Effects of paper and plastic bags on the performance of Thermo Scientific portable XRF analyzers

Application Note

Introduction

Field Portable X-Ray Fluorescence (FPXRF) instruments, including more than 3,000 Thermo Scientific™ portable XRF analyzers, are used extensively in various stages of mining activity from grass root exploration to exploitation, ore grade control, and even environmental investigations. With or without sample preparation, FPXRF analyzers deliver fast, accurate and repeatable results on samples containing a broad range of elements from magnesium (Mg) to uranium (U).

Handheld Thermo Scientific™ Niton™ XL3t and Niton XL2 Series analyzers and the Niton FXL field x-ray lab analyzers are making a critical difference in mining industry operations worldwide, providing geologists with new capabilities to prequalify and reduce laboratory samples, with exceptional portability and ease-of-use.

Application

FPXRF is a surface analysis technique that is capable of analyzing more than 30 elements in seconds in any type of sample, from soil to rock chips and drill cores. In some cases, depending on the sample type and required accuracy, clients may want to assay their samples in a paper or plastic bag. Depending on the thickness of bag and its composition, the number of x-rays reaching the detector will be lower than with direct assay. In such cases, calibration of the instrument using "cal-factors" is necessary. However, the overall time savings gained by eliminating various sample preparation steps can be significant in some projects.

Method

Pulverized samples from a sedimentary-hosted lead-zinc deposit were analyzed in both plastic (0.06 mm thick or 2-2.5 mils, 38 samples) and paper (0.11 mm thick or 4-5 mils; 18 samples) bags (Figure 1) and the results were compared to their lab assays (Figure 2). Samples were crushed and pulverized in mill steel to 95% passing 105 micron mesh. The laboratory assay methods used were a combination of instrumental neutron activation (INAA) with a 30g aliquot and inductively coupled plasma optical emission spectrometry (ICP-OES), with a four acid, near-total sample digestion of 0.25 g. The portable analyzer used was an XL3t-500 series with PIN detector using a filter time of 30 seconds per filter with analysis through the sample bags returned from the lab.

Figure 1. Plastic and paper bags used in this study.

Thermo Scientific XRF analyzers use Mining Mode and Soil Mode. Mining Mode is based on a Fundamental Parameters Calibration and relies on the detector's response to pure element spectra, whereas Soil Mode uses Compton Normalization where scatter (Compton Peak) in spectrum is related to sample matrix. Mining Mode provides suitable assay data on samples tested in a paper or plastic bag. Preliminary investigation of the samples and their assay data indicate that Soil Mode is not suitable due to high concentration of elements such as Fe, Pb and Zn. The summary of results is shown in Table 1.

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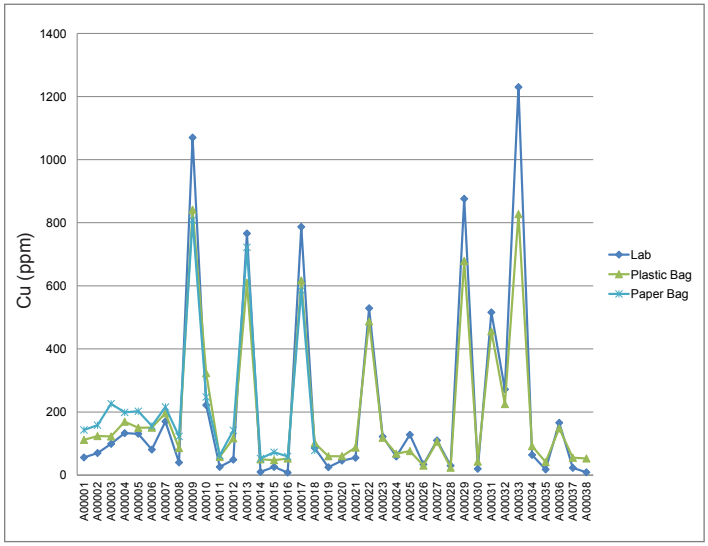
Results

