6.4A: Chemical Interferences

It is also possible to have chemical processes that interfere with atomic absorption and emission measurements. It is important to realize that the chemical interferences described herein can potentially occur in flame, furnace and plasma devices. One example of a chemical interference occurs for metal complexes that have low volatility. These are often difficult to analyze at trace concentrations because the atomization efficiency is reduced to unacceptably low levels.

Can you devise a strategy or strategies for eliminating the problem of a non-volatile metal complex?

One possibility is to use a higher temperature flame. Switching from an acetylene/air flame to an acetylene/nitrous oxide flame may overcome the volatility limitations of the metal complex and produce sufficient atomization efficiencies.

Another strategy is to add a chemical that eliminates the undesirable metal-ligand complex. One possibility is to add a ligand that preferentially binds to the metal to form a more volatile complex. This is referred to as a **protecting agent**. The sensitivity of calcium measurements is reduced by the presence of aluminum, silicon, phosphate and sulfate. Ethylenediaminetetraacetic acid (EDTA) complexes with the calcium and eliminates these interferences. The other strategy is to add another metal ion that preferentially binds to the undesirable ligand to free up the desired metal. This is known as a **releasing agent**. The presence of phosphate ion decreases the sensitivity of measurements of calcium. Excess strontium or lanthanum ions will complex with the phosphate and improve the sensitivity of the calcium measurement.

Another potential problem that can occur in flames and plasmas is to have too high a concentration of the analyte metal exist in an ionic form. Since neutral atoms are usually being measured (sometimes when using an ICP it may actually be preferable to measure emission from an ionic species), the presence of ionic species reduces the sensitivity and detection limits.

Can you devise a strategy to overcome unwanted ionization of the analyte?

One possibility might be to use a cooler atomization source, although there are limitations on the range to which this is feasible. The RF power used in an inductively coupled plasma does influence the temperature of the plasma, and there are recommendations for specific elements about the recommended source power. Similarly, changes in the fuel/oxidant ratio cause changes in the temperature of a flame.

A more common strategy is to add something to the sample known as an **ionization suppression agent**. An ionization suppressor is something that is easily ionized. Common ionization suppressors would include alkali metals such as potassium. Thinking of Le Chatlier's principle, ionization of the suppressor forms more electrons and greater charges of positive ions that suppress the ionization of the analyte species.