

ABSTRACT

Polystyrene food trays were analyzed with X-Calibur SDD Bench top Spectrometer System EDXRF analyzer equipped with a high resolution silicon drift detector. The quantification of the elemental composition was done by a fundamental parameter method that does not require any calibration standards.

OBJECTIVES

Perform Elemental and Quantitative analysis of all elements in Polystyrene food tray using Fundamental Parameter Software; without the use of certified calibration standards.

BACKGROUND

EDXRF

EDXRF is an ideal method for a quick and simple elemental analysis for industrial control purposes. This analytical techniques boasts in being extremely quick, noninvasive, requiring minimal sample preparation, and almost no training. Using an "operator" user interface the analysis can be automated to reduce the operational tasks to minimum and thus minimize the staff training.

Fundamental Parameters

Quantitative analysis in EDXRF is best done with regression analysis based on certified calibration standards (samples of known concentration and of the same matrix as the samples to be analyzed) and building calibration curves per element of interest. Yet, in the absence of standards, quantitative analysis can be performed using Fundamental Parameter software. The analysis may be purely based upon theoretical equations and the fundamental-parameter database, such as all the absorption of X-rays and the inter-elements effects, fluorescence and scattering effects that occur when x rays interact with the sample, using the so-called FP equations. The concentration results obtained by the fundamental parameter program can be improved by using one calibration standard.

ANALYTICAL CONFIGURATION

Figure 1: X-Calibur EDXRF analyzer



Table 1: Analytical Configuration

Instrument	X-Calibur SDD EDXRF Bench top Spectrometer System
Excitation	Rh-Anode X-ray Tube, 50KV 50W
Detector	High Performance Silicon Drift Detector SDD with specialized window for detection of low weight elements
Analysis Time	300 second
Type of analysis	Qualitative analysis of all elements using Professional Standardless Fundamental software
Environment	Vacuum purge to eliminate the O ₂ in the measuring chamber.
Sample preparation	Samples were analyzed as obtained for the customer

EXPERIMENTAL

Polystyrene food trays were provided and analyzed "as is" without any sample preparation. Two sample trays were analyzed. For each analysis two trays were stacked one on the other to form a double layer sheet of approximately 2x0.6mm thick. Quantitative analysis was performed using a dedicated Fundamental Parameter software that provides quantitative results without the need of calibration standards.

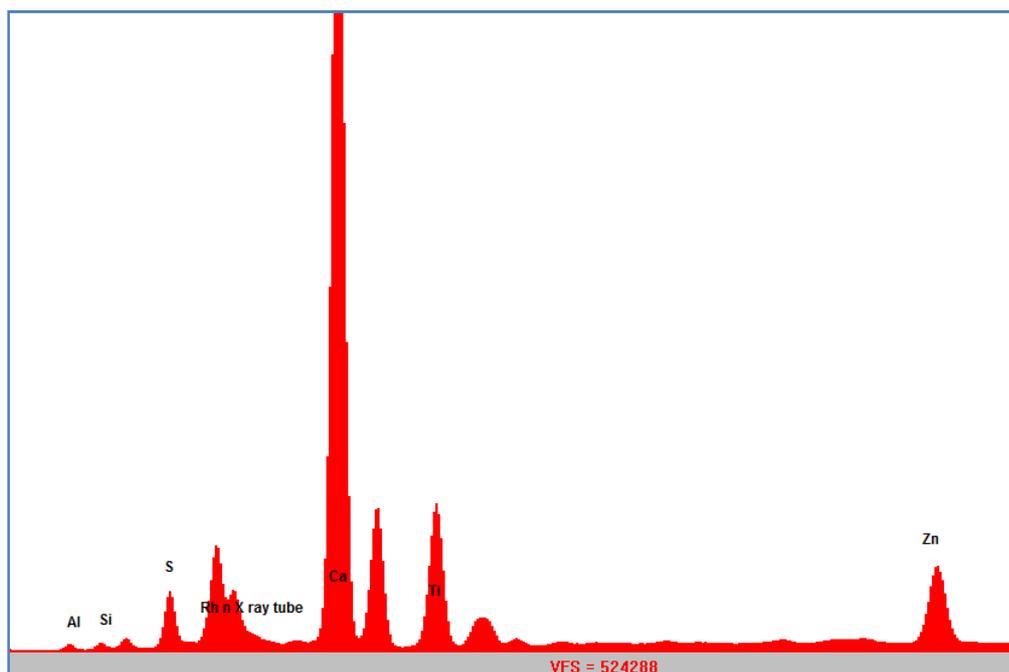
To determine the elements present in the sample, elemental analysis was performed (figure 3). In order to identify the low molecular elements as Al and Si vacuum was used to eliminate the Oxygen in the X ray beam path since otherwise the oxygen absorbs the low energy signal emitted by the light elements.

Figure 2: Polystyrene food trays



RESULTS :

Figure 3 : Spectrum of food tray sample; typical spectrum of polystyrene food tray



Quantitative analysis of food trays using Fundamental Parameter Method

Table 2: Two samples of Polystyrene food trays: Sample 1 and sample 2.

Type of Element	Sample 1		Sample 2		Average
	Element Conc. W/W%	Error W/W%	Element Conc W/W%	Error W/W%	
Polymer matrix: H, C	96.867	0.0000	97.276	0.0000	97.071
Al	0.116	0.0020	0.111	0.0020	0.114
Si	0.100	0.0016	0.119	0.0017	0.109
S	0.147	0.0007	0.125	0.0006	0.136
Ca	2.336	0.0022	2.005	0.0020	2.170
Ti	0.382	0.0009	0.320	0.0008	0.351
Zn	0.052	0.0002	0.045	0.0002	0.048

DISCUSSION

Two Polystyrene food trays were analyzed with X-Calibur SDD EDXRF analyzer. The analysis was performed by Fundamental Parameter software without the use of any standard. Furthermore, the amount (W/W %) of the polymer matrix of the overall sample weight was calculated. Generally, polymers made of Carbon and Hydrogen are transparent to EDXRF. Comparing the results obtained for the 2 samples, for all the elements, indicate little variations between two polystyrene trays.

CONCLUSIONS

This work demonstrates the excellent performance of Xenemetrix made X-Calbur SDD analyzer combined with fundament parameter software to analyze Polystyrene packaging food trays quickly and efficiently.