

Efficiency improvement for the environmentally hazardous substances management using Hitachi X-ray fluorescence analyzer EA1000VX/AIII

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1. Introduction

The EA1000VX/AIII X-Ray Fluorescence Analyzer is a specialized system for management of environmentally-regulated substances such as those subject to the Restriction of Hazardous Substances (RoHS) Directive and was designed to shorten inspection time substantially and reduce inspection costs through better operating performance (Fig. 1). This brief article describes the role of X-ray fluorescence analysis in management of environmentally-regulated substances and suggests uses of the EA1000VX/AIII system for improving task efficiency.

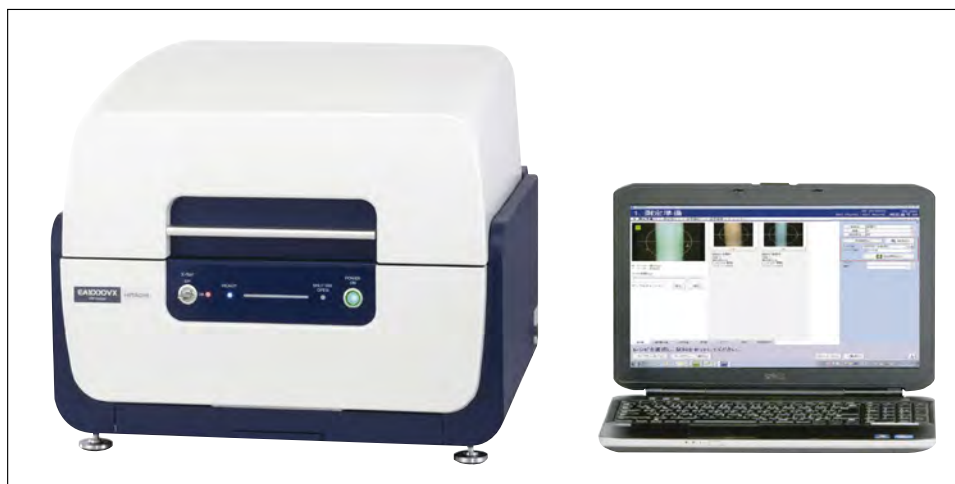


Fig. 1 External appearance of Hitachi EA1000VX X-Ray Fluorescence Analyzer

2. The role of X-ray fluorescence analysis in management of environmentally-regulated substances

For several major reasons, X-ray fluorescence analyzers are used widely for screening analysis techniques in management of environmentally-regulated substances:

- ① Measurement is easier and more convenient than in other techniques
- ② Human error in preprocessing and other steps is minimal
- ③ The time and cost needed for large volume parts inspection are low

For some time, we have sought to meet market demands for a high-throughput detector not requiring liquid nitrogen – one equipped with a precision control measurement function which automatically assesses concentration with satisfactory precision and terminates measurement, and one also equipped with simple software not requiring a knowledge of analysis.

In developing the EA1000VX/AIII, we provided various functions which address user concerns and requests in the management of environmentally-regulated substances, and which likewise improve task efficiency.

3. New functions for improved task efficiency

Figure 2 shows a flowchart for measurement during screening analysis of environmentally-regulated substances using an X-ray fluorescence analyzer. Users measure large numbers of different product samples every day. For each sample, the user has often determined optimal parameters in advance for measurement sites, concentration control limits, and measurement parameters. The operator needs to set these parameters for each sample, but a risk of selection errors exists. With this background, we created a database of results from previous measurements and provided a function which allows users to view “Reference measurement results” by simply inputting sample information. Parts and measurement sites can differ even for the same product, but a display of measurement site images based on prior results, as shown in Fig. 3, can mitigate judgment errors and confusion about measurement sites.

For samples with no prior measurement results, optimal measurement parameters must be created. For example, metals and resins were not measured correctly when it had not been switched to optimal parameters. Therefore, the EA1000VX/AIII was also developed with a “Materials assessment function”. After brief sample pre-measurement, the function automatically selects an analysis recipe* for six different sample material categories: resins, aluminum alloys, iron alloys, copper alloys, tin alloys, and other metals. Previously, it was the operators that selected analysis recipes, but this automatic function prevents selection errors or variations in operator judgment.

* An “analysis recipe” provides individual specimen material settings for items such as measurement parameters used in analysis and concentration criteria for environmentally-regulated substances.

