

**Development of Data to Support the Characterization of
Lead Concentrations in Residential Paint**

Final Report

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**Prepared by the
University of Cincinnati**

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A. Introduction

The purpose of this project was to characterize the lead content of enamel paints intended for residential use with an emphasis on attempting to determine the lead content of the paint when lead is apparently not intentionally added as a pigment, drying agent or for other purposes. The project's findings are provided in this report to the U. S. Environmental Protection Agency.

The project consisted of three tasks: (1) identification of existing paint lead sampling data (2) identification then collection of new paint samples; and (3) testing of new paint samples obtained under Task 2 in order to quantify the level of lead in these samples.

B. Project Tasks

Task 1: Identification of existing paint sampling data

In this task, data were collected from publications of the project investigators (1, 2, 3). In previous studies, the investigators analyzed the lead concentration in 374 samples from twelve countries (China, Ecuador, Egypt, India, Indonesia, Malaysia, Nigeria, Peru, Seychelles, Singapore, Taiwan and Thailand) (1, 2, 3). The lead concentration percentages by country were calculated for ranges of less than or equal 90 ppm (the current US standard) and less than or equal to 600 ppm (the former US standard) (2). The percentages in the two ranges varied by country, from 0 to 56 percent (90 ppm) and 4 to 67 percent (600 ppm). Detailed results are presented in the attachment.

Of the 374 samples, 138 samples had lead concentrations up to 300 ppm (Table 1). Almost one-half (46%) of the 138 samples had lead concentrations less than or equal 15 ppm. Seventy-nine percent (79%) of the samples had concentrations less than or equal to 90 ppm. In comparison, only about one-fifth of the samples (21%) were in the concentration interval between 91 to 300 ppm.

Lead Concentration Interval, ppm	# of Total Samples in Interval	% of Total Samples in Interval	Cumulative % of Total Samples
Less than or equal to 15 ppm	63	46	46
Greater than 15 ppm to 45 ppm	25	18	64
46 to 90 ppm	21	15	79
91 to 100 ppm	4	3	81
101 to 150 ppm	10	7	89
151 to 300 ppm	15	11	100
Total	138	100	

Task 2: Identification and Collection of New Paint Samples

New paint sampling was conducted in four countries to aid in the characterization of lead found in paints. The countries were selected based on two factors: (1) local groups could determine the availability of enamel paints, collect the paints and prepare samples for shipping to the Hematology & Environmental Laboratory at the University of Cincinnati and (2a) data were not currently available on the lead content of new paints in the region or, (2b) information available suggested that activities recently occurred that would result in lower lead

concentrations in new paints from some or all brands. Armenia and Kazakhstan were selected based on (2a) and Brazil and India were selected based on (2b).

Data from Brazil and India were examined to determine if they could provide relevant information on the level of lead in paint when lead is not intentionally added. In Brazil, Federal Law 11.762 (effective August 1, 2009) limits the lead concentration of paint to a maximum of 600 ppm. In India, project investigators and others have analyzed samples on a number of occasions. Additionally, India has a non-mandatory national standard for the recommended concentration of lead in paint. Comparing previously measured concentrations, with the lead concentrations in samples collected under this project, could provide an indication of the lead levels attainable if the use of lead in manufacturing the paints was terminated.

An average of twenty-five (25) paint samples was collected from each of the following countries: Armenia, Brazil, Kazakhstan and India. The collected samples were from multiple brands and colors. Additionally, samples collected from Brazil and India were from samples previously analyzed (1, 2, 3, 4).

Task 3: Preparation and Analysis of Paint Samples from Selected Countries

A detailed protocol, Quality Assurance Project Plan (QAPP), was developed and sent to the participating groups in the four countries. The protocol was reviewed during a Skype teleconference and questions regarding the procedures were answered to the satisfaction of the participants.

After the paint was obtained, a sample of each was applied carefully to one side of a pre-numbered, clean, unused piece of black ABS plastic (1 inch by 6 inches by ¼ inch). The sample was allowed to dry and then was placed in individual unused plastic bags. Information on manufacturing country, company headquarters location, and the date the paint was manufactured was obtained from the labels of the paint cans. Information not provided on the label was supplemented from the brand website.

Two methods were used to quantify the amount of lead in the samples; 1) analysis by a field portable X-Ray Fluorescence Analyzer (XRF with an X-ray tube source) in units of micrograms of lead per square centimeter of surface ($\mu\text{g}/\text{cm}^2$) and , 2) Atomic absorption spectroscopy (AA) in units of parts per million (ppm). Each sample was painted on a piece of ABS plastic. Then XRF analysis was performed on two locations on each of the samples. Once the XRF analysis was performed, the paint was carefully scraped off each piece of ABS plastic and prepared for AA analysis. Sample digestion and analysis procedures are presented in the QAPP.

Data and analysis from each of the selected countries are presented in two tables. The first table presents data from each sample (including the results of the AA and XRF analyses). The second table presents data by paint brand and includes a summary of the data by percentages of samples with concentrations, in ppm as determined by AA. The second table also displays values that are greater than or equal to 90 ppm and greater than or equal to 600 ppm. These two values represent the current (90 ppm) and the former (600 ppm) limits in the US for the lead concentrations in new decorative paints. Additionally, 600 ppm is also the current limit in Brazil and the voluntary limit in India.

C. Results of Analysis of New Samples

Armenia

Of the twenty-six (26) samples, from eight brands of enamel decorative paints collected in Armenia, 20 samples had lead concentrations above 1,000 ppm (Table 2). The highest lead concentration was 130,000 ppm (over 13% lead). The average lead concentration was 25,200 ppm. The highest lead concentrations,

101,000 ppm and 130,000 ppm, were from paints manufactured in Armenia by a company that is headquartered Iran.