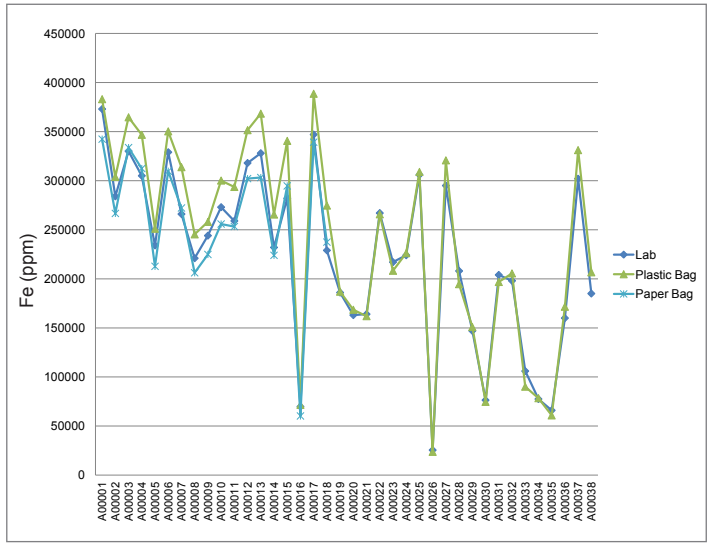
As Figure 2 shows, there are good correlations between lab assay data and portable XRF results. Mining Mode is a preferred method for elements in the ranges of concentrations shown in Table 1. If an application does not need very low levels of detection, the analyzer can be calibrated to the sample through various media.

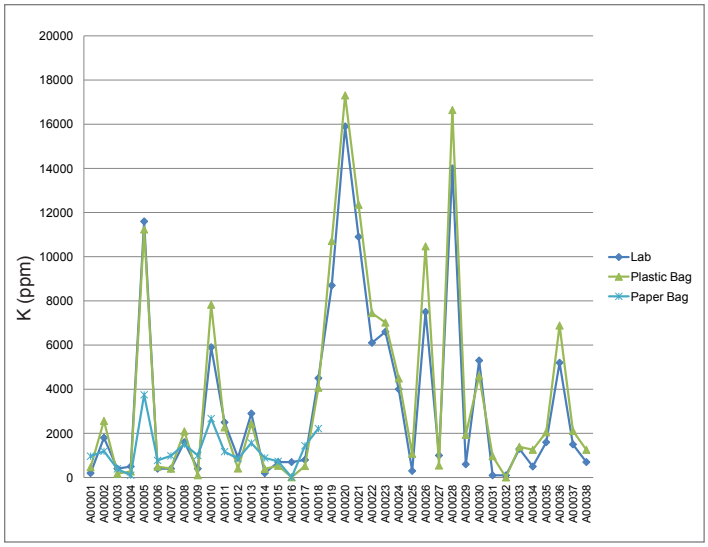
Element	Bag	Concentration	LOD	
			Plastic Bag	Paper Bag
Ag	Plastic	<60 ppm	16	15
As	Plastic	<70 ppm	88	78
Ca	Plastic	<11.1%	560	882
Cd	Plastic/paper	<1700 ppm	16	16
Cu	Plastic/paper	<1200 ppm	94	90
Fe	Plastic/paper	<40%	13245	11088
K	Plastic	<1.7%	1032	900
Mn	Plastic/paper	<2%	716	642
Ni	Plastic/paper	<650 ppm	198	176
Pb	Plastic/paper	<9%	546	446
S	Plastic	<35%	20954	19154
Sr	Plastic	<300 ppm	44	42
Ti	Plastic	<4500 ppm	213	171
Zn	Plastic/paper	<50%	252	217

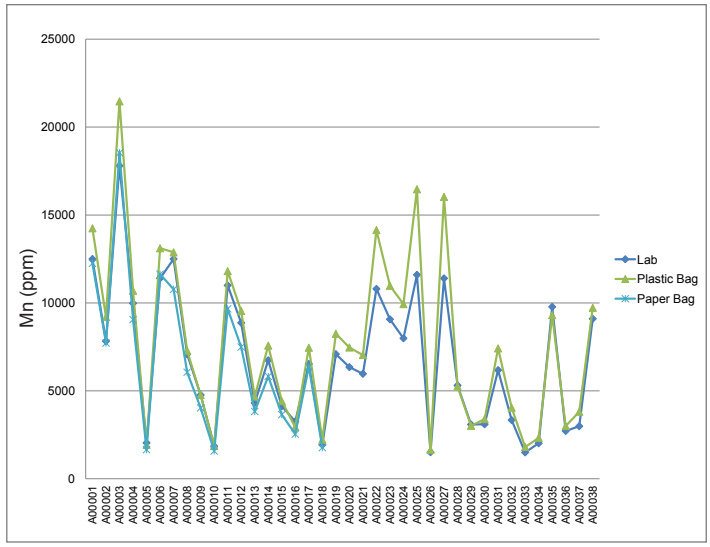
Table 1: Recommended bag type based on concentration and composition of samples used in this study. The concentration column shows the maximum concentration in the samples used in this study. Limits of Detection (LOD) are shown for each bag type using Mining Mode.

