Results of Proficiency Test
Bisphenol A in Plastic
April 2015

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

Author: dr. R.G. Visser
Corrector: ing. R.J. Starink

Report: iis15P04

July 2015

CONTENTS

Appendices:

1 INTRODUCTION

Bisphenol A (BPA) is a chemical that is mainly used in combination with other chemicals to manufacture plastics and resins. For example, BPA is used in polycarbonate, a high performance transparent, rigid plastic. Polycarbonate is used to make food containers, such as returnable beverage bottles, infant feeding (baby) bottles, tableware (plates and mugs) and storage containers. Residues of BPA are also present in epoxy resins used to make protective coatings and linings for food and beverage cans and vats. BPA can migrate in small amounts into food and beverages stored in materials containing the substance.

Bisphenol A is classified in Directive 2009/48/EC under Regulation (EC) No 1272/2008 as toxic. In the absence of any specific requirements, bisphenol A can be contained in toys in concentrations equal to or smaller than the relevant concentration established for the classification of mixtures containing it as CMRs, namely 5 % as from 20 July 2013 and 3 % as from 1 June 2015 respectively. It cannot be excluded that that concentration may lead to increased exposure to bisphenol A, compared to the migration limit of 0,1 mg/l for bisphenol A set by European standards EN 71-9:2005+A1:2007, EN 71-10:2005 and EN 71-11:2005.

The determination of Bisphenol A in plastics is known to give problems with the comparability of laboratory results. However, no appropriate Bisphenol A reference materials are yet available. As an alternative, participation in a proficiency test may enable laboratories to check their performance. Therefore, a proficiency test (laboratory-evaluating interlaboratory study) for the determination of Bisphenol A in plastics was organized by the Institute for Interlaboratory Studies in April 2014. This PT was continued in the 2015 PT program.

In the 2015 proficiency test iis15P04 58 laboratories in 22 different countries did participate. See appendix 3 for the number of participating laboratories per country.
In this report the results of the 2015 proficiency test are presented and discussed. This report is also electronically available through the iis internet site www.iisnl.com.

2 SET UP

The Institute for Interlaboratory Studies in Spijkenisse was the organiser of this proficiency test. It was decided to send two different plastic samples. The first sample, a PVC granulate, was especially prepared by a Chinese factory by addition of Bisphenol A to PVC and subsequent homogenization. The second sample, a PP granulate, was especially prepared by a Chinese factory by addition of Bisphenol A to PP and subsequent homogenization. Analyses for fit-for-use and homogeneity were subcontracted. The participants were asked to report the analytical results with one extra figure using the indicated units on the report form. These results with an extra figure are preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC 17043:2010. This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Also customer's satisfaction is measured on a regular basis by sending out questionnaires.

2.2 PROTOCOL

The protocol followed in the organisation was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3). This protocol can be downloaded via the FAQ page of the iis website http://www.iisnl.com.

2.3 CONFIDENTIALITY STATEMENT

All data presented in this report must be regarded as confidential and for use by the participating companies only. Disclosure of the information in this report is only allowed by means of the entire report. Use of the contents of this report for third parties is only allowed by written permission of the Institute for Interlaboratory Studies. Disclosure of the identity of one or more of the participating companies will be done only after receipt of a written agreement of the companies involved.

2.4 SAMPLES

Two different samples, one PVC and one polypropylene batch, both artificially fortified to be positive on Bisphenol A (with respective approx. 0.2 %M/M and 0.07 %M/M), were selected. Both materials were divided over plastic bags, approx. 3 grams for each sample.
The homogeneity of the subsamples was checked by determination of Bisphenol A (BPA) content on 8 stratified randomly selected subsamples.

	BPA in %M/M		BPA in %M/M
Sample #15067-1	0.1934	Sample #15068-1	0.0667
Sample #15067-2	0.1941	Sample #15068-2	0.0665
Sample #15067-3	0.1927	Sample #15068-3	0.0656
Sample #15067-4	0.1940	Sample #15068-4	0.0649
Sample #15067-5	0.1969	Sample #15068-5	0.0636
Sample #15067-6	0.1956	Sample #15068-6	0.0637
Sample #15067-7	0.1970	Sample #15068-7	0.0642
Sample #15067-8	0.1976	Sample #15068-8	0.0658

Table 1: homogeneity test results of the subsamples #15067 and #15068

From the above test results the repeatabilities were calculated. Comparison of the repeatabilities with 0.3 times the estimated reproducibility of EN14372:04 in agreement with the procedure of ISO 13528, Annex B2, regretfully was not possible. Therefore the comparison was

made with the repeatability of EN14372:04 and 0.3 times the reproducibility estimated from the Horwitz equation in the next table;

	BPA in %M/M	BPA in %M/M
r (observed) #15067	0.0052	--
r (observed) #15068	--	0.0034
reference method	EN14372:04	EN14372:04
r (ref. method)	0.0089	0.0029
0.3 x R (Horwitz)	0.0084	0.0033

Table 2: evaluation of repeatabilities of BPA contents of the subsamples #15067 and #15068

For sample #15067 the observed repeatability of the results of the homogeneity test is in agreement with the target precision data, but for sample #15068 the observed repeatability is larger than the repeatability of the reference method. However, the observed repeatability is in full agreement with 0.3 x the reproducibility estimated from the Horwitz equation and therefore the homogeneity of subsamples #15067 and #15068 was assumed.