The surface lead level loading ($\mu\text{g lead/cm}^2$) ranged from 0.14 $\mu\text{g lead/cm}^2$ to 437 $\mu\text{g lead/cm}^2$. The lowest XRF loading levels were associated with the lowest lead concentrations as determined by AA. The paint samples containing less than 90 ppm lead had lead loading levels ranging from 0.14 to 0.5 $\mu\text{g lead/cm}^2$. These findings are similar to the Consumer Product Safety Commission (CPSC) estimate that a single layer of paint with a concentration of 90 ppm would have a surface lead load of 0.63 $\mu\text{g of lead/cm}^2$ (7). The CPSC states that consumer products that are coated with paint containing 90 ppm lead "...are likely to have mass per area concentrations in the range of 0.5 – 2 $\mu\text{g lead/cm}^2$ " (7). The midpoint of this 0.5 – 2 range, about 1 $\mu\text{g lead per cm}^2$, would be the approximate cutoff, according to the CPSC report, between lead levels above and below 90 ppm. In this report, lead concentration levels (ppm) will be examined for lead loadings at this cutoff level. The Consumer Product Safety Improvement Act of 2008 limits lead in children's products to 2 $\mu\text{g lead/cm}^2$ (determined using XRF), on small areas of about 1 cm^2 where removal of the lead paint for laboratory analysis is not practical (8).

The distribution of lead concentrations by brand and brand headquarters for paints purchased in Armenia is presented in Table 3. Only one of eight brands of paint collected in Armenia had its headquarters located in Armenia. The other seven brands had headquarters located in six other countries: UAE, Germany, India, Iran, Russia and Turkey (two brands). Only two brands of paint were manufactured in Armenia.

Sample #	Brand No.	Brand Headquarters	Country where paint manufactured	Date manufactured	Color	AA ¹ (ppm)	XRF ² ($\mu\text{g/cm}^2$)
A-01	41	Emirates	Emirates	Not available	Blue	2,110	5.4
A-02	41	Emirates	Emirates	Not available	Green	76,200	190
A-03	41	Emirates	Emirates	Not available	Red	83,400	371
A-04	41	Emirates	Emirates	Not available	White	4.5	0.22
A-05	41	Emirates	Emirates	Not available	Black	3,270	11
A-06	42	Iran	Armenia	May-2011	Blue	4.5	0.35
A-07	42	Iran	Armenia	March-2011	Green	101,000	257
A-08	42	Iran	Armenia	Feb-2011	Red	36,400	84
A-09	42	Iran	Armenia	Sept-2011	White	5,830	27
A-10	42	Iran	Armenia	July-2011	Yellow	130,000	437
A-14	43	Germany	Russia(importer)	Unknown	White	4.5	0.14
A-16	44	Russia	Russia	June- 2010	Dark blue	1,210	5.3
A-17	44	Russia	Russia	July-2010	Dark green	1,110	5.9
A-18	44	Russia	Russia	Aug-2010	Red	1,240	8.1
A-19	44	Russia	Russia	Feb-2011	White	2,080	8.9
A-20	44	Russia	Russia	Feb-2011	Yellow	37,800	225
A-21	45	Turkey	Turkey	June-2010	Dark blue	4,030	17
A-22	45	Turkey	Turkey	June-20 10	Yellow	45,100	304
A-23	45	Turkey	Turkey	June-2010	Dark green	22,100	189
A-24	45	Turkey	Turkey	June -2010	Red	1,400	15

A-25	45	Turkey	Turkey	June- 2010	Chocolate	3,140	12
A-26	46	Turkey	Turkey	June-2011	Yellow	86,400	402
A-27	46	Turkey	Turkey	Feb-2011	White	4.5	0.24
A-29	47	Armenia	Armenia	Not available	Yellow	11,300	59.9
A-31	35 ^{3,4}	India	Emirates	Not available	White	41	0.39
A-32	35 ^{3,4}	India	Emirates	Not available	Snuff color	4.5	0.50

¹ AA: Atomic Absorption Spectroscopy Analysis method

² XRF: X-Ray Fluorescence Analysis method

³ Manufactured under license from a company in Dubai, UAE a subsidiary of Brand No. 19 located in India.

⁴ Label contains "No added lead mercury, arsenic, cadmium".

Brand	Brand Headquarters	# of Samples	Average ppm	%>=90 ppm	%>=600 ppm	%>=10,000 ppm	Maximum ppm
No. 35 ¹	India	2	23	0	0	0	41
No. 41	Emirates	5	33,000	80	80	40	83,400
No. 42	Iran	5	54,800	80	80	60	130,000
No. 43	Germany	1(white)	-	0	0	0	4.5
No. 44	Russia	5	8,680	100	100	20	37,800
No. 45	Turkey	5	15,100	100	100	40	45,100
No. 46	Turkey	2	43,200	50	50	50	86,400
No. 47	Armenia	1(yellow)	-	100	100	100	11,300
Overall		26	25,200	77	77	38	130,000

¹ Manufactured under license from a company in Dubai, UAE which is an indirect subsidiary of Brand No. 19 located in India (Information supplemented by the company website)

Brazil

Twenty (20) samples of new enamel decorative paints were collected in Brazil from December 8-12, 2011. Ten of the samples were from brands/colors previously tested (previously reported ranges were from 0.6 to 170,258 ppm)(4). One of the new samples collected was from a brand previously tested but not from the same color. The other nine samples were from new brands and were generally manufactured by smaller companies.

