APPLICATION NOTE

No. AN41715

Analysis of Zn Coating on Steel Plate

Thermo Scientific ARL OPTIM'X WDXRF Sequential Spectrometer

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Key words

ARL OPTIM'X 50 W, zinc, coating, steel, X-ray fluorescence, XRF

Goal

A series of zinc coated steel sheet samples are used to establish a calibration curve for zinc coating thickness with Thermo Scientific™ ARL™ OPTIM'X WDXRF instrument at 50 W.

Introduction

Corrosion of steel structures and products costs millions each year. Zinc coating provides the most effective and economical way of protecting steel against corrosion. Zinc-coated steel (also called galvanized steel) offers much enhanced longevity and performance. Hence manufacturers and consumers are demanding a higher content of zinc-protected sheet in durable goods and building products. Such coatings must be controlled in term of thickness of deposited zinc. X-ray fluorescence is an excellent technique to determine thickness of coated zinc on steel.

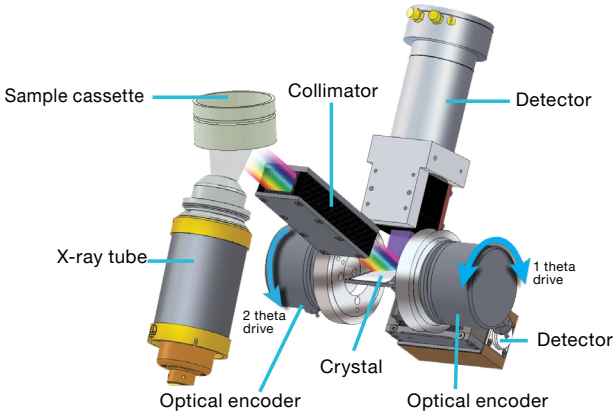
Sample preparation

No special sample preparation is used except cutting the metal sheets to the proper size for the ARL OPTIM'X sample holders (maximum diameter: 52 mm).

Instrumentation

An ARL OPTIM'X WDXRF spectrometer has been used to derive these results. It is fitted with an air-cooled Rh End-Window Tube with thin Be window (0.075 mm) and has a maximum power of 50 Watts.

Thanks to close coupling between X-ray tube anode and sample the performance of the ARL OPTIM'X is equivalent to a 200 W conventional WD-XRF instrument. The instrument can be equipped with the unique SmartGonio™, a series of Multichromators™ or both.



Sample	Zn weight	Zn thickness
2 A	139 g/m^2	20 µ
2 B	134 g/m^2	19 µ
2 C	134 g/m^2	19 µ
3 A	102 g/m^2	14 µ
3 B	87 g/m^2	12 µ
3 C	97 g/m^2	14 µ
6 A	68 g/m^2	10 µ
6 B	70 g/m^2	10 µ
6 C	82 g/m^2	11 µ
Blank	0 g/m^2	0

Table 1: Standard samples for calibration

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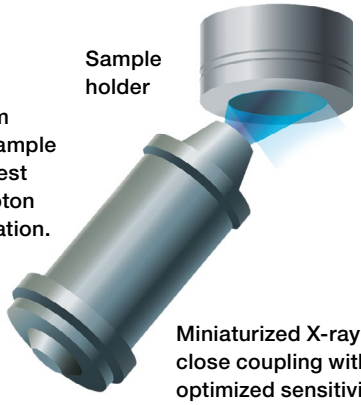

Whole X-ray beam exciting the full sample diameter for highest efficiency: no photon loss during irradiation.

Miniaturized X-ray tube allowing close coupling with sample for optimized sensitivity.