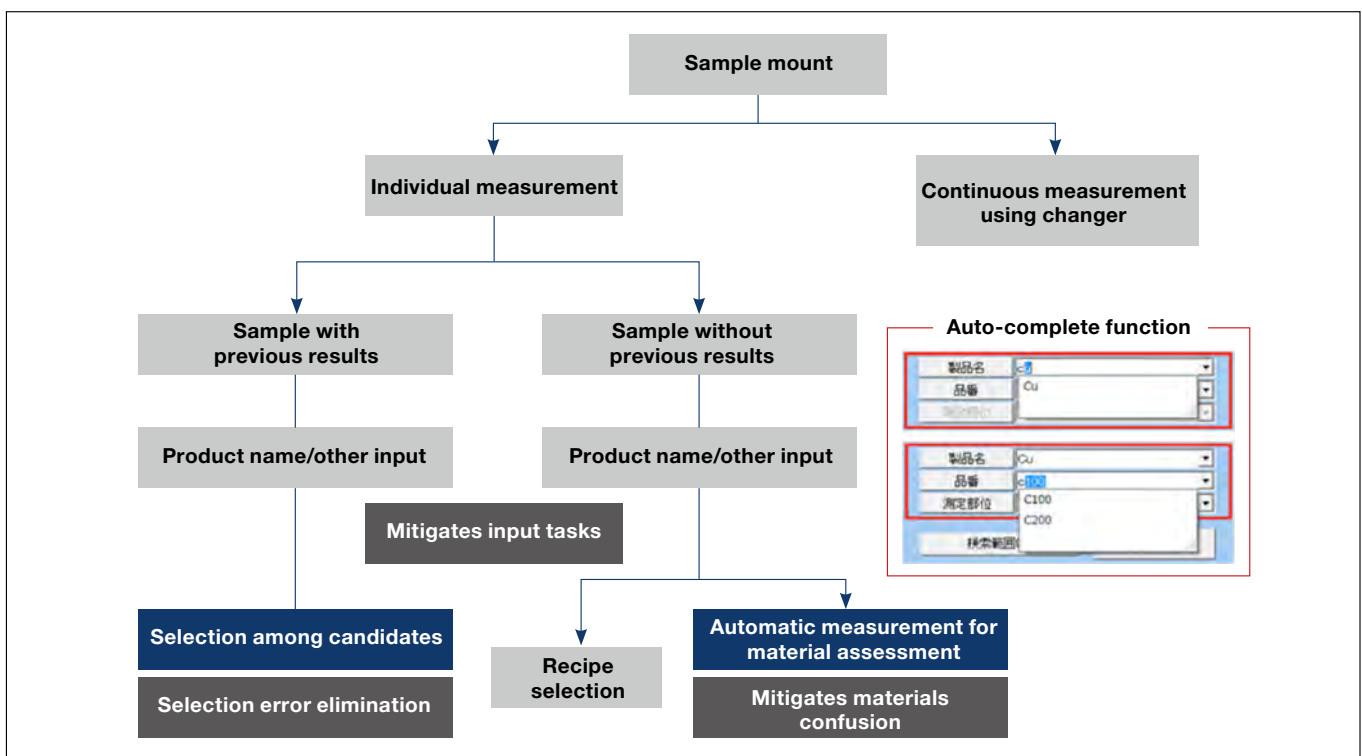


Fig. 2 Flowchart of screening using X-Ray Fluorescence Analyzer



Fig. 3 “Reference measurement results” function

The system hardware also improves operability. Figure 4 shows the front panel of the system. The LED at the center of the panel is a progress bar which displays measurement progress in five stages. An operator will often leave the system during measurement operation to perform sample preparation or other tasks. By simply observing the progress bar during operation, the operator can discern measurement status from a separate location even without the use of a PC, which contributes to higher throughput.



Fig. 4 Front panel of the EA1000VX/AIII EA1000VX(above) EA1000AIII(below)