As provided in Table 4, the ten previously tests paints were found in the current study to have lead concentrations less than the detectible levels of lead (4.5 ppm). The eleventh sample contained 90.7 ppm. The other nine samples collected in the current study were from four brands not previously tested. Two samples collected from one of these brands (black and white) had less than detectible levels of lead (4.5 ppm) as did a white sample from another brand in this group. One of the remaining six samples contained a lead concentration of 521 ppm. The lead concentration in the five other samples ranged between 1,470 ppm and 58,800 ppm, with an average of 22,500 ppm.

The four paint brands found to have high lead concentrations in a previous study (4) now demonstrated much lower lead concentrations. Many of the decreases in lead concentrations from the previous study to the

present were considerable. For example the yellow paint of one brand decreased from 170,000 ppm to less than 4.5 ppm.

In a finding that is similar to one for the Armenian paints, thirteen of the samples from Brazil that had XRF lead loading values of less than 1.0 ($\mu\text{g}/\text{cm}^2$) contained a less than detectable level of lead (4.5 ppm; Table 4). The distribution of the lead concentrations (ppm) by brand is summarized in Table 5.

Sample #	Brand No. ¹	Date manufactured	Label notations regarding lead content	Color	AA ³ Toxics Link (2009) Global Study (ppm)	AA ³ Current study (ppm)	XRF ⁴ level ($\mu\text{g}/\text{cm}^2$)
BRZ-35	48	(Aug-'14) ²	Does not contain heavy metals	Yellow	66,100	4.5	0.32
BRZ-36	48	(Aug-'15) ²	Does not contain heavy metals	Red	21,000	4.5	0.33
BRZ-37	49	March-'11	Does not contain heavy metals	Yellow	170,000	4.5	0.11
BRZ-38	49	Dec-'10	Does not contain heavy metals	Red	5,630	4.5	0.25
BRZ-39	50	Sept-'11	No information	Black	4,440	4.5	0.36
BRZ-40	50	Aug-'11	No information	White	3,900	4.5	0.32
BRZ-41	51	(June-'13) ²	No lead	Orange	60,700	4.5	0.43
BRZ-42	51	(Apr-'14) ²	No lead	Green	7,670	4.5	0.13
BRZ-43	51	(Sept-'13) ²	No lead	Blue	573	4.5	0.03
BRZ-44	51	(Nov-'13) ²	No lead	Red	19,100	4.5	0.47
BRZ-45	52	(Sept-'12) ²	No information	Black	Not tested	4.5	0.50
BRZ-46	52	(Aug-'12) ²	No information	White	Not tested	4.5	0.55
BRZ-47	53	(Oct-'14) ²	No lead	White	Not tested	4.5	0.04
BRZ-48	53	(April-'13) ²	No lead	Green	Not tested	1,470	21.2
BRZ-49	53	(April-'13) ²	No lead	Blue	Not tested	2,050	28.8
BRZ-50	55	March-'11	No information	Red	Not tested	58,800	1240
BRZ-51	68	June-'10	No information	Green	Not tested	48,000	434
BRZ-52	55	Nov-'10	No lead	Silver	Not tested	1,910	21.8
BRZ-53	55	Sept-'10	No information	Sand	Not tested	521	11.7
BRZ-54	51	(March-'13) ²	No lead	Yellow	Not tested	90.7	1.59

¹Headquartered and manufactured in Brazil.
² Date of manufacturing not provided; date of expiration was provided and is shown in parenthesis.
³ AA: Atomic Absorption Spectroscopy Analysis method
⁴ XRF: X-Ray Fluorescence Analysis method

Brand	Number of Samples	Average (ppm)	>=90 ppm (%)	>=600 ppm (%)	>=10,000 ppm (%)	Maximum (ppm)
No. 48	2	4.5	0	0	0	4.5
No. 49	2	4.5	0	0	0	4.5
No. 50	2	4.6	0	0	0	4.6
No. 51	5	21.7	20	0	0	90.7
No. 52	2	4.5	0	0	0	4.5
No. 53	3	1,180	67	67	0	2,050
No. 55	3	20,400	100	67	33	58,800
No. 68	1	-	100	100	100	48,000
Overall	20	5,644	35	30	10	58,829

¹All paints were manufactured in Brazil and all brand headquarters were based in Brazil

India

Twenty-six paint (26) samples from India were collected and analyzed in this study. Lead concentrations (ppm) and lead surface lead loading ($\mu\text{g}/\text{cm}^2$) are presented in Table 6. Nineteen of the samples collected were selected because the lead concentration for those brands and colors, based on the results from a previous survey (4), were greater than or equal to 90 ppm. Additionally, the 19 samples were from four of five of the most popular brands in India, as measured by market share of decorative paints (Brand Nos. 19, 35, 20, and 64).

The other seven samples were from three brands not previously tested (Brand Nos. 65, 66, 67). Two of these brands (Nos. 65 and 66) are considered to be from the “informal paint sector” and thus represent small and medium-sized (SME) facilities. The average lead concentration of the 26 samples collected in India was 16,600 ppm (Table 7). The sample from India with the highest concentration (134,000 ppm) was Golden Yellow (Brand No. 67)(Table 7). Brand No. 67 is manufactured locally in India under a license from an international brand. The brand however, was not located on the company website. The label on the Brand 67 can stated, “No added lead”. The other sample from this brand (white) did not contain a detectable level of lead.