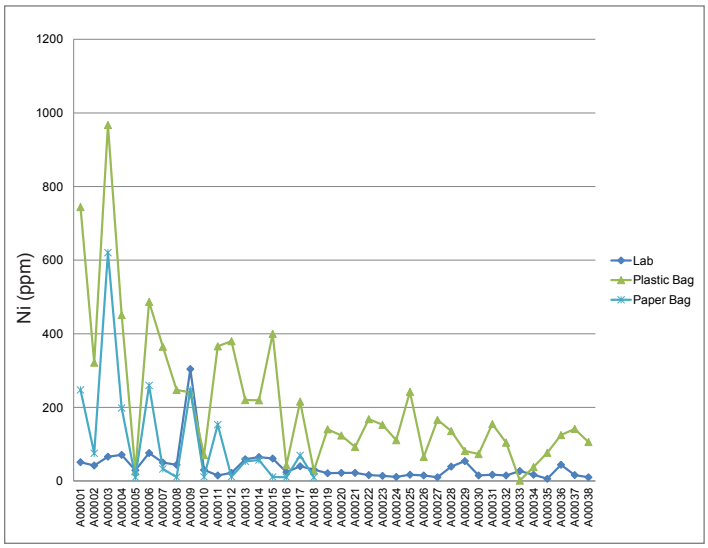
Figure 2. Comparison of lab data with those from portable XRF in Mining Mode used on samples in paper and plastic bags.