To each of the participating laboratories, one sample of approx. 3 grams PVC granulate, labelled #15067 and one sample of approx. 3 grams PP granulate, labelled #15068, were sent on April 22, 2015.

2.5 ANALYSIS

The participants were requested to determine and report the total Bisphenol A content on both samples #15067 and #15068.
The participants were explicitly asked to treat the samples as if they were routine samples and to report the analytical results using the indicated units on the report form and not to round the test results, but report as much significant figures as possible.
The participants were also asked not to report ‘less than’ results which are above the detection limit, because such results can not be used for meaningful statistical calculations.
To get comparable results a detailed report form, on which the units were prescribed and a report form on which some analytical details were requested, was sent together with each set of samples. Also a letter of instructions was added to the package.
The laboratories were asked to complete the report form with the requested details of the methods used.

3 RESULTS

During four weeks after sample despatch, the results of the individual laboratories were gathered. The original data are tabulated in the appendices of this report. The laboratories are presented by their code numbers.

Directly after the deadline, a reminder fax was sent to those laboratories that had not yet reported. Shortly after the deadline, the available results were screened for suspect data. A result was called suspect in case the Huber Elimination Rule (a robust outlier test, see lit.5)

found it to be an outlier. The laboratories that produced these suspect data were asked to check the results. Additional or corrected data are placed under 'Remarks' in the result tables in appendix 1. A list of abbreviations used in the tables can be found in appendix 3.

3.1 STATISTICS

Statistical calculations were performed as described in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3) For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded results. Results reported as '<…' or '>…" were not used in the statistical evaluation.

First, the normality of the distribution of the various data sets per determination was checked by means of the Lilliefors-test a variant of the Kolmogorov-Smirnov test and by the calculation of skewness and kurtosis. Evaluation of the three normality indicators in combination with the visual evaluation of the graphic Kernel density plot, lead to judgement of the normality being either 'unknown', 'OK', 'suspect' or 'not OK'. After removal of outliers, this check was repeated. Not all data sets proved to have a normal distribution, in which cases the statistical evaluation of the results should be used with due care.

According to ISO 5725 (1986 and 1994, lit.4 and 5) the original results per determination were submitted subsequently to Dixon's, Grubbs' and Rosner outlier tests. Outliers are marked by D(0.01) for the Dixon's test, by G(0.01) or DG(0.01) for the Grubbs' test and by R(0.01) for the Rosner General ESD test (ref. 23). Stragglers are marked by D(0.05) for the Dixon's test, by G(0.05) or DG(0.05) for the Grubbs' test and by R(0.05) for the Rosner General ESD test (ref. 23). Both outliers and stragglers were not included in the calculations of averages and standard deviations.

For each assigned value the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. When the uncertainty passed the evaluation no remarks are made in the report. However, when the uncertainty failed the evaluation it is mentioned in the report and it will have consequences for the evaluation of the test results.

Finally, the reproducibilities were calculated from the standard deviations by multiplying them with a factor of 2.8.

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis.

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.

Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms (see appendix 4, nos.15-16). Also a normal Gauss curve was projected over the Kernel Density Graph for reference.

3.3 Z-SCORES

To evaluate the performance of the individual participating laboratories the z-scores were calculated. In order to be able to have an objective evaluation of the performance of the individual participants, it was decided to evaluate this performance against the literature requirements. Therefore the z-scores were calculated using a target standard deviation. This target standard deviation was calculated from the literature reproducibility by division with 2.8.

The $z_{(target)}$-scores were calculated according to:

$z_{(target)}$ = (individual result - average of proficiency test) / target standard deviation

The $z_{(target)}$-scores are listed in the result tables in appendix 1.

When a laboratory did use a test method with a reproducibility that is significantly different from the reproducibility of the reference test method used in this report, it is strongly advised to recalculate the z-score, while using the reproducibility of the actual test method used, this in order to evaluate whether the reported test results is fit-for-use.

Absolute values for z<2 are very common and absolute values for z>3 are very rare. The usual interpretation of z-scores is as follows:

$|z| < 1$ good
$1 < |z| < 2$ satisfactory
$2 < |z| < 3$ questionable
$3 < |z|$ unsatisfactory

4 EVALUATION

In this interlaboratory study no problems were encountered during the execution.