One of the six, Brand No. 19, samples (Bus Green) contained ≥ 90 ppm lead (143 ppm). One of the four Brand No. 35 paints (Golden Yellow) had a concentration of 3,410 ppm. The Brand No. 35, Golden Yellow, sample previously collected (manufactured March 2009) had a concentration of 41,400 ppm (4). The highest concentration of paint from Brand No. 20, in the current study, was Golden Brown (382 ppm). Three of the five Brand No. 64 paints had concentrations of lead ranging from 9,490 ppm (deep orange) to 97,300 ppm (golden yellow); the other two samples contained 4.5 and 14.4 ppm lead. The label of the Brand No. 64 deep orange paint label indicated that it contained “no added lead”.

Of the brands whose paints had not been previously analyzed, paints from Brand No. 65 contained concentrations of lead ranging from 3,820 ppm to 92,800 ppm. A single sample of the Brand No. 66 paint (white) had a less than detectable level.

For sixteen of samples of paint, the lead loading by XRF, was less than $1.0 \mu\text{g}/\text{cm}^2$. For fifteen of these samples the lead concentration ranged up to 40.9 ppm when analyzed by AA. The highest loading (0.9

$\mu\text{g}/\text{cm}^2$) for a sample was 143 ppm lead. These findings are similar to the CPSC estimate that a single layer of paint with a concentration of 90 ppm would have a surface lead load of $0.63 \mu\text{g}$ of lead/ cm^2 (7).

Sample #	Brand No.	Brand Headquarters	Date Manufactured	Label notations regarding lead content	Color	AA ¹ (ppm) Previous Study	AA ¹ (ppm) Current Study	XRF ² ($\mu\text{g}/\text{cm}^2$)
I-100	19	India	Jan- '11 ³	No added Pb	Imperial crimson red	6,800 ⁴	18.7	0.21
I-101	19	India	Apr-'11 ³	No added Pb	Gray	2,410 ⁴	4.5	0.23
I-102	19	India	May-'11 ³	No added Pb	Phirozi blue	3,370 ⁴	4.5	0.4
I-103	19	India	Apr-'11 ³	No added Pb	Lemon yellow	122,000 ⁴	10.2	0.47
I-104	19	India	Jan-'11 ³	No added Pb	Brown	11,000 ⁴	40.9	0.37
I-105	19	India	Sept-'10 ³	No added Pb	Bus Green	54,900 ⁴	143	0.92
I-106	35	India	May-'11	No added Pb	Black	9,560 ⁴	15.2	0.37
I-107	35	India	Jan-'10	No information	Oxford blue	22,300 ⁵	20.1	0.41
I-108	35	India	July-'11	No added Pb	Snow white	15,200 ⁵	13.7	0.55
I-109	35	India	May-'10	No information	Golden yellow	41,400 ⁵	3,410	56.7
I-110	20	Japan	Apr-'11	No added Pb	Phirozi blue	3,890 ⁴	9.1	0.27
I-111	20	Japan	Apr-'11	No added Pb	Black	4,840 ⁴	10.1	0.33
I-112	20	Japan	Jan-'10	No added Pb	Golden brown	200 ⁴	382	1.97
I-113	20	Japan	Aug-'10	No added Pb	Tractor orange	85,200 ⁴	4.5	0.38
I-114	64	India	Apr-'11	No added Pb	Black	14,900 ⁶	4.5	0.45
I-115	64	India	Not clear	No information	Bus green	35,300 ⁶	29,800	433
I-116	64	India	March-'11	No added Pb	Dazzling white	3,460 ⁶	14.4	0.67
I-117	64	India	May-'10	No information	Golden yellow	287,000 ⁶	97,300	1,260
I-118	64	India	Apr-'11	No added Pb	Deep orange	185,000 ⁶	9,490	73.8
I-119	65	India	March-'11	No information	Phirozi blue	Not sampled	4,330	12.9

I-120	65	India	Feb-'11	No information	Bus green	Not sampled	57,200	535
I-121	65	India	Oct-'10	No information	Golden yellow	Not sampled	92,800	1050
I-122	65	India	Aug-'10	No information	White	Not sampled	3,820	29,8
I-123	66	India	Nov-'10 ²	No information	White	Not sampled	4.5	0.03
I-124	67	India	Aug-'09	No added Pb	Golden yellow	Not sampled	134,000	729
I-125	67	India	Apr-'11	No added Pb	Ultra white	Not sampled	4.5	0.22

¹ AA: Atomic Absorption Spectroscopy Analysis method

² XRF: X-Ray Fluorescence Analysis method

³ Packaging date

⁴ C.S. Clark, (2009)

⁵ Toxics Link, (2009)

⁶ Centre for Science and Environment, (2009)

Brand No.	Samples (#)	Average (ppm)	>= 90 ppm (%)	>= 600 ppm (%)	>= 10,000 ppm (%)	Maximum (ppm)
19	6	44	17	0	0	143
35	4	864	25	25	0	3,410
65	4	39,500	100	100	2	92,800
20	4	101	25	0	0	381
64	5	27,300	60	60	40	97,300
66	1	4.5	0	0	0	4.5
67	2	66,800	50	50	50	134,000
Overall	26	16,600	50	50	50	134,000

¹ All brand headquarters in India except for Brand No. 20 which is in Japan.

Kazakhstan

In Kazakhstan, 26 paints samples were analyzed. The samples were manufactured in five different countries (Table 8). The headquarters of the companies were located in four different countries. None of the paint can labels provided information on the lead content of the paint. Single samples of yellow paint collected from brands whose headquarters are located in Poland and Slovenia had lead concentrations of 4.5 ppm (less than detection) and 307 ppm, respectively.