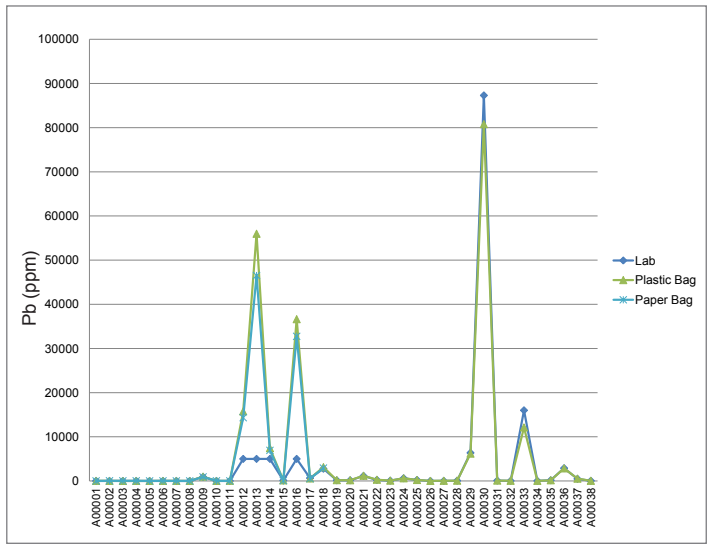




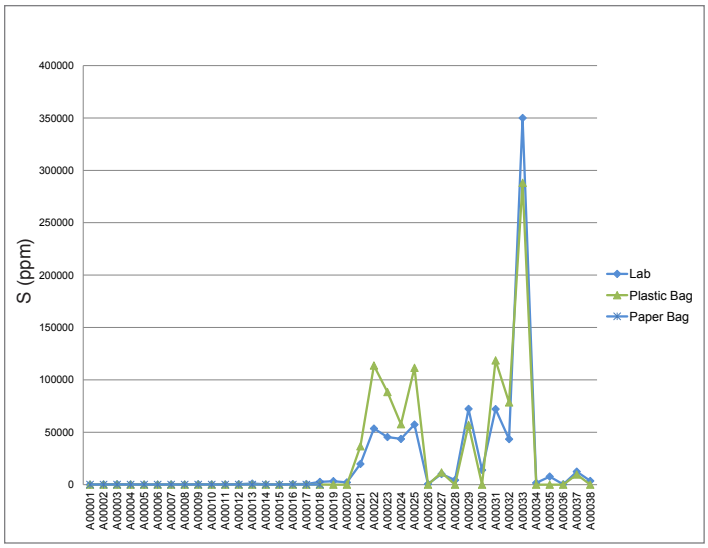


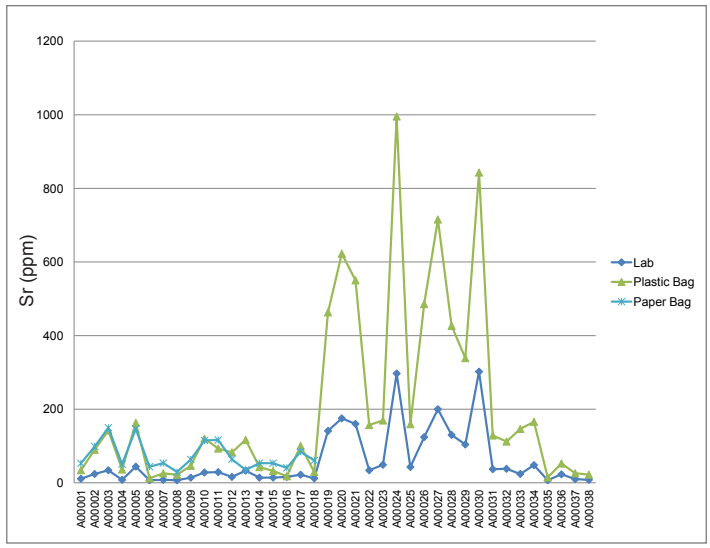


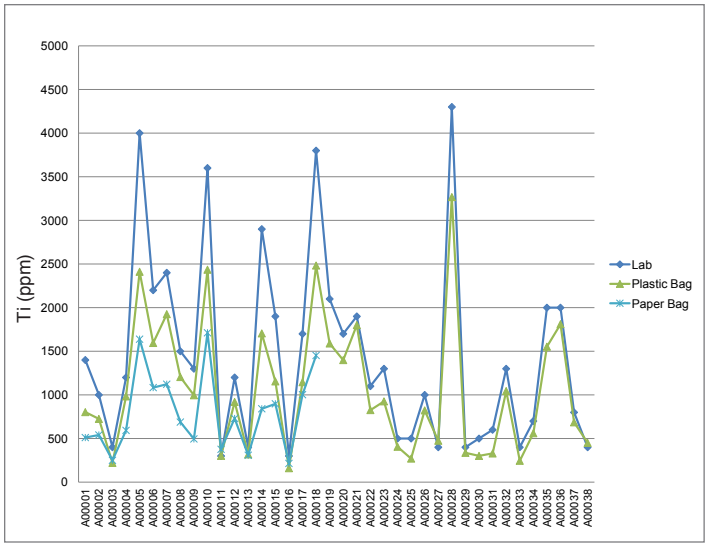


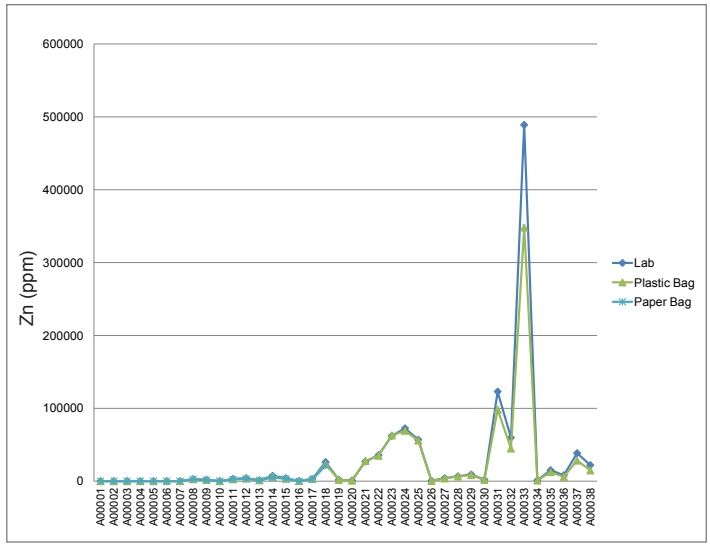


Cont. Figure 2.









Cont. Figure 2.

Conclusion

This case study shows that for many applications, portable XRF analysis of samples through a plastic bag or paper bag yields valuable and reliable data that can be used to make timely decisions in the field. Furthermore, the study documents that Mining Mode (for most sample matrices) is preferred if the user wishes to analyze samples in a bag.

To discuss your particular applications and performance requirements, or to schedule an on-site demonstration, please contact your local Thermo Scientific portable analyzer representative or contact us directly by email at niton@thermofisher.com, or visit our website at www.thermoscientific.com/niton.

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