Metals and Phthalates in Tier 3 Children's Products

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Data for this project are available from the project manager, Callie Mathieu, 360-407-6965 (callie.mathieu@ecy.wa.gov), upon request. Ecology is currently in the process of developing a database to store product testing data, which is anticipated to be available to the public by July 2014.

Questions regarding enforcement actions taken based on this study should be directed towards Joshua Grice, 360-407-6786 (joshua.grice@ecy.wa.gov), Ecology's Children's Safe Products Act enforcement officer.

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Cover photo: Laboratory Samples for Phthalates Analysis (by Callie Mathieu).

Metals and Phthalates in Tier 3 Children's Products

by

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Abstract

In 2013, the Washington State Department of Ecology (Ecology) conducted a study to assess compliance with Washington State's Children's Safe Products Act (CSPA) legislation. Ecology purchased 226 children's toys and products from 12 Washington retailers and screened them using X-ray fluorescence (XRF). Products collected included those subject to Tier 3 reporting under the CSPA Reporting Rule: products with a target age of 3-12 years old and potential for short-term exposure to the skin.

Thirty-five samples were sent to the laboratory for analysis of metal analytes based on XRF screenings, and 40 samples were sent to the laboratory for analysis of phthalates.

Ninety-one percent (32 out of 35) of the samples selected for metals analysis contained one or more of the target analytes above the reporting limit (1 ppm). Metal concentrations ranged from below the reporting limit (< 1 ppm) to 499 ppm. Fourteen products contained a concentration of one or more metals above 100 ppm. Ecology's CSPA enforcement official reviewed these data to determine whether these manufacturers are in compliance with the reporting rule. Two samples were above (did not meet) the state criteria for cadmium (>40 ppm), and three samples were above the state criteria for lead (>90 ppm). Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission, the federal agency that enforces the Consumer Product Safety Improvement Act.

Thirty-five percent (14 out of 40) of the product samples contained one or more of the following phthalates: di-n-octyl phthalate, di-2-ethylhexyl phthalate, diisononyl phthalate, and diisodecyl phthalate. Levels of individual phthalates ranged from 19 – 190,000 ppm. Eleven of the samples exceeded 1,000 ppm of at least one of the banned phthalates. Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission.

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Introduction

Children's Safe Products Act (CSPA)

In 2008 Washington State passed the Children's Safe Products Act (CSPA) to address the risk of toxic chemicals in children's products. The law limited the amount of lead, cadmium, and phthalates permissible in children's products sold in Washington State[1] and required the Departments of Ecology (Ecology) and Health (DOH) to develop a list of chemicals of high concern for children (CHCC)[2]. Manufacturers of children's products are required to report to Ecology if their products contain a chemical from the CHCC list, under the Reporting Rule.

Implementation of the Reporting Rule was based on a phased-in schedule according to the type of product and size of manufacturer. Product types, or "tiers", are defined by intended use, exposure route, and target age (Table 1) and manufacturers are separated into size categories by annual aggregate gross sales. The Reporting Rule requires manufacturers to notify Ecology if a product or product component contains a CHCC concentration of:

- Any amount greater than practical quantitation limits (PQLs), defined by Ecology (2012), if the chemical was intentionally added to the product. *or*
- 100 ppm or higher, if the chemical is present as a contaminant.

Starting in August 2012, the largest manufacturers were required to start reporting CHCCs present in Tier 1 products. Reporting for Tier 2 products began in February 2013 and Tier 3 products started in August 2013. Tier 4 products will not be reported on, except by amendment of the Reporting Rule based on a case-by-case evaluation. Manufacturers in successively smaller categories must report CHCCs in their products following the schedule outlined in the Reporting Rule (WAC 173-334).

Table 1. Product Type by Tier as Defined in WAC 173-334.