Five participants did not report any test results due to several unknown reasons. Finally, 53 laboratories reported 104 numerical test results. Observed were 6 statistically outlying test results, which is 5.5% of all numerical test results. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER SAMPLE

In this section the results are discussed per sample.

Due to the lack of a suitable test method with precision data, it was decided to use the requirements from the standardised method EN14372:04, “Child use and care articles, Cutlery and feeding utensils, Safety requirements and tests” for evaluation of the results of this interlaboratory study.
Regretfully, only a relative within-laboratory standard deviation RSDr is given in EN14372:04. Multiplication of RSDr by 2.8 gives the repeatability. Multiplication of the repeatability by 3 gives a good estimate of the target reproducibility. For comparison the estimated reproducibility calculated using the Horwitz equation is also given.

Sample #15067

BPA: The determination of Bisphenol A was problematic at the level of 0.18 %M/M. Three statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the estimated reproducibility of EN14372:04. See also discussion (chapter 5)

Sample #15068

BPA: The determination of Bisphenol A was very problematic at the level of 0.05 %M/M. Three statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not at all in agreement with the estimated reproducibility of EN14372:04. See also discussion (chapter 5)

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibilities as found for the group of participating laboratories and the estimated reproducibilities of EN14372:2004 (R_{target}) in the next tables:

Parameter	Unit	n	Average	2.8 * sd	R (target)
Bisphenol A	%M/M	50	0.184	0.117	0.070

Table 3: overview of results for sample #15067

Parameter	Unit	n	Average	2.8 * sd	R (target)
Bisphenol A	%M/M	48	0.047	0.071	0.018

Table 4: overview of results for sample #15068

5 COMPARISON OF THE PROFICIENCY TEST OF APRIL 2015 WITH THE PREVIOUS PT

	April 2015	April 2014
Number of reporting labs	53	60
Number of results reported	104	120
Number of statistical outliers	6	6
Percentage outliers	5.5%	4.8%

Table 5: Comparison with previous proficiency test

In proficiency tests, outlier percentages of 3% - 7.5% are quite normal.

Parameter	Concentration (%M/M)	April 2015	April 2014	Est. EN14372
BPA	<0.10	54%	n.e.	13.5%
BPA	0.10 – 0.25	23%	34%	13.5%
BPA	>0.25	n.e.	21%	13.5%

Table 6: Development of relative uncertainties over the years

The uncertainty in the test result of BPA for concentrations between 0.10-0.25 %M/M in the iis15P04 PT has improved in comparison with the previous PT, but it is still not fully in line with the uncertainty requirements of the method (see table 4).

6 DISCUSSION

A number of different test methods were reported to have been used. Most often “in house” (49 laboratories = 92%) was mentioned as test method used.
From the analytical details in appendix 2, it can be noticed that several different extraction techniques and solvents were used. In the previous report iis14P04 of 2014, it was observed that the calculated reproducibility for one sample was smaller (and the consensus value was higher) when only the reported results were evaluated of the laboratories that used Ultrasonic as release technique. This year the majority of the participants (43 = 81%) used Ultrasonic as release technique. The extraction solvents used vary over a large range.

When for both samples the data sets for results from Ultrasonic extraction, THF extraction and the combination dichloromethane plus Ultrasonic extraction are compared, it is clear that the average BPA concentration per technique does not differ, but that the combination dichloromethane plus Ultrasonic extraction as release technique, shows the best precision and for sample #15067 with the highest BPA concentration the observed precision is almost in agreement with the target test method EN14372.

Parameter	Unit	n	Average	2.8 * sd	R (target)
Bisphenol A (only ultrasonic)	%M/M	44	0.183	0.108	0.069
Bisphenol A (DCM-ultrasonic)	%M/M	20	0.182	0.077	0.069
Bisphenol A (THF-ultrasonic)	%M/M	12	0.178	0.171	0.067

Table 7: overview of separate evaluation for sample #15067

Parameter	Unit	n	Average	2.8 * sd	R (target)
Bisphenol A (only ultrasonic)	%M/M	43	0.049	0.069	0.018
Bisphenol A (DCM-ultrasonic)	%M/M	19	0.045	0.066	0.017
Bisphenol A (THF-ultrasonic)	%M/M	11	0.048	0.081	0.018

