always binds with a metal ion by surrounding it, making a chelate.

Denticity

Complexing agents can be monodentate or multidentate.

Chelating agents cannot be monodentate; they are always multidentate.

Summary - Complexing Agent vs Chelating Agent

Ligands are chemical species which can bind with metal ions through coordination bonds. Complexing agents and chelating agents are such ligands which are very useful in industry. The main difference between complexing agent and chelating agent is that complexing agent is an ion, molecule or a functional group that can bind with a metal ion through one or several atoms to form a large complex whereas a chelating agent is a compound that can bind with a metal ion to produce a chelate through several atoms in the same molecule.

References:

1. "Chelates and chelating agents." Chemical of the Week -- Chelates and Chelating Agents. N.p., n.d. Web. [Available here](#). 06 June 2017.
2. "How Does Chelation Work." How Does Chelation Work? | Life Enhancement Products. N.p., n.d. Web. [Available here](#). 06 June 2017.

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