Tier	Children's Product Type	Example
1	Products intended to be put into a child's mouth or applied to the child's body, or any mouthable product intended for children who are age 3 or under.	Teethers, pacifiers, lotions, shampoos, creams, toys for ages 3 and under
2	Products intended to be in prolonged (>1 hr) direct contact with a child's skin.	Clothes, jewelry, bedding
3	Products intended for short (<1 hr) periods of direct contact with child's skin.	Most toys for ages 3 - 12 years
4	Product components that during reasonable and foreseeable use and abuse of the product would not come into direct contact with the child's skin or mouth.	Inaccessible, internal components for all children's products

[1] These action levels are substantially pre-empted by the federal Consumer Product Safety Improvement Act.
[2] See the CHCC List at www.ecy.wa.gov/programs/swfa/cspa/chcc.html

CSPA Enforcement

Ecology began independent testing of CHCCs in Tier 1 and Tier 2 children's products in 2012 to assess compliance with the CSPA Reporting Rule (Stone, 2012a; Stone, 2012b; Grice, 2012). Tier 1 and 2 products, such as baby teething rings and children's personal care products, were analyzed for metals, phthalates, parabens, and 15 volatile organic compounds (e.g., formaldehyde, toluene). Other product testing by Ecology included assessing compliance with the ban on bisphenol A in baby bottles, sippy cups, and sports bottles (Mathieu, 2013) and evaluations of PBDEs and PBDE alternatives in consumer products (Stone, 2012c). Ecology also conducted a study to assess the usefulness of X-ray fluorescence (XRF) as a screening tool for product testing in 2011 (Furl et al., 2012).

Ecology enforces CSPA by contacting the manufacturer when a discrepancy is found between laboratory results from a product and the reported data. When it appears that a violation of the Reporting Rule has occurred, a letter is sent to the responsible party informing them of the discrepancy. The responsible party has an opportunity to explain the discrepancy before Ecology takes further action.

If Ecology finds products that exceed state standards for lead, cadmium, or phthalates, Ecology evaluates how best to ensure compliance. If Ecology determines that state standards are preempted by federal law, Ecology requests action by the Consumer Product Safety Commission (CPSC), the federal agency that enforces the Consumer Product Safety Improvement Act (CPSIA). If the standards are not preempted, Ecology examines what actions are needed under state law.

Metals and Phthalates on the CHCC List

Six metals and eight phthalates are included on the CSPA CHCC list because they met the following criteria: (1) research has shown reproductive, developmental, endocrine disrupting, or carcinogenic effects, and (2) the chemical has either been found in children's products or is documented to be present in human tissue.

The metals included in the CHCC list (antimony, arsenic, cadmium, cobalt, mercury, and molybdenum) are used in metal alloys, inks, paints, and plastics, and have been reported in children's products such as jewelry and backpacks (Strandesen and Poulsen, 2008; Svendsen et al., 2007). The presence of metals in children's products is a concern because several have reported evidence of carcinogenicity, as well as demonstrated reproductive, developmental, or neurological effects (Ecology, 2011 and references therein).

Phthalates are a group of chemicals added to plastics and polyvinyl chloride (PVC) as a softener and to personal care products to make fragrances last longer. Phthalates are not chemically bound to the product and may leach out over time during normal use of the product or after disposal. The phthalates on the CHCC list (DEP, DBP, DnHP, BBP, DEHP, DnOP, DIDP, and

DINP[3]) are excreted easily from the body, but humans are constantly exposed due to their ubiquity in consumer products. Concern over possible developmental, reproductive, and endocrine disrupting effects of these phthalates have prompted bans in children's products by several states and the CPSC.

Study Design

Ecology's Environmental Assessment Program conducted a study in 2013 to measure metals and phthalates in Tier 3 children's products. The goal of this study was to evaluate compliance with the state's CSPA Reporting Rule and restrictions on lead, cadmium, and phthalates in children's products. This is the first Ecology study to assess metals and phthalates in Tier 3 children's products; these contaminants have previously been assessed by Ecology in Tier 1 and 2 products (Stone, 2012a; Stone, 2012b; Grice, 2012).

Ecology purchased children's products from Washington State retailers, screened product components using an XRF analyzer, and sent component samples to laboratories for analysis of metals and phthalates. Target analytes included the six metals and eight phthalates on the CHCC list, as well as lead and dimethyl phthalate (DMP). Detailed information on product selection, product screening, and laboratory analysis is provided in the following sections.

Methods

Sample Collection

Ecology purchased 226 Tier 3 children's products from ten retail stores within the south Puget Sound area and two on-line retailers in March and April of 2013. Ecology targeted large "chain" retailers and stores that sell discount items. Major retailers primarily carry similar merchandise throughout their chain stores, supplied by the same distribution center, indicating that products bought in the south Puget Sound area are representative of merchandise available throughout the state (Mathieu, 2013). Two retail stores visited were stand-alone stores, not part of a chain, and thus representative of products available at that store. Items bought from the on-line retailers are considered representative of products available to anyone in the state.