The average concentration in the 26 samples collected in Kazakhstan was 15,700 ppm (Table 9). Seven of the eight brands had at least one sample with a lead concentration above 90 ppm. Six of the brands had at least one sample with a lead concentration greater than 2,000 ppm and five had at least one sample above 25,000 ppm. Four of the brands had one sample with low lead concentration (<90 ppm). Four of the seven (57%) paints from Iran and six of sixteen samples (38%) from Russia had lead concentrations greater than or equal to 10,000 ppm. Three samples had lead loadings, measured by XRF, of less than 1.0 µg/cm². The maximum concentration, measured by AA, for these three samples was 35 ppm.

Table 8
Lead Concentration (ppm) and Lead Surface Loading ($\mu\text{g}/\text{cm}^2$) of New Enamel Architectural Paints Purchased in Kazakhstan (lead content was not indicated on any of the paint can labels)

Sample #	Brand No.	Brand Headquarters	Country where paint Manufactured	Date Manufactured	Color	AA ¹ (ppm)	XRF ² ($\mu\text{g}/\text{cm}^2$)
KZ-01	42	Iran	Iran	April-08	Brown	9,000	257
KZ-02	42	Iran	Iran	Jan-08	Blue	9,320	341
KZ-03	42	Iran	Iran	Feb-10	White	4.5	0.09
KZ-04	42	Iran	Iran	May-08	Green	71,300	2,530
KZ-05	57	Iran	Iran	March-09	Blue	11,800	315
KZ-06	57	Iran	Iran	Not given	Brown	39,300	1,140
KZ-07	57	Iran	Iran	Aug-09	Red	47,900	1,590
KZ-08	58	Russia	Russia	March-09	Yellow	50,500	1,640
KZ-09	58	Russia	Russia	April-10	White	73	1.13
KZ-10	54	Russia	Ukraine	July-09	Yellow	39,200	733
KZ-11	54	Russia	Ukraine	May-10	White	1,120	29.8
KZ-12	54	Russia	Ukraine	Sept-09	Red	16,300	565
KZ-13	54	Russia	Ukraine	May-10	Brown	2,090	73.2
KZ-14	54	Russia	Ukraine	June-09	Green	12,100	468
KZ-15	54	Russia	Ukraine	May-10	Blue	1,140	37.6
KZ-16	54	Russia	Ukraine	March-10	Green	5,390	108
KZ-17	54	Russia	Ukraine	April-10	Yellow	56,000	886
KZ-18	60	Slovenia	Slovenia	Not given	Yellow	307	10.4
KZ-19	61	Poland	Poland	Not given	Yellow	4.5	0.4
KZ-20	62	Russia	Russia	May-10	Blue	2,470	74.5
KZ-21	62	Russia	Russia	June-10	White	1,940	60.6
KZ-22	63	Russia	Russia	Not given	Green	4,930	130
KZ-23	63	Russia	Russia	Not given	Yellow	25,800	753
KZ-24	63	Russia	Russia	Not given	Blue	2,830	58.2
KZ-25	63	Russia	Russia	Not given	Red	2,440	33.0
KZ-26	63	Russia	Russia	Not given	White	35	0.05

¹ AA: Atomic Absorption Spectroscopy Analysis method

² XRF: X-Ray Fluorescence Analysis method

Table 9
Lead Concentration (ppm) by Brand and Brand Headquarters of New Enamel Architectural Paints Purchased in Kazakhstan

Brand No.	Brand Headquarters	Samples (#)	Average (ppm)	≥ 90 ppm (%)	≥ 600 ppm (%)	$\geq 10,000$ ppm (%)	Maximum (ppm)
42	Iran	4	22,400	75	75	25	71,300
54	Russia	7	16,700	100	100	57	47,600
57	Iran	3	33,000	100	100	100	47,900
58	Russia	2	25,300	50	50	50	50,500
60	Slovenia	1 ¹	-	100	0	0	307
61	Poland		-	0	0	0	4.5

62	Russia	1	2,200	100	100	0	2,470
63	Russia	5	7,200	80	80	20	25,800
Overall		26	15,700	81	77	38	71,300

Combined Data for New Paints from Armenia, Brazil, India and Kazakhstan

A comparison of the lead concentrations (ppm) and distributions for the four countries where samples were collected for analyses (Table 10) reveals that the percentage of samples that exceeded 90 ppm and 600 ppm was highest for the two countries from which samples had not previously been analyzed (Armenia and Kazakhstan). Thirty eight percent of samples exceeded 10,000 ppm for these two countries. In India, concentrations of lead in paint for larger paint companies have decreased. Other paint companies in India, however, continue to have samples with lead concentrations exceeding 10,000 ppm.

Country	Number of Brands Tested	Number of Samples	Average (ppm)	>= 90 ppm (%)	>= 600 ppm (%)	>= 10,000 ppm (%)	Maximum ppm
Armenia	8	26	24,800	77	77	38	130,000
Brazil	8	20	5,640	35	30	10	58,800
India	7	26	16,600	50	50	50	134,000
Kazakhstan	8	26	15,700	81	77	38	71,300

Comparison of Lead Content Information on Paint Can Labels with Measured Lead Concentration (ppm)

Information pertaining to the lead content was indicated on the labels of thirty-two (32) (44 %) of the paints purchased in Armenia, Brazil and India but for none of the paints from Kazakhstan. A summary of the cans containing lead content information (Table 11) revealed lead concentration of more than 75% of these paints (25 of 32) was less than 90 ppm. However, the lead concentrations in the seven paints containing more than 90 ppm were: 90, 143, 382, 948, 1470, 2050 and 134,000 ppm. The latter concentration was the highest detected in the new samples analyzed for this project.