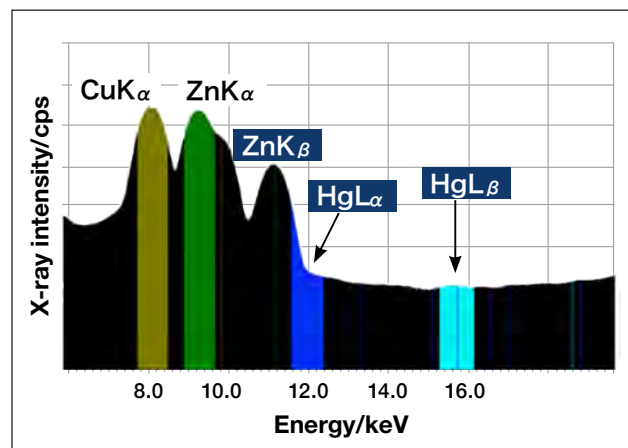


Fig. 5 Automatic analysis line switching function

To improve operability, an “Analysis line switching function”, “Analysis assistance function”, and a “Peak auto-analysis function” are also provided. Figure 5 shows an X-ray fluorescence spectrum during measurement of trace mercury in brass. Mercury has two different analytical lines, $L\alpha$ and $L\beta$, but the more intense of the two, $L\alpha$, is used by default. However, brass also includes zinc, and the $ZnK\beta$ peak interferes with the $HgL\alpha$ peak, preventing accurate analysis. For this reason, an “Analysis line auto-select function” automatically identifies peak overlap of content elements and automatically selects an analysis line which presents no overlap effect. In this example, measurement accuracy is approximately 3 fold greater when using the automatically selected $HgL\beta$ peak versus the $HgL\alpha$ peak.

An “Analysis assistance function” also displays the rationale for determination when the software makes an automatic determination, providing the operator with the expertise of other operators skilled in environmentally-regulated substance management.

X-ray fluorescence spectra can also contain many additional overlapping peaks. Figure 6 shows a spectrum for measurement of trace lead in stainless steel. In an energy dispersion-type X-ray fluorescence analyzer like the

EA1000VX/AIII, counting circuits generate sum peaks and escape peaks which appear together with X-ray fluorescence peaks. The "Peak auto-analysis function" analyzes these peaks, labels the peaks, and displays peak separation results. In this example, we see that the function automatically detects trace lead peaks ($PbL\alpha$ and $PbL\beta$) among sum peaks which incorporate all the principal component elements of stainless steel, i.e., iron (Fe), chrome (Cr), and nickel (Ni). This function allows performance of detailed validation for analytical results.

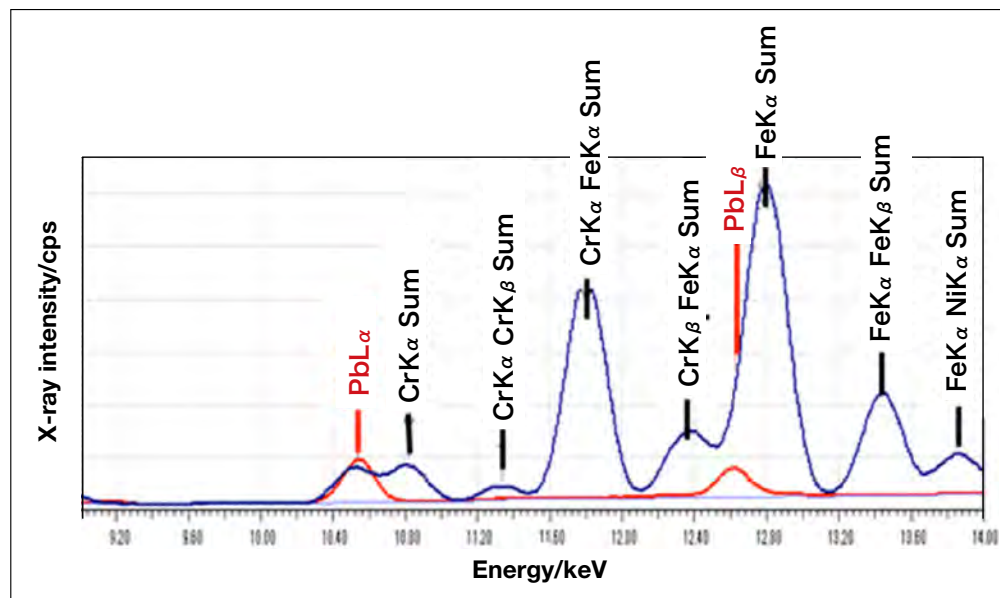


Fig. 6 Peak auto-analysis function

4. Concluding Remarks

The EA1000VX/AIII was developed as a successor model to the existing EA1000 series, of which more than 3,000 units are in use worldwide. In addition to the functions described here, the system includes powerful database functions specially designed for environmentally-regulated substances management. These functions provide comprehensive solutions beyond measurement alone and guarantee the role of the system in improved task efficiency for management of environmentally-regulated substances.

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