Ecology selected Tier 3 products for analysis. Therefore, products that were purchased consisted of toys and products intended for children aged 3 - 12 years with the potential for short term (<1 hour) contact with a child's skin. Toys made of metal materials and hard plastic were targeted for metals analysis. Soft plastic toys (e.g., bendable figurines, vinyl textiles, and "slimy" novelty items) were collected for phthalates analysis. Existing product information, such as that reported by the Danish Environmental Protection Agency was reviewed prior to product collection (Svendsen et al., 2006; Svendsen et al., 2007; Tonning et al., 2010). Product

[3] DEP = diethyl phthalate; DBP = dibutyl phthalate; DnHP = di-n-hexyl phthalate; BBP = butyl benzyl phthalate; DEHP = di-2-ethylhexyl phthalate; DnOP = Di-n-octyl phthalate; DIDP = diisodecyl phthalate; DINP = diisononyl phthalate.

types that have been shown to contain metals and phthalates in previous studies were selected. Figure 1 shows the types of products collected organized by Global Product Classification system categories (brick category).

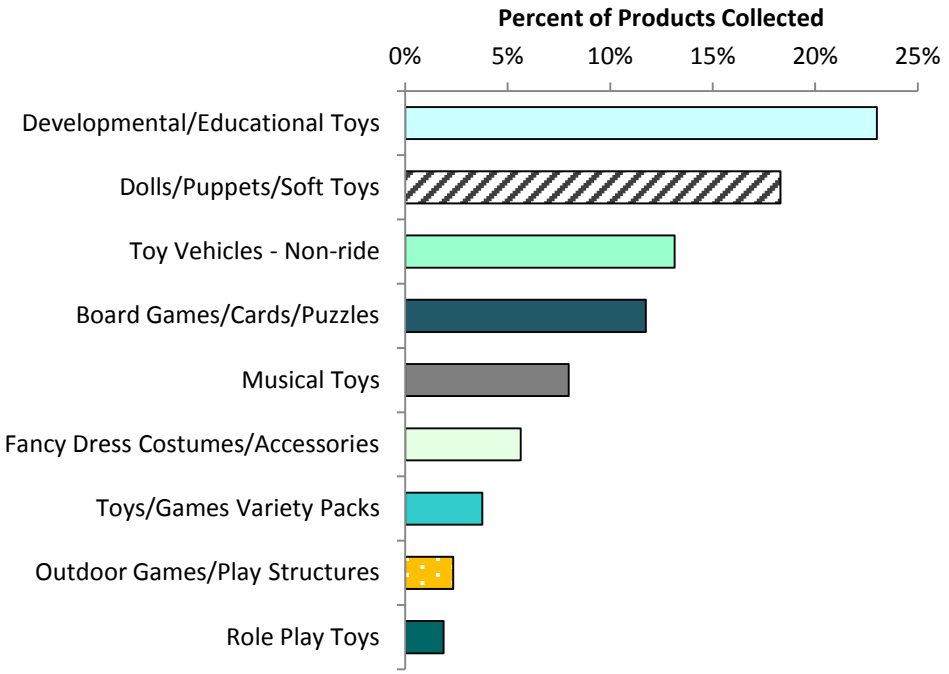

Figure 1. Product Types Purchased for This Study.

Only categories making up more than 1% of the total are included in graph.

Sample Processing and Screening

Products were processed and screened according to the protocols described in the Quality Assurance Project Plan (Mathieu and Bookter, 2013). After purchase, products were taken to Ecology Headquarters, removed from their packaging, and deconstructed into separate components. Components are defined as individual pieces or parts of the product containing different colors, functions, and/or material. Only accessible product components were selected for laboratory testing. Internal components were excluded from laboratory testing as they fall under Tier 4 reporting rules.

After deconstruction, isolated product components were screened individually for metal analytes using a Niton XL3t XRF analyzer. X-ray fluorescence is a quick, non-destructive method for obtaining the elemental composition of products. A previous Ecology study found XRF technology to be a useful screening tool for product testing, with the requirement that the product component is isolated from the rest of the product and placed in a stand for measurement (Furl et al., 2012).

