# Quantitative determination of coating thickness on ABS parts

EDXRF Analyzer: **EX-6600**

Equipped with Silicon Drift Detector (SDD)

## Abstract

Three plastic parts made of Acrylonitrile Butadiene Styrene (ABS) and coated by multi layers coating consisting of: Cu, Ni and Cr, were analysed on Xenemetrix EX-6600 system, to determine the thickness of the different coating layers.
Determination of the thickness of the different coating layers was done using a Fundamental Parameter method that does not require a set of calibration standards.

## Objective

To establish a method for measuring the thickness of multi layers coating on ABS, in the absence of calibration standards.

## Background

EDXRF is a fast and non-destructive technique that can quantify elemental contents in any type of sample such as solid, powder, or liquids or determine thickness of elemental layers on different samples. A few advantages of Xenemetrix EDXRF analyzers are: 1) no sample preparation required and 2) non-skilled operators can perform the analysis thanks to the user friendly graphical user interface. An additional advantage is the Fundamental parameter software for quantitative analysis without the need of costly and not always available calibration standards for the analysis.

## Analytical Configuration

**Table 1:** Instrumental analytical configuration

| | |
|---|---|
| **Instrument** | EX-6600 |
| **Anode** | Rh-Anode X-ray Tube, 60kV,300W |
| **Detector** | Silicon Drift Detector (SDD) |
| **Environment** | Air |
| **Excitation mode** | Direct excitation |
| **Type of analysis** | Quantitative analysis |
| **Analysis time** | 100 sec |
| **Sample Preparation** | No sample preparation |

## Experimental and Results

Three coated plastic parts were received for measuring the thickness of the different coated layers. The coating is consisting of the following layers:

1. 100% Cu – Inner layer; the closest to the ABS
2. 100% Ni – middle layer
3. 100% Cr – Outer layer

**Figure 1:** Sketch of Cu, Ni and Cr layers on the ABS samples

| 100% Cr |
|---|
| 100% Ni |
| 100% Cu |
| **ABS (substrate)** |

Each plastic part was placed "as is" in the sample tray and analyzed. Typical spectrum of part 1 is shown in figure 2.

Static precision tests were performed on the three samples to show the repeatability of the method and the performance of EX-6600 Analyzer. The precision was performed by acquiring the spectra five times without moving the sample between acquisitions. The precision results; individual results and measured average concentration±1 standard deviation, are shown in table #2, 3 and 4.

**Figure 2:** Typical spectrum of Cu, Ni and Cr multi layers coating on ABS (part 1)

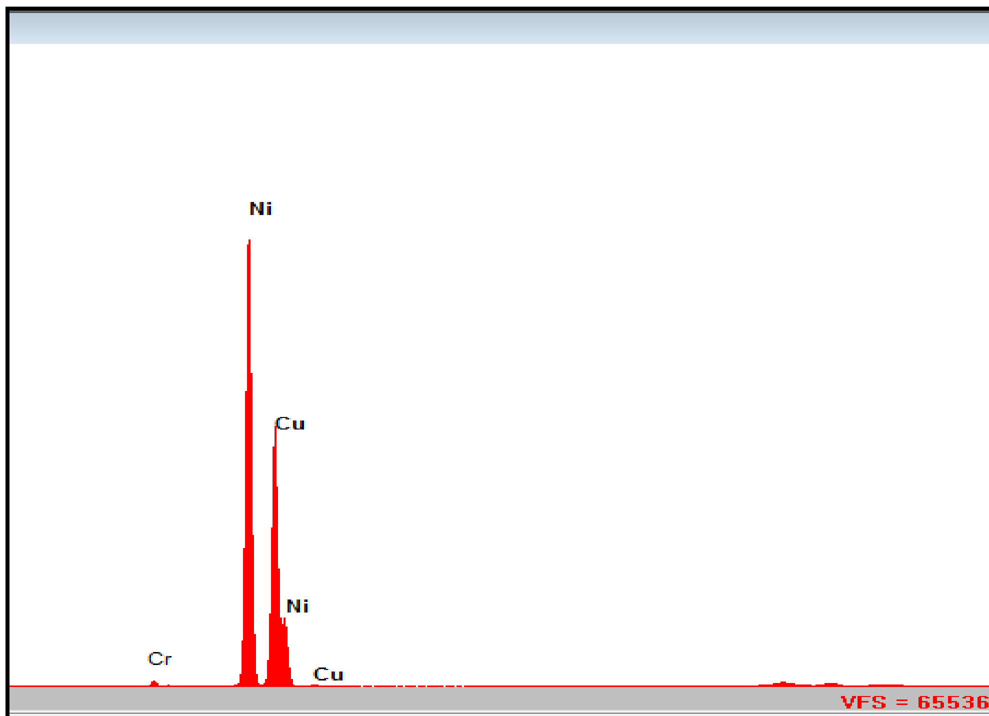


**Table 2:** Sample 1 precision test results

| | Cu [µm] | Ni [µm] | Cr [µm] |
|---|---|---|---|
| Sample 1_A | 14.55 | 10.36 | 0.09 |
| Sample 1_B | 13.11 | 10.15 | 0.09 |
| Sample 1_C | 13.67 | 10.25 | 0.09 |
| Sample 1_D | 14.70 | 10.51 | 0.1 |
| Sample 1_E | 12.24 | 9.88 | 0.09 |
| **Average ± standard deviation** | 13.66±1.03 | 10.23±0.24 | 0.09±0.00 |

