IRAQI JOURNAL OF APPLIED PHYSICS
IJAP, Vol. 10, No. 4, October-December 2014, p. 26

Analysing Asbestos using High-Speed X-Ray Diffraction

Introduction

Asbestos is a naturally occurring silicate material and is often used as a building material for its excellent resistance to acid and heat. However, the material is known to cause adverse health effects and hence has progressively been banned. Following the revision of Japan's Ordinance on Prevention of Asbestos Hazards and Industrial Safety and Health Act enforcement ordinance in 2006, the proposed limit value for asbestos content was made more rigorous. As a result, in any product, the present content by weight of asbestos is stipulated to be below 0.1%.

Since X-ray diffraction has been implemented as the standard method for determining asbestos content, the two formal techniques stipulated for its analysis are:

- JIS A 1481-2: Determination of asbestos in building material products – Part 2: Sampling and qualitative analysis for judgment of existence of containing asbestos
- JIS A 1481-3: Determination of asbestos in building material products - Part 3: Quantitative analysis of containing asbestos by X-ray diffraction method

This article shows an example of rapid quantitative analysis of the chrysotile (a type of asbestos) using the new high-speed, wide-range detector OneSight.

OneSight: Wide-Range High-Speed Detector

OneSight is a wide-range, high-speed detector that features a semiconductor sensor array with over 1000 channels. The instrument allows rapid measurement and achieves sensitivity that is more than 20X greater than is possible with current scintillation detectors. In addition, the OneSight includes the "One Shot" mode that allows quick and easy quantitative analysis. In this mode, the detector is focused on a single peak through a wide acquisition angle. Figure 1 shows the XRD-7000 fitted with the OneSight detector.

Figure 1. *XRD-7000 equipped with OneSight*

Asbestos Analysis

The base standard absorption correction technique is used to perform quantitative analysis of asbestos. Here, asbestos was first treated with formic acid and collected onto a filter. It is then mounted on a base standard Zn plate and measured (Figure 2). Utilizing the transmitted Zn diffraction intensity, the measured diffraction intensity was rectified and a calibration curve was produced. Following this, the lower limit of quantitation was measured. Figure 3 shows the rotation sample attachment.

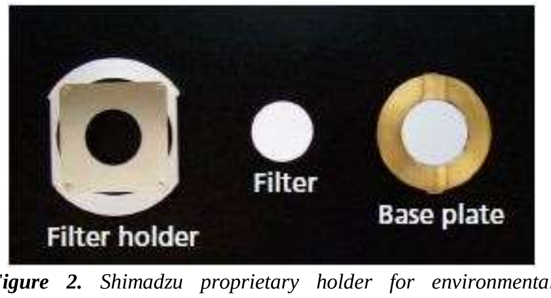

Figure 2. *Shimadzu proprietary holder for environmental quantitative analysis*

Figure 3. *Rotation sample attachment (for environmental quantitation)*

Calibration Curve

The sample utilized for producing a calibration curve was measured through the One Shot mode of the OneSight detector. This mode not only removes the necessity for scanning with a goniometer, but also allows rapid measurement by focusing on the position of the target peak to acquire sufficient intensity.

In this type of measurement, the time taken for measuring the Zn peak and the asbestos peak was 120 seconds each. Figures 4 and 5 show the peak profiles of the calibration curve samples and the calibration curve of chrysotile over an integration time of 120s, respectively.

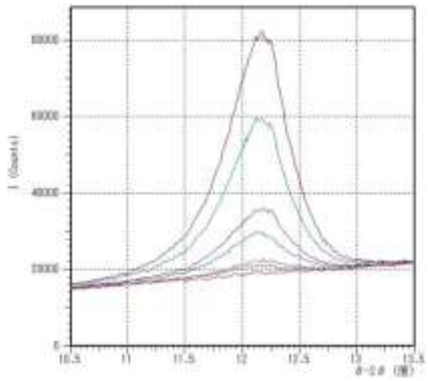

Figure 4. *Peak profiles of the calibration curve samples (chrysotile 0.05, 0.1, 0.3, 0.5, 1, 3, and 5mg)*

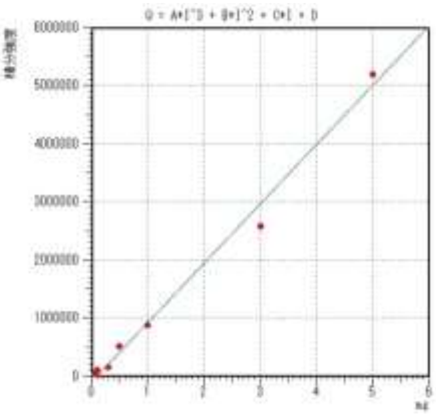

Figure 5. *Calibration curve of chrysotile over 120 sec integration time*

Conclusion

The quantitative analysis measurement conditions when performed according to JIS A 1481-3 standards yielded excellent accuracy. Similar precision was also achieved by the 120-second measurement using the high-speed, wide-range detector. Thus, using the OneSight detector, accurate measurements can be performed easily and quickly.