Table 8: overview of separate evaluation for sample #15068

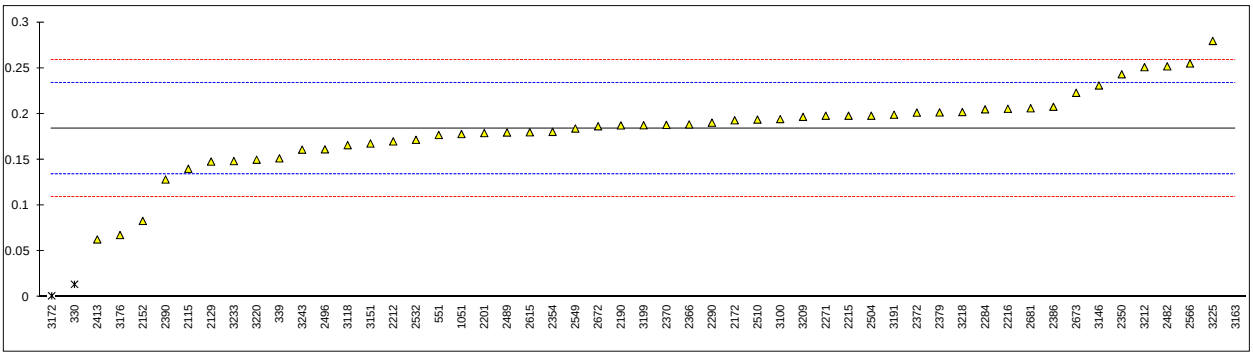
It can be concluded that the observed spread in this interlaboratory study may not be caused by just one critical point in the analysis. Each participating laboratory will have to evaluate its performance in this study and decide about any corrective actions if necessary.

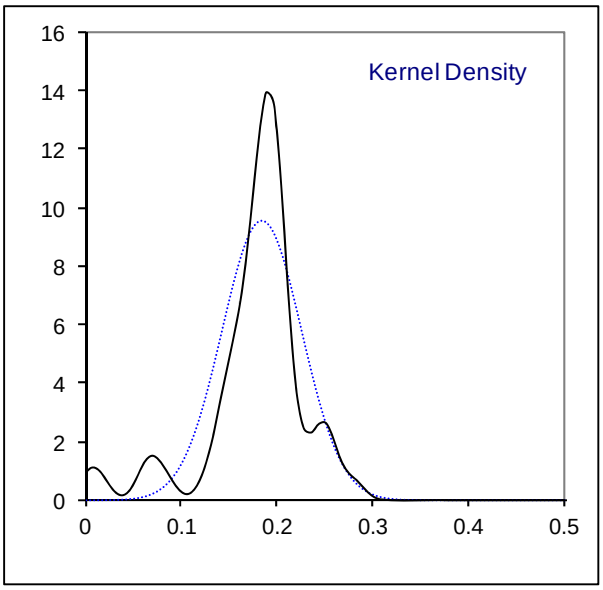
APPENDIX 1

Determination of Total Bisphenol A (BPA) on sample #15067; results in %M/M

lab	method	value	mark	z(targ)	remarks
110		-----		-----	
330	in house	0.014	R(0.01)	-6.84	
339	in house	0.15150		-1.31	
551	in house	0.177		-0.28	
1051	in house	0.178	C	-0.24	first reported 1782.77 %M/M
2115	in house	0.1401		-1.77	
2129	in house	0.148		-1.45	
2146		-----		-----	
2152	in house	0.0832		-4.06	
2169		-----		-----	
2172	in house	0.193		0.36	
2190	in house	0.1874197		0.14	
2201	in house	0.1791		-0.20	
2212	in house	0.170		-0.56	
2215	in house	0.1980	C	0.56	reported 1980 %M/M
2216	in house	0.20557223	C	0.87	reported 2055.7223 %M/M
2271	in house	0.1980		0.56	
2284	in house	0.2050		0.85	
2290	in house	0.19043		0.26	
2350	in house	0.2432		2.38	
2354	in house	0.1804		-0.14	
2366	in house	0.1885		0.18	
2370	in house	0.188		0.16	
2372	JETRO	0.2014	C	0.70	first reported 2014 %M/M
2379	in house	0.2016		0.71	
2386	in house	0.2078		0.96	
2390	in house	0.128413		-2.24	
2413	in house	0.0630		-4.87	
2469		-----		-----	
2482	in house	0.2519		2.73	
2489	in house	0.1797	C	-0.17	first reported 1797.20 %M/M
2496	in house	0.1613		-0.91	
2504	in house	0.198		0.56	
2510	in house	0.1938		0.39	
2511		-----		-----	
2532	in house	0.1717		-0.50	
2549	in house	0.18408		0.00	
2566	in house	0.255		2.86	
2615	EPA3550C	0.1799		-0.16	
2672	in house	0.1865		0.10	
2673	in house	0.223		1.57	
2681	in house	0.20612		0.89	
3100	EPA3550C	0.1943		0.41	
3118	in house	0.1659		-0.73	
3146	in house	0.231	C	1.89	first reported 2308 %M/M
3151	in house	0.1677		-0.66	
3163	in house	1.95	R(0.01)	71.10	
3172	in house	0.001499	R(0.01)	-7.35	
3176	in house	0.06778		-4.68	
3191	in house	0.1991		0.61	
3199	in house	0.1876		0.15	
3209	in house	0.19679	C	0.51	reported 1967.9 %M/M
3212	CPSC-CH-C1001-09	0.251		2.70	
3218	in house	0.2020		0.72	
3220	in house	0.15		-1.37	
3225	in house	0.2796		3.85	
3233	in house	0.1485		-1.43	
3243	in house	0.161		-0.93	
	normality	not OK			
	n	50			
	outliers	3			
	mean (n)	0.18400			
	st.dev. (n)	0.041655			
	R(calc.)	0.11663			
	R(EN14372:04)	0.06955			Compare R(Horwitz) = 0.02659