Country (Brand #)	Information on Label on Can Pertaining to Lead Content ¹	# of paints	Range in Lead Concentration (ppm)
Armenia (35)	No added lead, mercury, arsenic and cadmium	2	4.5 to 41
Brazil (48)	Does not contain heavy metals	2	4.5
Brazil (49)	Does not contain heavy metals	2	4.5
Brazil (51)	No lead	5	4.5 to 90
Brazil (53)	No lead	3	4.5 to 2,050
India (19)	No added lead	6	4.5 to 143
India (35)	No added lead	3	14 to 20
India (20)	No added lead	4	4.5 to 382
India (64)	No added lead	3	4.5 to 949
India (67)	No added lead	2	4.5 to 134,000

¹Although text on can labels varied considerably, it is likely that each was intended to mean that compounds containing either "heavy metals" as a group, or one or

Lead Loading, $\mu\text{g}/\text{cm}^2$, by Concentration Range, ppm

The lead loading by lead concentration ranges for the four countries are presented in Table 12. For 37 of the 38 samples that had a lead loading of less than $1.0 \mu\text{g}/\text{cm}^2$, the lead concentration (ppm) was less than or equal to 45 ppm. The last sample had a concentration of 143 ppm.

Table 12

Number of XRF Readings by Lead Concentration Range (ppm) by Country Where Sample Collected (range of XRF readings indicated in parenthesis ($\mu\text{g}/\text{cm}^2$))

Concentration Range (ppm)	Armenia # ($\mu\text{g}/\text{cm}^2$)	Brazil # ($\mu\text{g}/\text{cm}^2$)	India # ($\mu\text{g}/\text{cm}^2$)	Kazakhstan # ($\mu\text{g}/\text{cm}^2$)	Total # ($\mu\text{g}/\text{cm}^2$)
<= 45	6 (0.14-0.50)	13 (0.03-0.55)	15 (0.03-0.67)	3 (0.05-0.4)	37 (0.03-0.67)
46-90	0	0	0	1 (1.13)	1 (1.13)
91-600	0	2 (1.59-11.7)	2 (0.92-1.67)	1 (10.4)	5 (0.92-11.7)
601-10,000	10 (5.3-27)	3 (21.2-28.8)	4 (12.9-73.8)	11 (29.8-341)	28 (5.3-341)
10,001-100,000	8 (59.9-402)	2 (434-1240)	4 (433-1,260)	10 (315-2530)	24 (59.9-2530)
>100,000	2 (257-437)	0	1 (729)	0	3 (257-729)
Total	26	20	26	26	98

D. Acknowledgements

We would like to acknowledge the support of following organizations in the selection of paint brands to examine and in the preparation of samples: Khazer Ecological and Cultural Organization (Armenia), APROMAC Environment Protection Association (Brazil), Toxics Link (India), Greenwomen (Kazakhstan) and the International POPS Elimination Network in which the previous organizations are members. We also acknowledge the support of the following individuals at the University of Cincinnati: Sandy Roda and Caroline Lind of the Hematology and Environmental Labs and Bill Menrath.

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Attachment

Archived Database of Samples with Lead Concentration Less than or Equal to 300 ppm

Attachment

**Archived Database of Samples with Lead Concentration Less than or Equal to
300 ppm**

Country	ID	Brand	Can Size	Purchase Price	Color on Label	Color Category	AA ppm	Smpl date	Manuf date
China	64	1			White	White	185.1	9/04	
China	67	2			Grey	Grey	4.5	9/04	
China	71	3			Brown (metallic)	Brown	4.5	9/04	
China	C-11	4	1L	55 (RMB)	White	White	73.8		10/11/2006
China	C-12	4	1L	55 (RMB)	Yellow : 48YY 77/529	Yellow	59.9		10/11/2006
China	C-13	4	1L	55 (RMB)	Green : 10GG 57/307;	Green	49.4		10/17/2006
China	C-14	4	1L	55 (RMB)	Sky Blue : 86BG 43/321;	Blue	32.7		10/17/2006
China	C-15	4	1L	55 (RMB)	Pink : 48YR 50/372	Red	31.4		10/11/2006
China	C-21	5	0.8kg	22(RMB)	White	White	106.1		4/10/2006
China	C-24	5	0.7kg	22(RMB)	Blue : 319	Blue	238.9		5/29/2006
China	C-25	5	0.7kg	22(RMB)	Red : 103	Red	42.9		5/31/2006
China	C-31	6	1L	90(RMB)	White	White	4.5		9/29/2006
China	C-32	6	1L	90(RMB)	Yellow : 2940-2	Yellow	4.5		8/16/2006
China	C-33	6	1L	90(RMB)	Green : 4500-1	Green	4.5		9/29/2006
China	C-34	6	1L	90(RMB)	Blue : 6740-2	Blue	4.5		9/29/2006
China	C-35	6	1L	90(RMB)	Red : 1500-1	Red	36.4		9/29/2006
China	C-41	7	1L	45(RMB)	White:1692	White	71		7/25/2006
China	C-42	7	1L	45(RMB)	Yellow:1631	Yellow	16.2		7/25/2006
China	C-70a	8	200mL	18	Red	Red	4.5	12/28/2006	11/26/2006
China	C-71a	8	200mL	18	Yellow	Yellow	4.5	12/28/2006	10/13/2006
China	C-72a	8	200mL	18	Black	Black	4.5	12/28/2006	4/3/2006
China	C-73	1	900mL	33	Yellow	Yellow	10.4	1/2/2007	10/18/2006
China	C-74	5	800mL	20	Black	Black	36	1/2/2007	12/12/2006
China	C-75	7	460mL	35	White	White	72	1/2/2007	10/19/2006
China	C-76	7	1000mL	70	Red	Red	4.5	1/2/2007	8/2/2006
China	C-77	7	460mL	35	White	White	4.5	1/2/2007	10/19/2006
China	C-78	9	400mL	80	White	White	20.6	1/2/2007	8/11/2006
China	C-83	10	0.93L	110RMD	White	White	21.1		
China	C-84	1	0.9L	75RMD	Venice green	Green	4.5		
China	C-85	1	0.9L	75RMD	Blue	Blue	4.5		
China	C-87	1	1L	75RMD	Golden yellow	Yellow	4.5		
China	C-88	11	0.8L	28RMD	Golden yellow	Yellow	20.6		
China	C-90	12		30RMD	Golden yellow	Yellow	25.5		
China	C-91	13	0.6kg	20RMD	Ocean Blue	Blue	4.5		

