SHIMADZU

Application News

X-ray Analysis No.X236

EDXRF Analysis of Lead, Cadmium, Mercury and Chromium in Zinc Alloy

X-ray fluorescence analysis can be used to quickly and easily analyze samples in solid, powder and liquid states nondestructively, and is therefore widely used as a screening method for compliance with the RoHS/ELV directives. Here we present the results of our evaluation of the calibration curves for Pb, Cd, Hg and Cr in MBH-manufactured Zn alloy reference materials, as well as our evaluation of the analysis sensitivity. Many Zn alloys are used as Zn plating and Zn-alloy die cast parts in automobiles and electrical and electronic equipment. Moreover, Zn alloy reference materials can be applied to the analysis of copper, nickel and iron, whose atomic numbers are near one another, in addition to the alloy brass, and these reference materials also feature the presence of mercury in their composition.

■ Samples

Zn alloy reference materials made by MBH Analytical Ltd.

Sample	Content (ppm)			
	Pb	Cd	Hg	Cr
41X ZSC1	621	288	260	39
41X ZSC2	1111	16	53	36
41X ZSC3	273	1190	21	148
41X ZSC4	1560	131	500	299
41X ZSC5	137	502	1470	0
41X ZSC6	77	2150	290	0

■ Analysis Results: Detection Limits

Element	Cd	Pb	Pb	Hg	Cr
Spectrum	Cd Kα	Pb Lβ1	Pb Lα	Hg Lβ1	Cr Kα
Voltage (kV)	50□	50□	50□	50□	30□
Measurement time (sec)	300□	300□	300□	300□	300□
Detection limit (ppm)	8.5	54.3	79.2	82.2	56.4

- Measurement was conducted on a cut and ground area of the surface of the Zn alloy reference sample.
- HgLβ1 was used for the Hg analysis line to avoid overlapping of Hg Lα and Zn Kβ.
- The optimum primary filters were used in the analyses.
- The detection limits were calculated using the equation at right.

∗ Equation for determining detection limit

$$L.L.D. = 3 \times k \times \sqrt{\frac{I_{back}}{T}}$$

k : Slope of calibration curve (ppm/cps)

I_{back} : Background intensity (cps)

T : Measurement time (sec)

■ Calibration Curves

The calibration curves for Cd, Pb (2 curves), Hg, and Cr using the EDX-720 are shown in Fig. 1 - 5, respectively. Measurement was conducted on a cut and ground area of the surface of the Zn alloy reference sample. HgLβ1 was used for the Hg analysis due to possible overlapping of Hg Lα and Zn Kβ.

The Cd content range is 16 - 2150 ppm. Since there are some samples with less than 100 ppm, which is the threshold of RoHS/ELV directives, there are situations where it may be advisable to use a brass reference sample (Sumitomo Metal Technology, Inc., refer to Application News No. X225) with a certified level of Cd less than 100 ppm.

The Cr content range is 0 - 299 ppm. Determinations in the vicinity of 1000 ppm, the threshold of RoHS/ELV directives, are beyond the limits of the calibration curve. Similarly as with Cd, there are situations where it might be advisable to use a brass reference sample.

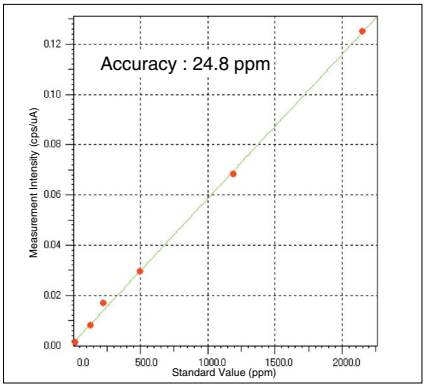

Fig.1 Calibration Curve for Cd Kα

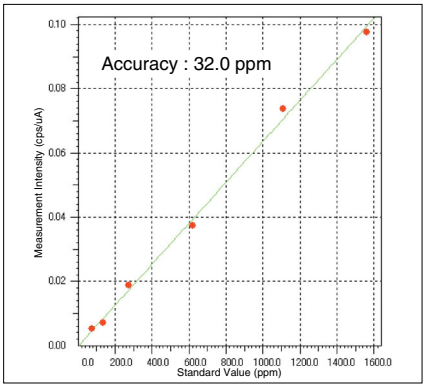

Fig.2 Calibration Curve for Pb Lβ1

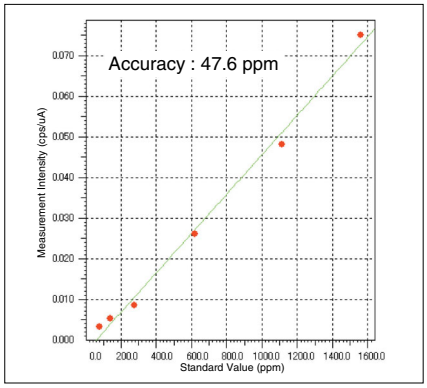

Fig.3 Calibration Curve for Pb Lα

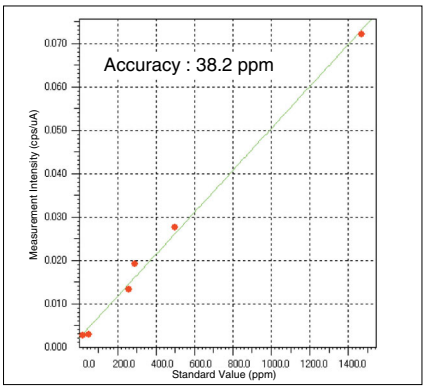

Fig.4 Calibration Curve for Hg Lβ1

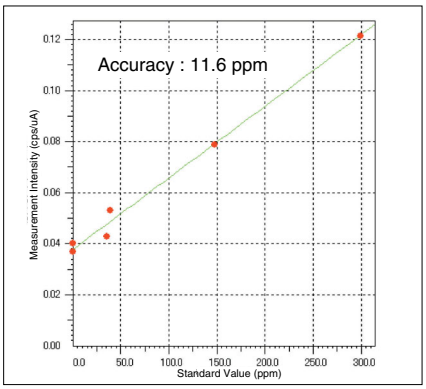

Fig.5 Calibration Curve for Cr Kα

Table 1 Analytical Conditions

Instrument	: EDX-720, GP□
X-Ray Tube	: Rh target □
Filter	: EDX-720; Filter #4 (for Cd,), Filter #3 (for Hg, Pb), Filter #2 (for Cr) □
	EDX-GP; Filter #1 (for Cd), Filter #4 (for Hg, Pb), Filter #3 (for Cr)□
Voltage - Current	: 50 kV - (Auto) μA except for Cr, Cr: 30 kV - (Auto) μA □
Atmosphere	: Air□
Measurement Diameter	: 10 mm□
Measurement Time	: 300 sec □
Dead Time	: 40%

NOTES:
✻This Application News has been produced and edited using information that was available when the data was acquired for each article. This Application News is subject to revision without prior notice.

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