Determination of Total Bisphenol A (BPA) on sample #15067; continued

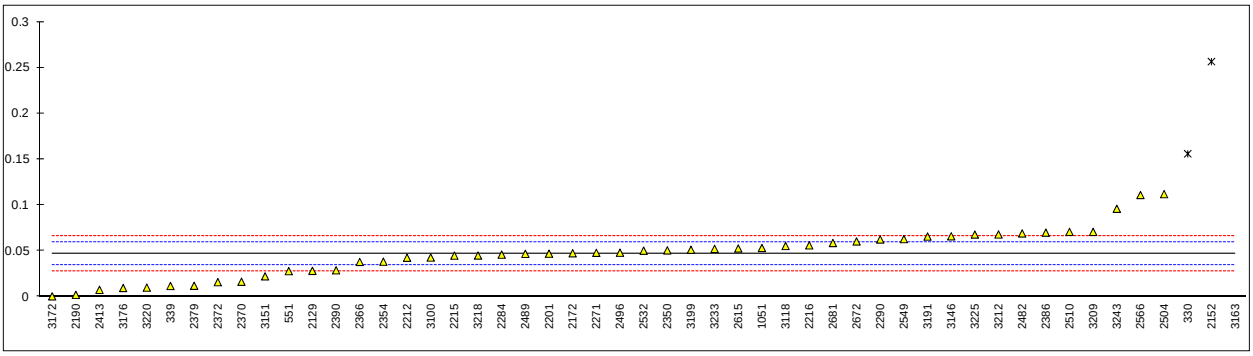


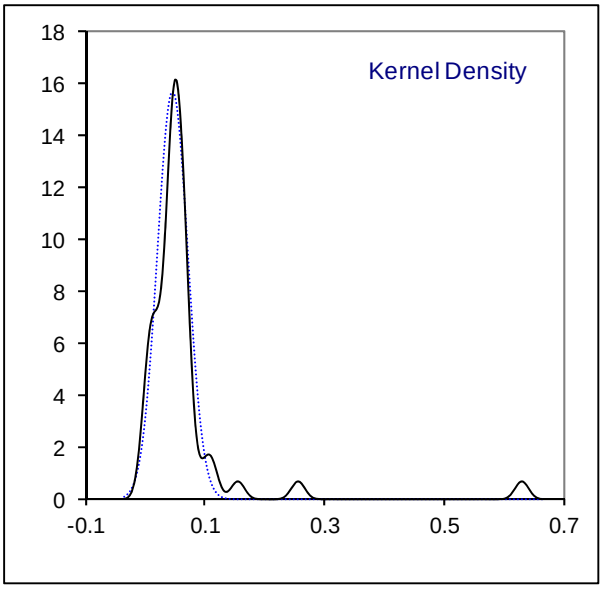


Determination of Total Bisphenol A (BPA) on sample #15068; results in %M/M

lab	method	value	mark	z(targ)	remarks
110		-----		-----	
330	in house	0.156	R(0.01)	17.11	
339	in house	0.01176		-5.56	
551	in house	0.028		-3.01	
1051	in house	0.0532	C	0.95	first reported 532.47 %M/M
2115	in house	<0.01		-----	
2129	in house	0.0283		-2.96	
2146		-----		-----	
2152	in house	0.2566	R(0.01)	32.92	
2169		-----		-----	
2172	in house	0.0475		0.06	
2190	in house	0.0021277		-7.07	
2201	in house	0.0470		-0.02	
2212	in house	0.0426		-0.71	
2215	in house	0.0449	C	-0.35	reported 449 %M/M
2216	in house	0.05611505	C	1.41	reported 561.1505 %M/M
2271	in house	0.0480		0.14	
2284	in house	0.0460		-0.18	
2290	in house	0.06251		2.42	
2350	in house	0.05064		0.55	
2354	in house	0.0383		-1.39	
2366	in house	0.0380		-1.43	
2370	in house	0.0164		-4.83	
2372	JETRO	0.01594	C	-4.90	first reported 159.4 %M/M
2379	in house	0.0120		-5.52	
2386	in house	0.06997		3.59	
2390	in house	0.028829		-2.88	
2413	in house	0.0076		-6.21	
2469		-----		-----	
2482	in house	0.06911		3.46	
2489	in house	0.0469	C	-0.04	first reported 469.12 %M/M
2496	in house	0.0481		0.15	
2504	in house	0.112		10.20	
2510	in house	0.0708		3.72	
2511		-----		-----	
2532	in house	0.0503		0.50	
2549	in house	0.06291		2.48	
2566	in house	0.111		10.04	
2615	EPA3550C	0.0527		0.88	
2672	in house	0.06037		2.08	
2673		-----		-----	
2681	in house	0.05869		1.82	
3100	EPA3550C	0.0428		-0.68	
3118	in house	0.0554		1.30	
3146	in house	0.066	C	2.97	first reported 660 %M/M
3151	in house	0.02232		-3.90	
3163	in house	0.630	R(0.01)	91.61	
3172	in house	0.0004592		-7.34	
3176	in house	0.00955		-5.91	
3191	in house	0.0657		2.92	
3199	in house	0.0513		0.66	
3209	in house	0.07083	C	3.73	reported 708.3 %M/M
3212	CPSC-CH-C1001-09	0.068		3.28	
3218	in house	0.0450		-0.33	
3220	in house	0.01		-5.84	
3225	JETRO	0.0679		3.26	
3233	in house	0.0523		0.81	
3243	in house	0.096		7.68	
	normality	OK			
	n	48			
	outliers	3			
	mean (n)	0.047128			
	st.dev. (n)	0.0253871			
	R(calc.)	0.071084			
	R(EN14372:04)	0.017814			Compare R(Horwitz) = 0.008360

Determination of Total Bisphenol A (BPA) on sample #15068; continued





APPENDIX 2

Method information sample #15067

Lab	sample grinded or cut	final particle size	extraction technique used	extraction solvent used	analysis technique
110					
330			Ultrasonic	CH2CL2	LC-MS-MS
339	YES		Ultrasonic	Dichloromethane/Methanol	LC-MS-MS
