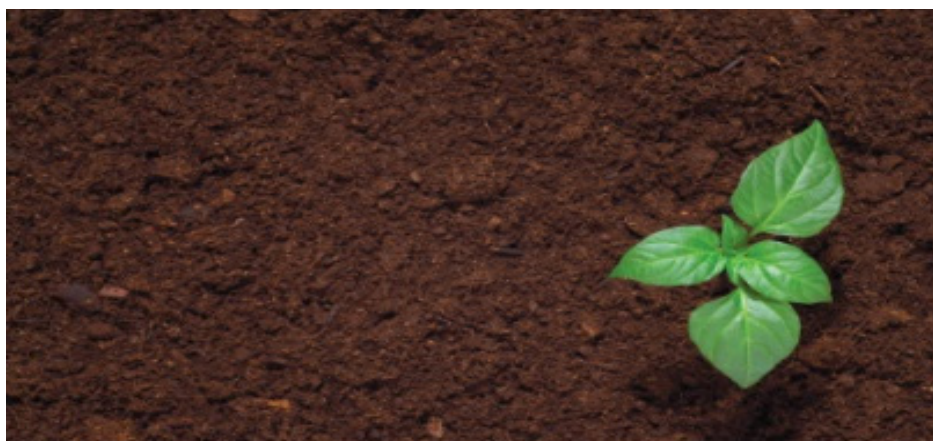


## Determination of Cr, Cu, Ni and Zn in Soils Using Fast Sequential Mode



### High throughput analysis

Laboratories testing soils using Atomic Absorption Spectroscopy (AAS) face pressure due to the number of elements to be measured and large numbers of samples. It is not uncommon to measure from 4 to 10 different elements in each soil sample. Conventional flame AAS systems can only detect one element per one sample aspiration, which means multiple aspirations are needed for multi-element testing. It is time-consuming and laborious when there are a large number of elements and samples waiting for analysis.

The Agilent 240FS is a high performance flame atomic absorption spectrometer. It combines four lamps with the Agilent [Fast Sequential \(FS\) mode](#) which doubles sample throughput and dramatically reduces running costs. Fast Sequential mode operates all four lamps simultaneously. A fast lamp selection mirror and high speed wavelength drive are used to switch between the lamp and wavelength required to measure each element. The Hammer gas control system initiates instantaneous changes to the gas flows, ensuring each element is analyzed under optimal conditions. This results in much higher analytical efficiency, lower operating cost, minimized sample consumption, as well as reduced reagent and handling costs.

In this study, the Agilent 240FS Flame AA was used to measure four elements: Cu, Zn, Ni and Cr in Geochemical Soil Certified Reference Samples (GSS series). The method used FS mode to quickly measure the four elements in a sample before moving onto the next sample (as shown in Figure 1).

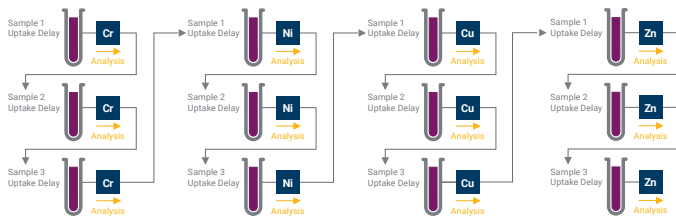
#### Fast Sequential mode

Using Fast Sequential mode, samples are only aspirated once, with all elements being measured before the next sample is aspirated.



#### Conventional mode

Conventional AA determines only one element from each sample aspiration, so samples are analyzed time and time again during a multi-element sequence.



**Figure 1.** In Fast Sequential mode, all elements are measured in each sample before moving onto the next sample. This compares with conventional AAS, where a single element is measured in each sample at a time.

Table 1 displays the instrument operating conditions for Cu, Zn, Ni and Cr. The results in Table 2 show that the measured results compare well with the certified values. It took only about 15 minutes to determine 4 elements in 8 samples, saving about 50% of the time and gas consumption compared with conventional AA system.

**Table 1.** Operating conditions of using FS Mode to determine Cu, Zn, Ni and Cr in soil.

	Cu	Zn	Ni	Cr
Lamp current (mA)	10	10	10	10
Wavelength (nm)	324.8	213.9	232.0	357.9
Slit Width (nm)	0.5	0.2	0.2	0.2
Flame Type	Air-acetylene			
Acetylene Flow (L/min)	2.0	2.0	2.0	2.0
Air Flow (L/min)	13.5	13.5	13.5	13.5

The measured concentrations of the samples show excellent accuracy. Each result was within  $\pm 10\%$  of the certified value (see Table 2).

**Table 2.** A comparison of the measured concentrations for Cu, Zn, Ni, and Cr against the certified concentrations for the soil samples.

Sample		Cu (mg/kg)	Zn (mg/kg)	Ni (mg/kg)	Cr (mg/kg)
GSS-4	Measured value	40.97	199.08	60.77	371.48
	Certified value	40 $\pm$ 3	210 $\pm$ 13	64 $\pm$ 5	370 $\pm$ 16
GSS-8	Measured value	24.67	67.77	29.97	64.51
	Certified value	24.3 $\pm$ 1.2	68 $\pm$ 4	31.5 $\pm$ 1.8	68 $\pm$ 6
GSS-9	Measured value	25.20	59.78	32.74	72.92
	Certified value	25 $\pm$ 3	61 $\pm$ 5	33 $\pm$ 3	75 $\pm$ 5
GSS-11	Measured value	21.41	63.81	24.89	57.02
	Certified value	21.4 $\pm$ 1.2	65 $\pm$ 5	25.4 $\pm$ 1.3	59 $\pm$ 3
GSS-13	Measured value	22.29	65.56	28.65	63.26
	Certified value	21.6 $\pm$ 0.8	65 $\pm$ 3	28.5 $\pm$ 1.2	65 $\pm$ 2
GSS-21	Measured value	24.52	67.78	27.30	50.68
	Certified value	24 $\pm$ 1	66 $\pm$ 3	28 $\pm$ 1	55 $\pm$ 5
GSS-23	Measured value	31.61	94.61	37.73	82.34
	Certified value	32 $\pm$ 1	97 $\pm$ 3	38 $\pm$ 1	82 $\pm$ 4
GSS-24	Measured value	27.20	80.28	24.86	62.36
	Certified value	28 $\pm$ 1	81 $\pm$ 2	24 $\pm$ 1	62 $\pm$ 2

Using FS mode, it took only 15 minutes to determine four elements in eight samples. This was a 50% reduction in time and gas consumption, compared with a conventional AA system. The 240 FS is an efficient flame AAS instrument, able to measure large numbers soil samples quickly and accurately.

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