Prodigy ICP

Technical Note

Using Adjustable Slits to Reduce Interfering Element Effects

INTRODUCTION

The Inductively Coupled Plasma (ICP) is one of the most widely used emission sources for routine trace metal analysis. This is due to its relative freedom from chemical interferences when compared to Atomic Absorption (AA), as well as its speed of analysis, superior dynamic range and inherent multi-element capability.

The property of the ICP most responsible for its freedom from chemical interference is the temperature of the plasma. Inside the axial channel of the plasma (where the sample penetrates) the temperature exceeds 6000^{o}C which is sufficient to decompose virtually any molecular species contained in a sample.

The high temperature of the plasma is also the cause of the most common type of interference found in ICP; that being effects from neighboring emission lines (or interfering element effects). Because every species present in the plasma emits light, interfering elements effects can be encountered frequently; especially with low resolution spectrometers such as the Czerny-Turner monochromators and Rowland Circle polychromators that are in common use today. Interfering element effects can be minimized by using a spectrometer with high spectral resolution. Any residual effects can then be managed using interfering element correction (IEC) factors.

The standard optical resolution of the Prodigy is 0.008 nm which is sufficient to virtually eliminate the need for IECs on routine samples. With the use of ICP expanding into more complex and exotic sample types, the need for even higher optical resolution is appearing. The Prodigy provides a solution for these applications by using an optional adjustable slit assembly that allows the user to select the optical resolution of the spectrometer. This is accomplished by the use of a Hartmann Diaphragm slit mechanism which is shown in *Figure 1*. By moving the series of rectangular slits relative to each other, various slit sizes (and optical resolutions) can be obtained. The actual assembly is illustrated in *Figure 2*.

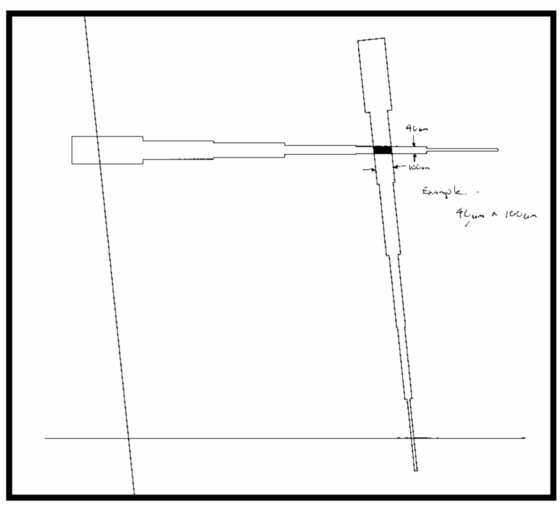

Figure 1. Adjustable Slit Schematic

6 Wentworth Drive • Hudson, NH 03051 U.S.A.
Tel: 603 886 8400 • Fax: 603 886 9141 • www.leemanlabs.com

To demonstrate the effect of the adjustable slit assembly, a well-known interference was chosen: the copper interference on the phosphorous 214.914 nm line, which is commonly used to judge an instrument's resolution capability.

EXPERIMENTAL

The Prodigy was calibrated for phosphorus using 0, 1, 5 and 10 ppm standards. A 25-ppm copper standard, which contained no phosphorus, was then run as a sample. The experiment was performed at three slit settings: 80 x 100 µm, 40 x 100 µm, and 15 x 100 µm. The results are presented in *Table 1*.

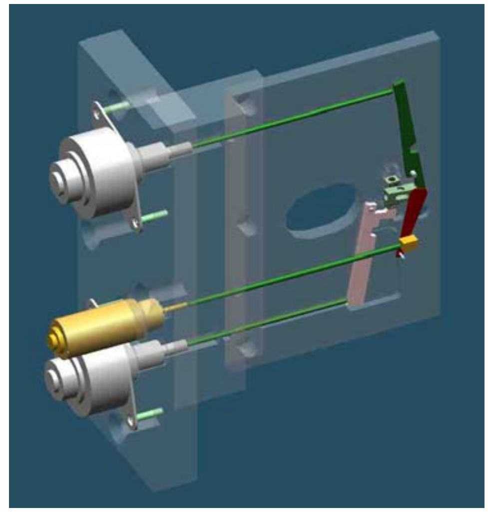

Figure 2. Adjustable Slit Mechanism

"Apparent" Phosphorous Concentration, mg/L	SD	RSD	Slit Width, µm	Optical Resolution, nm
5.072	0.0447	0.881	80	0.017
1.773	0.0174	0.979	40	0.008
1.188	0.0046	0.389	15	0.006

Table 1.