551	Cut	2mm * 2mm	Ultrasonic	Dichloromethane	HPLC/DAD
1051	YES	2mm	Ultrasonic	Toluene	HPLC-fluorescent
2115	NO	As received	Ultrasonic	Dichlorometane	HPLC-UV
2129	NO		Ultrasonic	Dichloromethane	LC-MS-MS
2146					
2152	NO	As received	Soxhlet	Chloroform:Methanol	GC-MS
2169					
2172	YES	<2mm	Ultrasonic	THF	LC-MS-MS
2190	NO	As received	Passive	Acetonitrile	LC-MS QQQ
2201	Cut	1 *1 mm	Ultrasonic	Chloroform:MeOH 2:1 (v/v)	LC-MS-MS
2212	Cut	2mm	Ultrasonic	Dichloromethane	HPLC/MS
2215	YES	2mm * 2mm	Ultrasonic	THF	HPLC/MS
2216	Grinded	1.0mm sieve	Other	DCM	HPLC/MS
2271	Cut	1mm * 1mm	Ultrasonic	Dichloromethane	LC-MS-MS
2284	NO	3mm * 3mm	Ultrasonic	Dichloromethane	HPLC/FLD
2290	Cut	3mm * 3mm	Ultrasonic	CHCl3:MeOH (2:1)	LC-MS-MS
2350	NO	2mm * 3mm * 3mm	Ultrasonic	Dichloromethane	LC-MS-MS
2354	NO	2mm	Ultrasonic	Dichloromethane	LC-MS-MS
2366	YES	2mm * 2mm * 2mm	Soxhlet	Dichloromethane	HPLC/DAD
2370	NO	5mm * 5mm	Ultrasonic	DCM	LC-MS-MS
2372	NO	0.3mm	Ultrasonic	DCM	LC-MS-MS
2379	NO		Ultrasonic	Dichloromethane	HPLC/MS
2386	Kryo milled	<0.5mm	Ultrasonic	Dichloromethane	LC-MS-MS
2390	NO	2.54 - 2.83 mm	Ultrasonic	Dichloromethane	HPLC/MS
2413	NO		Ultrasonic	THF	Inhouse
2469					
2482	NO	As received	Ultrasonic	Toluene	GC-MSD
2489	YES	<3mm	Ultrasonic	Chloroform, Methanol	LC-MS-MS
2496	Cut	1mm * 1mm	Ultrasonic	Dichloromethane	GC-MS
2504	Cut	3mm * 3mm	Ultrasonic	Acetone	LC-DAD-MS
2510	Cut	Approx $1mm^3$	Ultrasonic	Dichloromethane	HPLC-fluorescent
2511					
2532	YES	0.1mm	Ultrasonic	Chloroform:Methanol	LC-MS-MS
2549	Cut	0.5mm	Ultrasonic	Dichloromethane	LC-MS-MS
2566	NO	As received	Ultrasonic	THF/ACN	LC-MS-MS
2615	YES	1mm * 1mm	Ultrasonic	THF	HPLC/FLD
2672	Grinded	<0.2mm	Ultrasonic	DCM/MeOH (90:10)	HPLC-MSD/FLD
2673	NO		Ultrasonic	THF/Methanol	HPLC/FLD
2681	NO	<5mm * 5mm	Ultrasonic	THF	LC-MS-MS
3100	YES	3mm * 3mm	Ultrasonic	Methanol:Chloroform (1:2)	HPLC-FLD-DAD
3118	Cut	2mm * 2mm	Ultrasonic	Chloroform:Methanol	LC-MS-MS
3146	NO	As received	Ultrasonic	Chloroform:Methanol (2:1)	LC-MS-MS
3151		0.2cm	Ultrasonic	THF	LC-MS-MS
3163					
3172					
3176	NO	Original	Ultrasonic	THF	LC-MS-MS
3191	NO	As received	Ultrasonic	Dichloromethane	LC-MS-MS
3199	NO	As received	Ultrasonic	THF	HPLC/MS
3209	Cut	<0.1mm	Ultrasonic	Dichloromethane	LC-MS-MS
3212			Ultrasonic	THF	GC-MS
3218	NO	As received	Ultrasonic	Chloroform:Methanol (2:1)	HPLC-DAD/FLD
3220	Cut	0.1 mm	Ultrasonic	Methanol	GC-MS
3225	NO	2mm * 2mm	Water bath shaking	CAN	LC-MS-MS
3233	NO		Ultrasonic	THF and CAN	LC-MS-MS
3243	Cut	2mm * 2mm	Ultrasonic	Dichloromethane	GC-MS