China	C-93	13	0.6kg	20RMD	Red	Red	143.9		
China	C-94	13	0.6kg	20RMD	White	White	4.5		
China	C-96	6	2L	345	Yellow 2-9402	Yellow	30.9		
China	C-99	14	400g	6.2RMD	Black	Black	180		
China	C-102	14	400g		White	White	5.1		
China	C-104	15	400g	6RMD	Red	Red	298		
China	C-105	15	400g	6RMD	White	White	4.5		
Ecuador	E-1	17	1L	\$4.36	Tan White (Tan Blanco)	White	52.6	10/30/2006	Lot # 390 10864; 2006/09
Ecuador	E-4	17	1L	\$4.36	Spanish blue (TJan Alul Espanol)	Blue	14.3	10/30/2006	Lot # 39005817 2006/05
Ecuador	E-6	18	946cm ³	\$1.50	White bone (Blanco Hueso)	White	22	10/30/2006	520 L:15081218
Ecuador	E-7	18	946cm ³	\$1.50	Blue (Azul)	Blue	268.9	10/30/2006	
India	8	19			White (brilliant)	White	137	1/06	
India	9	20			White (brilliant)	White	4.5	1/06	
India	10	20			Blue (oxford)	Blue	154	1/06	
India	I-48	21	500mL		Brilliant white	White	4.5	Jan 12 '07	Aug-06
India	I-49	21	500mL		Golden Brown	Brown	4.5	12-Jan-07	Oct. 2006
India	I-50	21	500mL		Sky Blue	Blue	4.5	Jan 12 07	Oct. 2006
India	I-51	21	500mL		Black	Black	23.1	Jan 12 07	Sep-06
India	I-52	21	1L		Bus Green	Green	22.5	Jan 12 07	Apr-06
India	I-57	20	50mL	15rupees	Brilliant white	White	49.5	Jan 13 07	4-Jan
India	I-65	20	500mL	86rupees	Brilliant white	White	13.1	Jan 16 07	6-Aug
India	I-66*	20	500mL	87rupees	Golden brown	Brown	200.2	Jan 16 07	6-Nov
Indonesia	B-10	40	1L	58000rupiah	Marine Blue 615	Blue	158.8	22-Jan-07	5228 5 (bottom of can) OCD2341 C822 (below bar code)
Indonesia	B-12	21	1L	59000rupiah	Fashion Yellow A365-882	Yellow	210	22-Jan-07	2000000 1 09732 C822 (below bar code)
Indonesia	B-13	22	1L	59000rupiah	Yellow	Yellow	92.3	22-Jan-07	Mixed at time of sale, Base -C/169569 (bottom of can)
Malaysia	8	21			Yellow	Yellow	4.5		
Malaysia	31	23			White	White	123.9		
Malaysia	60	25			Yellow (Golden)	Yellow	262.4	5/04	

Malaysia	61	25			Red (PO)	Red	75.6	5/04	
Malaysia	62	21			Yellow (Citrus)	Yellow	133.7	5/04	
Malaysia	63	22			Yellow	Yellow	40.4	5/04	
Malaysia	75	26			Blue (Wiva)	Blue	166.9	9/04	
Malaysia	M-80	6	1L	21RM	1145 White	White	91.3	19-Jan-07	
Malaysia	M-100	21	1L	25RM	G/F 437 Signal Red	Red	10.1	19-Jan-07	
Malaysia	M-101	22	1L	24.80RM	G 780 Signal Red	Red	4.5	19-Jan-07	
Malaysia	M-102	22	1L	23RM	G 510 Barley White	White	12.9	19-Jan-07	
Malaysia	M-103	22	1L	23RM	G 548 Wira Blue	Blue	4.5	19-Jan-07	
Malaysia	M-104	22	1L	23RM	G 718 Chocolate	Brown	10.8	19-Jan-07	
Malaysia	M-107	23	75mL	1.90RM	10847 White	White	58.1	19-Jan-07	
Malaysia	M-108	23	75mL	1.90RM	10869 Black	Black	125.1	19-Jan-07	
Malaysia	M-82	19	1L	21RM	1471 Wira Blue	Blue	61.7	19-Jan-07	
Malaysia	M-85	27	1L	13RM	9102 White	White	109.3	19-Jan-07	
Malaysia	M-87	27	1L	13RM	9103 Black	Black	33.4	19-Jan-07	
Malaysia	M-90	28	1L	21RM	1145 White	White	46.4	19-Jan-07	
Malaysia	M-92	28	1L	27RM	1129 Orange	Orange	57.6	19-Jan-07	
Malaysia	M-93	28	1L	21RM	1365 Neptune (blue)	Blue	48.7	19-Jan-07	
Malaysia	M-94	28	1L	29RM	1060 Green	Green	49.2	19-Jan-07	
Malaysia	M-95	21	1L	27RM	G/F (sp) 290 Brilliant White	White	38.6	19-Jan-07	
Malaysia	M-96	21	1L	25RM	G/F 13339 Conifer	Brown	38.2	19-Jan-07	
Malaysia	M-97	21	1L	25RM	GF 613 Regal Blue	Blue	4.5	19-Jan-07	
Malaysia	M-98	21	1L	25RM	G/F 122 Black	Black	18.1	19-Jan-07	
Malaysia	M-99	21	1L	25RM	G/F 2024 Lemon	Yellow	36.2	19-Jan-07	
Malaysia	77	21			Yellow (Citrus)	Yellow	6.3		
Malaysia	M-110	6	1L	27.00RM	Pearl White 1301	White	4.5	Oct 30 07	Mixed in store
Malaysia	M-111	6	1L	32.00RM	Emerald 1509 (green)	Green	4.5	Oct 30 07	Mixed in store
Malaysia	M-112	6	1L	32.00RM	Sunflower 1505	Yellow	4.5	Oct 30 07	Mixed in store
Malaysia	M-113	6	1L	39.00RM	Mandarin 1331 (red)	Red	4.5	Oct 30 07	Mixed in store
Malaysia	M-114	6	1L	31.00RM	Wira blue (1471)	Blue	4.5	Oct 30 07	Mixed in store
Malaysia	M-117	6	1L	25RM	Signal yellow	Yellow	22.3	Oct 30 07	Mixed in store
Malaysia	M-118	6	1L	24RM	Signal red	Red	4.5	Oct 30 07	Mixed in store
Peru	LO-10	30			Red (Rojo)	Red	34.6	4/06	
Peru	LO-4	31			White (Blanco)	White	145.3	4/06	