As expected, the extent of the Cu interference is greater at the wider slit settings, where the lower resolution causes a greater degree of overlap. This is illustrated by the increasing "apparent" phosphorus concentration. The actual extent of the spectral overlap at each of the slit settings can be seen in *Figures 3, 4* and *5*. (It is interesting to note that the resolution at the widest slit setting used (0.017 nm) is approximately equal to the resolution of Rowland Circle based solid-state detector systems. This means these systems will suffer from considerable interfering element effects in all but the simplest matrices.)

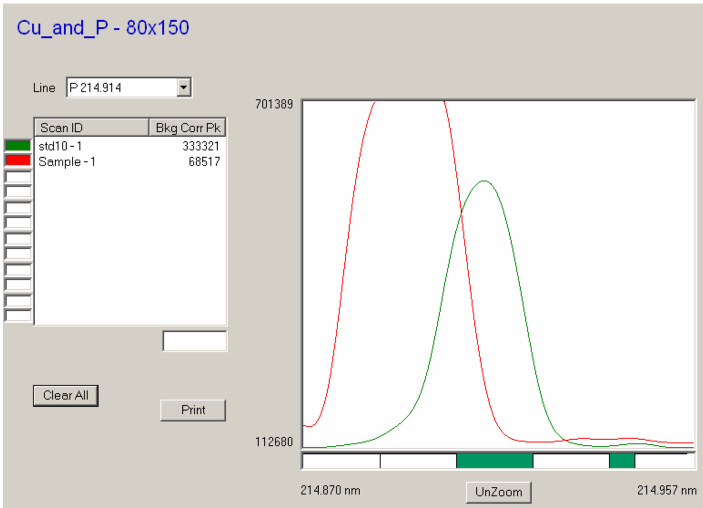

Figure 3. 80 x 150 µm Slit

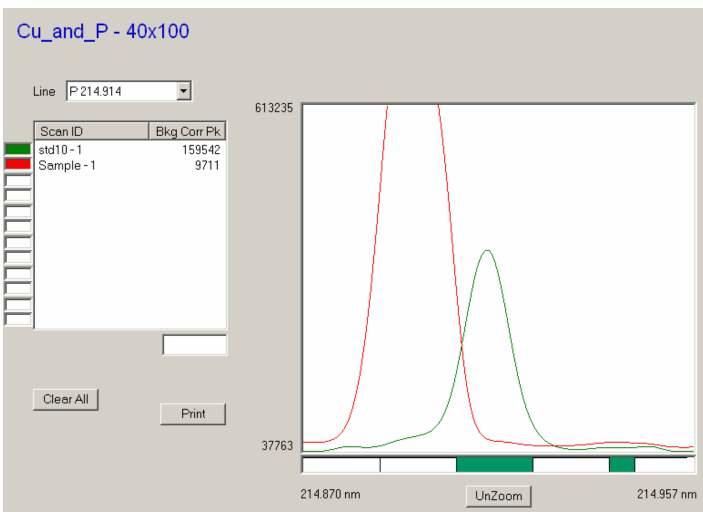

Figure 4. 40 x 100 µm slit

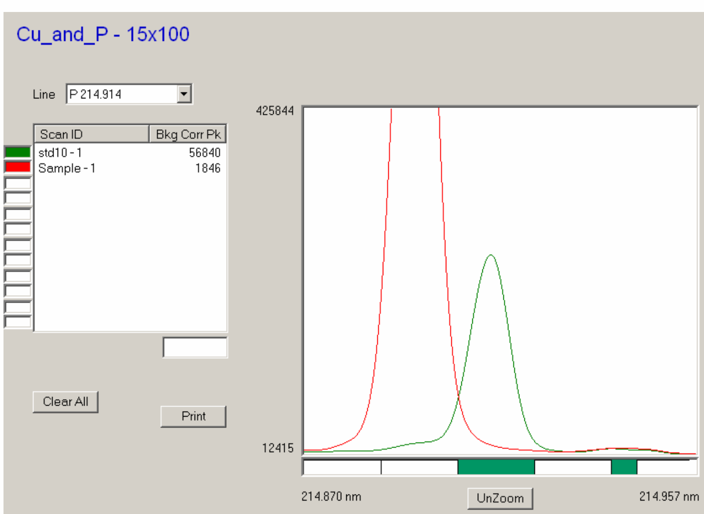

Figure 5. 15 x 100 µm Slit

This experiment essentially duplicates how an Interfering Element Correction (IEC) factor is determined: a standard of known concentration of the interfering element (Cu) is analyzed as a