Method information, sample #15068

Lab	sample grinded or cut	final particle size	extraction technique used	extraction solvent used	analysis technique
110					
330			Ultrasonic	CH2CL2	LC-MS-MS
339	YES		Ultrasonic	Dichloromethane	LC-MS-MS
551	Cut	2mm * 2mm	Ultrasonic	Dichloromethane	HPLC/DAD
1051	YES	2mm	Ultrasonic	Toluene	HPLC-fluorescent
2115	NO	As received	Ultrasonic	Dichloromethane	HPLC-UV
2129	NO		Ultrasonic	Dichloromethane	LC-MS-MS
2146					
2152	NO	As received	Soxhlet	Chloroform:Methanol	GC-MS
2169					
2172	YES	<2mm	Ultrasonic	THF	LC-MS-MS
2190	No	As received	Passive	Acetonitrile	LC-MS QQQ
2201	Cut	1 * 1 mm	Ultrasonic	Chloroform:MeOH 2:1 (v/v)	LC-MS-MS
2212	Cut	2mm	Ultrasonic	Dichloromethane	HPLC/MS
2215	YES	2mm * 2mm	Ultrasonic	THF	HPLC/MS
2216	Grinded	1.0mm sieve	Other	DCM	HPLC/MS
2271	Cut	1mm * 1mm	Ultrasonic	Dichloromethane	LC-MS-MS
2284	YES	2mm * 2mm	Ultrasonic	Dichloromethane	HPLC/FLD
2290	Cut	3mm * 3mm	Ultrasonic	CHCL3:MeOH (2:1)	LC-MS-MS
2350	NO	2mm * 2mm * 3mm	Ultrasonic	Dichloromethane	LC-MS-MS
2354	NO	2mm	Ultrasonic	Dichloromethane	LC-MS-MS
2366	YES	2mm * 2mm * 2mm	Soxhlet	Dichloromethane	HPLC/DAD
2370	NO	5mm * 5mm	Ultrasonic	DCM	LC-MS-MS
2372	NO	0.3mm	Ultrasonic	DCM	LC-MS-MS
2379	NO		Ultrasonic	Dichloromethane	HPLC/MS
2386	Kryo milled	<0.5mm	Ultrasonic	Dichloromethane	LC-MS-MS
2390	NO	2.11 - 2.18 mm	Ultrasonic	Dichloromethane	HPLC/MS
2413	NO		Ultrasonic	THF	Inhouse
2469					
2482	NO	As received	Ultrasonic	Toluene	GC-MSD
2489	YES	<3mm	Ultrasonic	Chloroform, Methanol	LC-MS-MS
2496	Cut	1mm * 1mm	Ultrasonic	Xylene	GC-MS
2504	Cut	3mm * 3mm	Ultrasonic	Acetone	LC-DAD-MS
2510	Cut	Approx 1 m	Ultrasonic	Dichloromethane	HPLC-fluorescent
2511					
2532	YES	0.1mm	Ultrasonic	Chloroform:Methanol	LC-MS-MS
2549	Cut	0.25mm	Ultrasonic	Dichloromethane	LC-MS-MS
2566	NO	As received	Ultrasonic	THF/ACN	LC-MS-MS
2615	YES	1mm * 1mm	Ultrasonic	THF	HPLC/FLD
2672	Grinded	<0.2mm	Ultrasonic	DCM/MeOH (90:10)	HPLC-MSD/FLD
2673					
2681	Cut	<2mm * 2mm	Ultrasonic	THF	LC-MS-MS
3100	YES	3mm * 3mm	Ultrasonic	Methanol:Chloroform (1:2)	HPLC-FLD-DAD
3118	Cut	2mm * 2mm	Ultrasonic	Chloroform:Methanol	LC-MS-MS
3146	NO	As received	Ultrasonic	Chloroform:Methanol (2:1)	LC-MS-MS
3151		0.2cm	Ultrasonic	THF	LC-MS-MS
3163					
3172					
3176	NO	Original	Ultrasonic	THF	LC-MS-MS
3191	YES	<0.25mm	Ultrasonic	Dichloromethane	LC-MS-MS
3199	NO	As received	Ultrasonic	THF	HPLC/MS
3209	Cut	<0.1mm	Ultrasonic	Dichloromethane	LC-MS-MS
3212			Ultrasonic	THF	GC-MS
3218	NO	As received	Ultrasonic	Chloroform:Methanol (2:1)	HPLC-DAD/FLD
3220	Cut	0.1 mm	Ultrasonic	Methanol	GC-MS
3225	NO	2mm * 2mm	Water bath shaking	DCM	LC-MS-MS
3233	NO		Ultrasonic	THF and CAN	LC-MS-MS
3243	Grinded	<2mm	Ultrasonic	Dichloromethane	GC-MS