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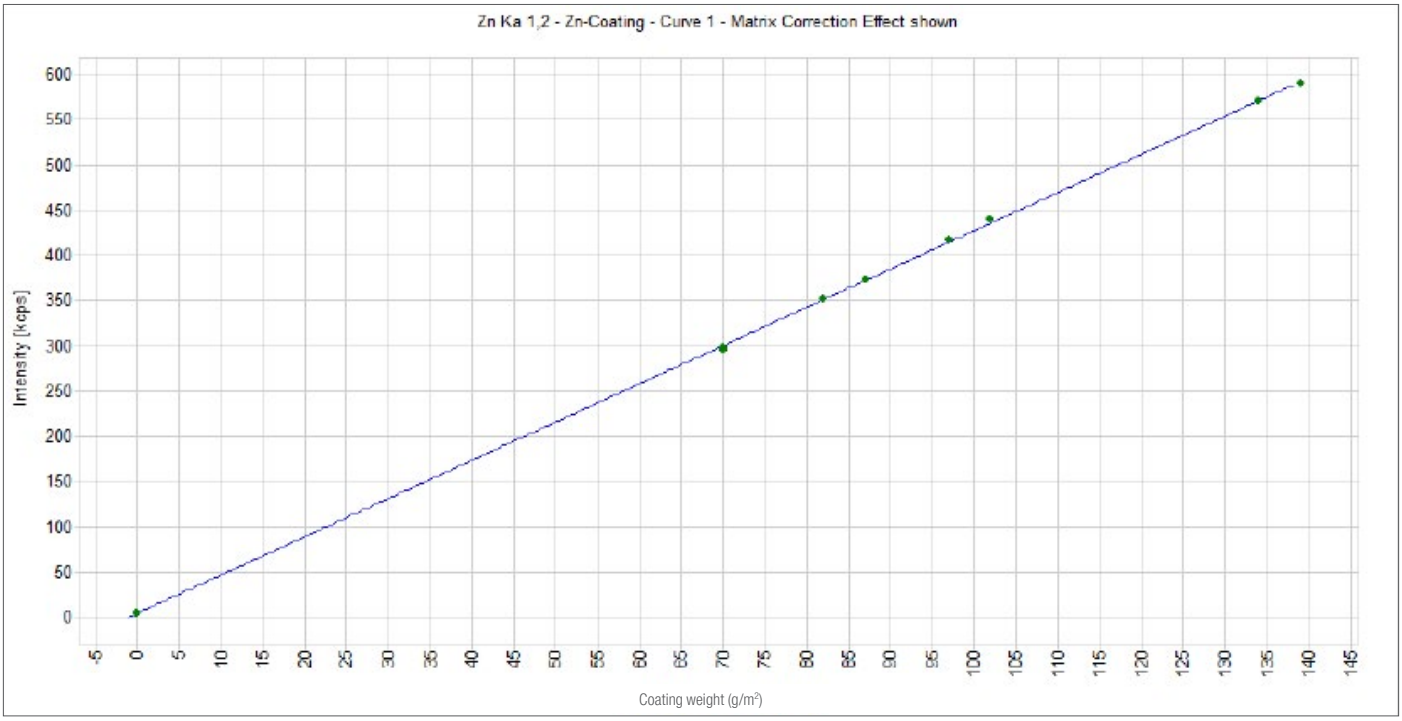

Figure 1: Zn Gross peak calibration

The SmartGonio is fitted with three crystals (AX06, InSb and LiF200) as well as two detectors (Flow Proportional counter and scintillation counter). For analysis of batches of samples a 13-position magazine is available. Ease of operation is obtained through the state-of-the-art OXSAS software running under Windows XP® Professional environment.

Liquids analysis can also be rapidly performed as a quick change-over to helium environment thanks to the small size of the ARL OPTIM'X spectrometer tank.

Calibration results

For this analysis we establish a calibration curve using the Zn Gross peak with a counting time of 60 seconds. LiF200 crystal and scintillation counter are used. As shown in Figure 1 a good correlation is obtained for our calibration curve. The standard error of estimation is only 0.42 g/m2 on the calibrated range.

Repeatability results

Both a static repeatability test and a dynamic test were performed on the ARL OPTIM'X spectrometer.

Static test – 10 repeats without unloading the sample. We can see that the standard deviation is excellent at 0.11% using a counting time of 60 seconds.

Dynamic test – 10 repeats with loading and unloading of the sample. We can see that the standard deviation is excellent at 0.1% using a counting time of 60 seconds.

Runs	Sample #2 Zn Gross [g/m²]	Sample #6 Zn Gross [g/m²]
Run 1	133.2	83.1
Run 2	133.2	83.2
Run 3	133.3	83.1
Run 4	133.2	83.0
Run 5	133	82.9
Run 6	133	83.1
Run 7	133.1	83.1
Run 8	133.3	83.1
Run 9	133.2	82.9
Run 10	133.3	83.0
Average	133.18	83.05
Std. Dev. abs.	0.11	0.10

Table 2: Repeatability for the analysis of zinc using 60-second counting time without unloading sample #2 and with loading and unloading sample #6

Conclusion

These results show that an ARL OPTIM'X spectrometer with 50 W power is well suited for the analysis of Zn coating on steel sheets. The analytical strategy using simply the Zn Kα intensity is recommended. The standard error of estimation of the calibration curves and both the short term and long term precision show excellent results. Only one spectral position is required for the Gross peak method which makes it a very fast analysis requiring only 60 seconds per sample.

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