Seychelles	S-13	32	261	1L	Blue	Blue	261	6/06	
Seychelles	S-21	33			Teak (brown)	Brown	4.5		
Seychelles	S-23	33			Grey	Grey	4.5		
Seychelles	S-24	33			Black	Black	4.5		
Seychelles	S-26	33			Off White	White	4.5		
Seychelles	S-27	33			Mid Summer (light blue)	Blue	4.5		
Seychelles	S-28	33			LB Grey	Grey	4.5		
Seychelles	S-29	33			Terracotta	Brown	4.5		
Seychelles	S-3	32	1L	85	Blue	Blue	98.7	6/06	
Seychelles	S-8	32	1L	120	Blue	Blue	159.6	6/06	
Singapore	1	21			Yellow (slicker)	Yellow	4.5	4/03	
Singapore	2	21			Red (signal)	Red	4.5	4/03	
Singapore	3	21			White (off; jasmine)	White	4.5	4/03	
Singapore	4	21			Green (dark; GEM)	Green	4.5	4/03	
Singapore	5	21			Brown (suede)	Brown	4.5	4/03	
Singapore	6	21			Yellow (ribbon)	Yellow	9	4/03	
Singapore	7	21			Green (spruce)	Green	4.5	4/03	
Singapore	9	6			Yellow (canary)	Yellow	9.3	5/03	
Singapore	10	6			Red (vermillion)	Red	9	5/03	
Singapore	11	6			Blue (marine)	Blue	47.9	5/03	
Singapore	12	6			Green (grass)	Green	34.6	5/03	
Singapore	13	6			Yellow (mayam)	Yellow	86.8	4/03	
Singapore	14	6			Yellow (earth)	Yellow	4.5	5/03	
Singapore	16	34			Brown (golden)	Brown	84.6	5/03	
Singapore	17	34			Yellow (chrome)	Yellow	4.5	5/03	
Singapore	19	34			White	White	4.5	5/03	
Singapore	21	35			Brown (bahama)	Brown	49.5	5/03	
Singapore	24	35			Green (strong)	Green	26.3	5/03	
Singapore	SQ-30	22	1L	16.50\$SG	0570-Y10R	Yellow	96.9	20/01/07	Mixed 20/01/07
Singapore	SQ-31	34	100mL	1.50\$SG	303 Chrome Yellow	Yellow	110.1	20/01/07	n.a.
Singapore	SQ-32	6	1L	14.00\$SG	9002(PC) Canary	Yellow	63.1	20/01/07	1.11001E+12
Singapore	SQ-33	21	1L	13.20\$SG	26139 Yellow Ribbon	Yellow	66.4	20/01/07	1.12001E+12
Singapore	SQ-36	21	1.0 L	S\$14.80	Slicker 26215	Yellow	150.9	10/30/2007	0039/I6
Singapore	SQ-38	22	1.0L	S\$13.50	yellow	Yellow	17.2	10/30/2007	
Egypt	EG-1	37	0.5L	10EgPds	Royal Blue	Blue	4.5		March 6 06

Egypt	EG-2	37	0.5L	10EgPds	Brillant Green	Green	4.5		Jan 21 07
Egypt	EG-3	37	0.5L	10EgPds	Chinese Red	Red	4.5		Dec 11 06
Egypt	EG-4	37	0.5L	10EgPds	White	White	4.5		Jan 3 07
Egypt	EG-9	38	0.25L	5EgPds	White	White	4.5		Aug 17 06
Egypt	EQ-11	39	0.5L	7.5EgPds	Blue	Blue	106.5		Nov 06
Egypt	EG-14	39	0.5L	7.5EgPds	White	White	46.6		May 07
Thailand	TH-18	22	1L	\$13.85	Signal Yellow	Yellow	103.1	3/08	9/04