APPENDIX 3

Number of participating laboratories per country

1 lab in	BELGIUM
1 lab in	BRAZIL
1 lab in	FINLAND
4 labs in	FRANCE
7 labs in	GERMANY
5 labs in	HONG KONG
5 labs in	INDIA
1 lab in	INDONESIA
1 lab in	IRELAND
3 labs in	ITALY
1 lab in	JAPAN
1 lab in	KOREA
13 labs in	P.R. of CHINA
1 lab in	PAKISTAN
1 lab in	SERBIA
2 labs in	TAIWAN R.O.C.
2 labs in	THAILAND
1 lab in	THE NETHERLANDS
1 lab in	TUNISIA
1 lab in	TURKEY
4 labs in	U.S.A.
1 lab in	VIETNAM

APPENDIX 4

Abbreviations:

C = final result after checking of first reported suspect result
D(0.01) = outlier in Dixon's outlier test
D(0.05) = straggler in Dixon's outlier test
G(0.01) = outlier in Grubbs' outlier test
G(0.05) = straggler in Grubbs' outlier test
DG(0.01) = outlier in Double Grubbs' outlier test
DG(0.05) = straggler in Double Grubbs' outlier test
R(0.01) = outlier in Rosner' outlier test
R(0.05) = straggler in Rosner' outlier test
n.a. = not applicable
n.d. = not detected
fr = first reported result

Literature:

1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, April 2014
2 ASTM E178-02
3 ASTM E1301-03
4 ISO 5725: 1986
5 ISO 5725, parts 1-6, 1994
6 2001/804/EC, Official Journal of the European Communities, L304/26, (2001)
7 98/485/EC, Official Journal of the European Comminities, L217/35, (1998)
8 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
9 W.J. Youden and E.H. Steiner, Statistical Manual of the AOAC, (1975)
10 IP 367/84
11 DIN 38402 T41/42
12 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
13 J.N. Miller, Analyst, 118, 455, (1993)
14 ASTM F963:"standard consumer safety specification on toy safety"
15 Analytical Methods Committee Technical brief, No4 January 2001.
16 The Royal Society of Chemistry 2002, Analyst 2002, 127 pages 1359-1364, P.J. Lowthian and M. Thompson
17 ISO/FDIS 13528, 2005e, Statistical methods for use in proficiency testing by interlaboratory comparisons
18 R.G. Visser, Reliability of proficiency test results for metals and phthalates in plastics, Accred Qual Assur, 14:29-34 (2009)
19 Annex XVII to REACH Regulation 1907/2006
20 Guideline on the interpretation of the concept "which can be placed in the mouth" as laid down in the entry 52 of Annex XVII to REACH Regulation 1907/2006, published July 18, 2012 on http://echa.europe.eu
21 16 C.F.R. Part 1501 and 16 C.F.R. 1500.50-53
22 16 C.F.R. 1199, Federal Register /Vol. 78, No. 31 /Thursday, February 14, 2013
23 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, T*echnometrics*, 25(2), pp. 165-172, (1983)