SHIMADZU

Application News

Tableware Analysis Using ICPE-9000

Kitchen utensils and containers regularly come in direct contact with food articles, and therefore can contaminate food with toxic heavy metals, etc. through migration, thus posing a health hazard. In particular, ceramic and glass tableware may be decorated and coated with pigments and glaze which contain toxic lead and cadmium, and physical injury due to migration of these toxic elements becomes a problem. Based on this, the Ministry of Heath, Labour and Welfare of Japan revised the Food Sanitation Act "Standards for Foods and Additives" on July 31, 2008 with respect to Notification No. 370 of the Ministry of Health, Labour and Welfare (1959). The main points of revision concerning tableware are (1) standardization according to the material, capacity, and shape of containers, and (2) strengthening of the standard for migration of cadmium and lead in accordance with ISO. Table 1 shows the revised specification standards according to material. The inspection method is a migration test, in which the heavy metal is placed in contact with 4 % acetic acid, assuming vinegar as the easiest dissolution food substance, for 24 hours at ambient temperature to allow migration into the acid solution. Quantitative analysis of the solution is conducted by atomic absorption spectrophotometry or ICP emission spectrometry. ICP-AES (ICP emission spectrometry) is a high-sensitivity technique that allows simultaneous analysis of multiple elements. Here we introduce the analysis of commercial tableware using the Shimadzu ICPE-9000 multi-type emission spectrometer.

Table 1 Revised Specifications According to Material Category

Material	Classification		Cd	Pb
Glass	Sample which cannot be filled with liquid, or sample whose depth is less than 2.5 cm		0.7 µg/cm^2	8 µg/cm^2
	Sample whose depth is 2.5 cm or greater when filled with liquid			
	Other than heat-cookware	Capacity less than 600 mL	0.5 µg/mL	1.5 µg/mL
		Capacity 600 mL or more, and less than 3 L	0.25 µg/mL	0.75 µg/mL
		Capacity 3 L or more	0.25 µg/mL	0.5 µg/mL
	Heat-cookware		0.05 µg/mL	0.5 µg/mL
Ceramic	Sample which cannot be filled with liquid, or sample whose depth is less than 2.5 cm		0.7 µg/cm^2	8 µg/cm^2
	Sample whose depth is 2.5 cm or greater when filled with liquid			
	Other than heat-cookware	Capacity less than 1.1 L	0.5 µg/mL	2 µg/mL
		Capacity 1.1 L or more, and less than 3 L	0.25 µg/mL	1 µg/mL
		Capacity 3 L or more	0.25 µg/mL	0.5 µg/mL
	Heat-cookware		0.05 µg/mL	0.5 µg/mL
Porcelain Enamel	Sample which cannot be filled with liquid, or sample whose depth is less than 2.5 cm			
	Other than heat-cookware		0.7 µg/cm^2	8 µg/cm^2
	Heat-cookware		0.5 µg/cm^2	1 µg/cm^2
	Sample whose depth is 2.5 cm or greater when filled with liquid			
	Capacity 3 L or more		0.5 µg/cm^2	1 µg/cm^2
	Other than heat-cookware	Capacity less than 3 L	0.07 µg/mL	0.8 µg/mL
	Heat-cookware		0.07 µg/mL	0.4 µg/mL

■ Samples

Commercial tableware (glass, ceramic)

■ Sample Preparation

(According to Standards for Foods and Additives)
After washing the sample well with water, fill it with 4 % acetic acid solution (v/v), and leave it at ambient temperature in a dark place for 24 hours. Use this solution as the test solution.

■ Results

Fig. 1 shows the ICPE-9000 spectral profiles, and Table 2 shows the quantitation results and detection limit of this analysis. The detection limit in this analysis is less than 1/100 of the standard value, demonstrating high sensitivity.

■ Analytical Conditions

Instrument	: ICPE-9000
RF output	: 1.2 (kW)
Plasma gas flow rate	: 10 (L/min)
Auxiliary gas flow rate	: 0.6 (L/min)
Carrier gas flow rate	: 0.60 (L/min)
Sample introduction	: Coaxial nebulizer
Spray chamber	: Cyclone chamber
Plasma torch	: Mini torch
Observation method	: Axial

Table 2　Quantitative Results for Tableware (Unit: μg/mL)

Sample Name	Sample Type	Element Name Detection Limit	Cadmium (Cd) 0.0001	Lead (Pb) 0.002
Sample 1	Glass cup with pattern design		0.0002	< 0.002
Sample 2	Earthenware cup		< 0.0001	0.020
Sample 3	Earthenware saucer		< 0.0001	< 0.002
Sample 4	Porcelain teacup with pattern design		0.0010	0.056
Sample 5	Small porcelain pot with pattern design		0.0027	0.221
Sample 6	Porcelain coffee cup		< 0.0001	0.061

<: Detection limit (3σ) obtained from the standard deviation of N=10 repeat measurements using a calibration curve blank (4 % acetic acid solution (v/v))
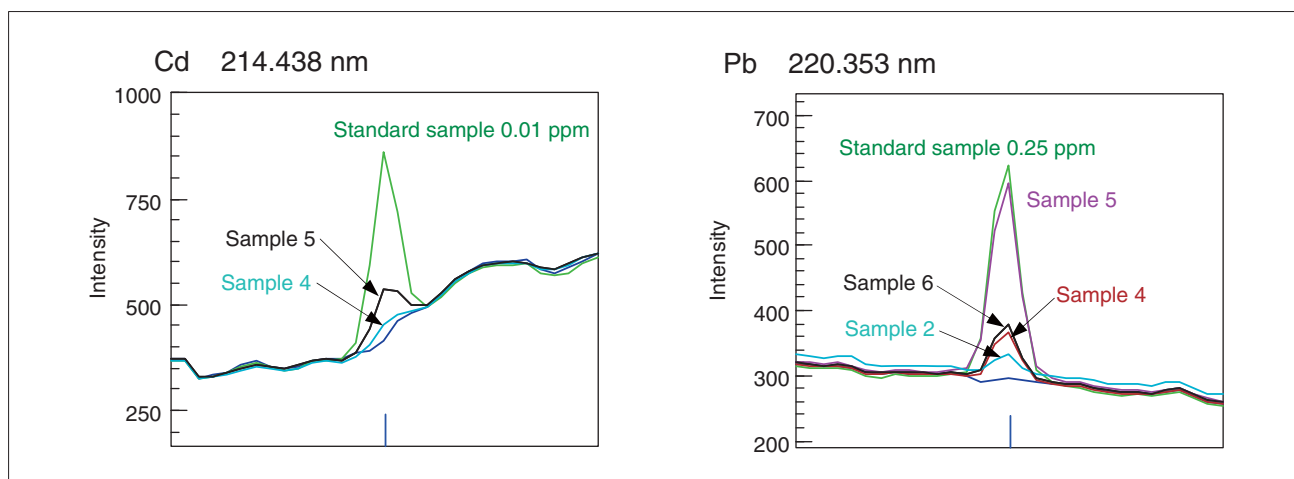
Fig.1　Spectral Profiles of Tableware