sample at the analyte line (P). The ratio of the apparent concentration of the analyte to the concentration of the interfering element is the IEC factor. *Figure 6* contains a plot of the IEC factors vs. Slit Width calculated from the concentration data contained in Table 1. The calculated values are listed in *Table 2*.

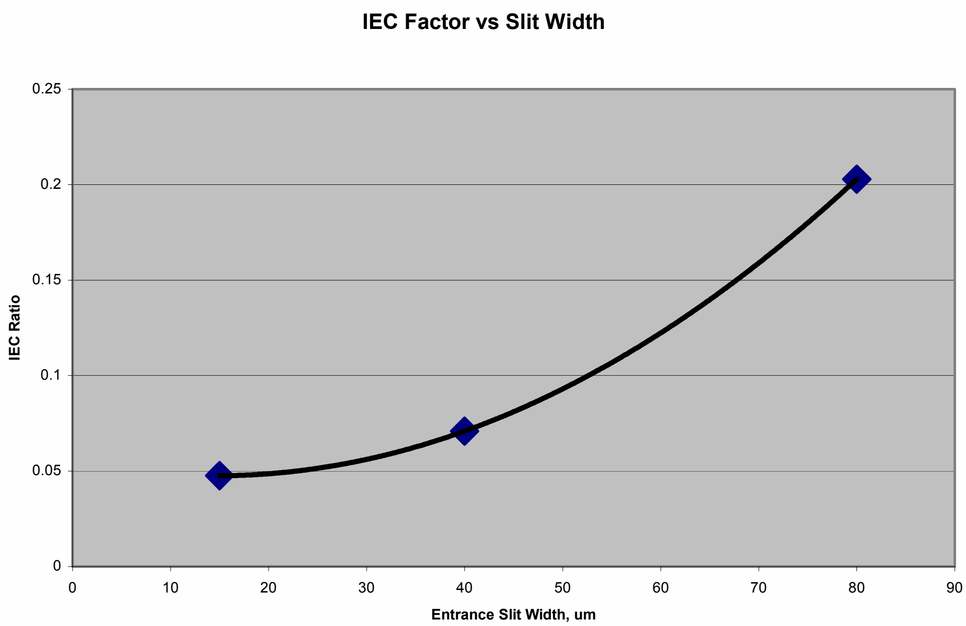

Figure 6. IEC Factor vs. Slit Widths

Line	Apparent Concentration	Slit Width, µm	IEC
P 214.914	5.072	80	0.202878
	1.773	40	0.070917
	1.188	15	0.047507

Table 2. Interfering Element Correction Factors

CONCLUSION

The Teledyne Leeman Labs Prodigy ICP provides the analyst with the ability to choose the optical resolution that best fits their application. In comparison to other systems, the Prodigy provides this capability without sacrificing wavelength range or the ability to perform true simultaneous analysis.

To discuss how Teledyne Leeman Labs can help you solve your elemental analysis challenges, contact us at 1-800-634-9942 or visit us at www.LeemanLabs.com.