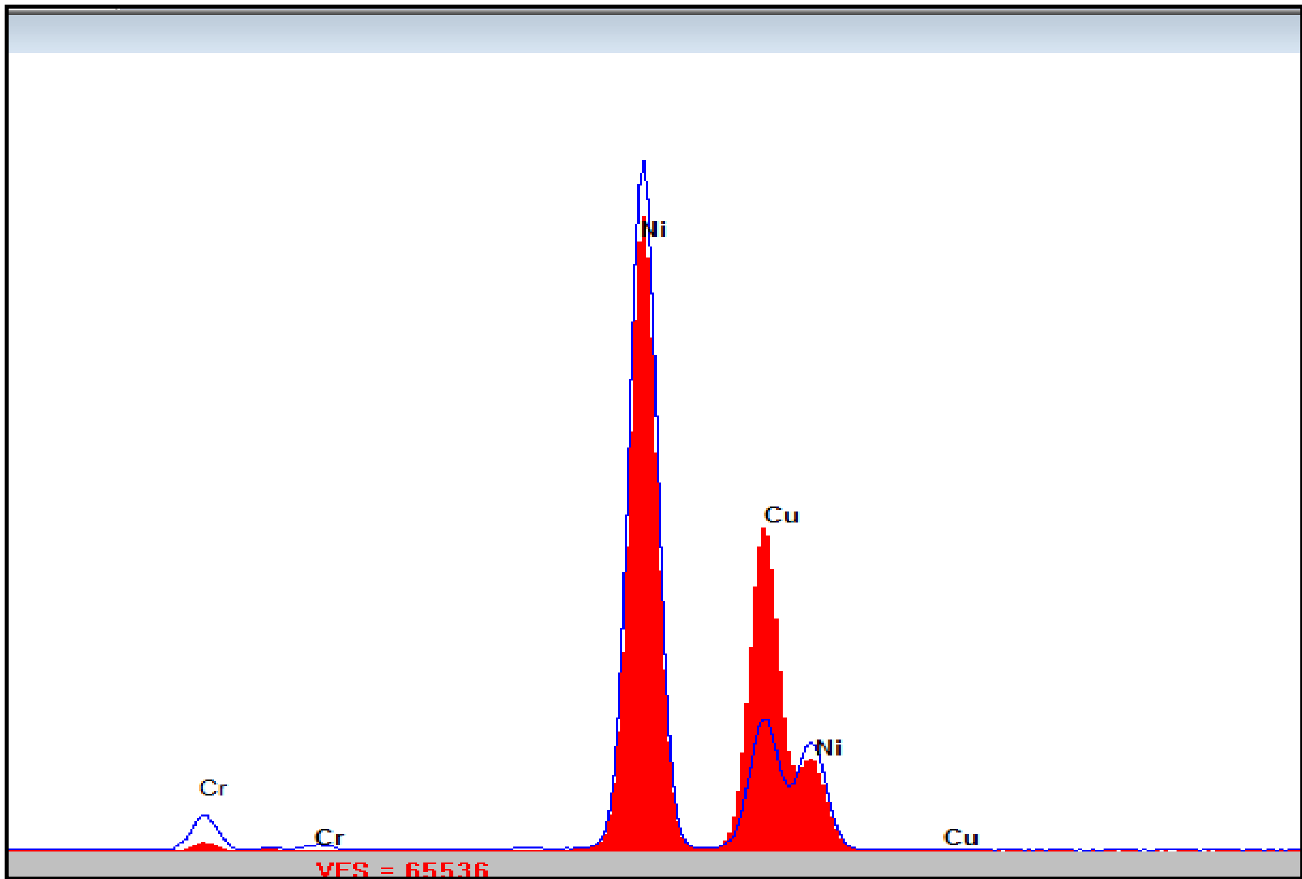
**Table 3:** Sample 2 precision test results

| | Cu [µm] | Ni [µm] | Cr [µm] |
|---|---|---|---|
| Sample 2_A | 9.07 | 16.68 | 0.47 |
| Sample 2_B | 9.79 | 17.11 | 0.47 |
| Sample 2_C | 9.69 | 17.01 | 0.47 |
| Sample 2_D | 9.79 | 17.12 | 0.46 |
| Sample 2_E | 9.39 | 16.94 | 0.46 |
| **Average ± standard deviation** | 9.54±0.31 | 16.97±0.18 | 0.47±0.00 |

**Table 4:** Sample 3 precision test results

| | Cu [µm] | Ni [µm] | Cr [µm] |
|---|---|---|---|
| Sample 3_A | 14.61 | 18.21 | 0.37 |
| Sample 3_B | 15.25 | 18.40 | 0.37 |
| Sample 3_C | 14.95 | 18.44 | 0.37 |
| Sample 3_D | 15.94 | 18.65 | 0.37 |
| Sample 3_E | 15.78 | 18.55 | 0.37 |
| **Average ± standard deviation** | 15.31±0.56 | 18.45±0.17 | 0.37±0.00 |

**Figure 3:** Comparison between sample 1 (main red spectrum) and sample 2 (blue contour spectrum)




Spectra comparison shown in figure 3 above strongly suggests that the Cu layer in sample 1 is thicker than sample 2.

## CONCLUSION

This application report shows how simple and rapid the determination of multi layer coating thickness can be performed on Xenemetrix EDXRF analyzer, model EX-6600 SDD combined with Fundamental Parameter calculations. In the absence of calibration standards, fundamental parameter technique is the only solution for EDXRF quantitative analysis.