Components were placed inside a bench-top stand and measured by XRF in 120 second intervals for the seven metal analytes. Screening protocols followed manufacturer's recommendations and a modification of ASTM Method F 2617-08 *Standard Test Method for Identification and Quantification of Chromium, Bromine, Cadmium, Mercury, and Lead in Polymeric Material Using Energy Dispersive X-ray Spectrometry* (ASTM, 2008). XRF measurements were used solely as a screening tool and, therefore, are not included in this report.

Selection for Laboratory Analysis

XRF screening levels were outlined in the project plan to provide a basis for selection of samples to be sent for laboratory metals analysis. A total of 918 components were screened for the seven metal analytes using the XRF analyzer. Table 2 shows the number of component measurements that were above XRF screening levels. Of the 918 components, 245 contained an XRF-measured concentration of one or more of the metal analytes above defined screening levels.

Samples with the highest XRF readings across the range of metals were chosen for laboratory analysis because of the large number of components exceeding the screening levels.

Several samples were sent to the laboratory for "low level analysis" (i.e., where the XRF reading was below the limit of detection (LOD)). None of the laboratory results were above the XRF LOD for these samples, which would have indicated a "false negative" problem with the screening tool.

Table 2. XRF Screening Levels and Laboratory Selection Results.

Analyte	Sb	As	Cd	Co	Pb	Hg	Mo
XRF Screening Level (ppm)	50	50	20	50	45	NL	50
XRF Measurements above Screening Level (#)	27	11	9	112	44	22*	20
Samples sent to lab based on XRF reading (#)	5	3	2	12	7	3	3

*Number of measurements greater than limit of detection.
NL = no level established.

Products were selected for laboratory analysis of phthalates based on their apparent potential to contain phthalates. This included (1) information on the label, (2) the type of plastic used (e.g., soft flexible plastics and "slimy" materials), and (3) other types of information, such as existing data from other agencies and groups.

Laboratory Procedures

Cryomilling

All samples selected for laboratory analysis were sent to ALS Laboratories for cryomilling prior to analysis. Thirty-four samples were successfully cryomilled. Cryomilling was not possible on samples that were of very soft plastic material (e.g., "slimy" material). These materials did not harden when frozen, so could not be milled. Samples consisting of metal matrices could also not be cryomilled as they would damage the cryomilling vessel. Metal products that were too thick to be reduced in size by snips were drilled with a titanium bit and the shavings were captured for analysis.

Samples that could be cryomilled were done so following ALS Standard Operating Procedure EXT-GRIND. Samples were made brittle using cryogenic temperatures and then milled in an enclosed capsule by magnetically shaking the capsule back and forth. After cryomilling, samples consisted of homogenous fine particles (>5 microns).

ALS Laboratories decontaminated all cryomill equipment between each sample by washing with detergent and rinsing with deionized water. A methanol rinse blank was collected after each sample; one rinse blank per 20 samples was analyzed for metals and phthalates.

Metals Analysis

Ecology's Manchester Environmental Laboratory (MEL) prepared samples for metal analyses using EPA Method 3052. All samples went into solution, indicating complete digestion was achieved.

Antimony, arsenic, cadmium, cobalt, lead, and molybdenum were analyzed via inductively coupled plasma mass spectrometry (ICP-MS) following EPA Method 200.8. Mercury analysis was done using cold vapor atomic absorption (CVAA) following EPA Method 245.1. Cryomill rinseate samples were prepared and analyzed following EPA Method 200.8 for all metals except for mercury, which followed EPA 245.1. MEL conducted all metals analyses in July and August 2013.

Phthalates Analysis

Microwave-assisted solvent extraction following a modification of EPA Method 3546 was used to prepare samples for phthalates analysis. Extracts were analyzed using gas chromatography/ mass spectrometry (GC/MS). Phthalate identification and quantification followed EPA Method 8270D (modified). Dimethyl phthalate-D6 was used as an internal surrogate with each sample. MEL conducted the phthalate analyses during September – November 2013.

DINP and DIDP are isomeric mixtures containing 20 or more compounds with varying peaks and overlapping retention times. One peak from each was selected for quantitation. The predominant peak that did not overlap with the other isomer was chosen so as not to overestimate the concentration from overlapping DINP/DIDP areas. Selective ion monitoring (SIM) was not

used because of reduced identification capabilities. Only the unbranched mixture of DINP was analyzed and is reported in this study.

Data Quality

Cryomilling

Quality control (QC) tests for the cryomilling process consisted of analyzing one rinseate blank per 20 samples for target metals and phthalates to assess potential contamination introduced by the cryomill vessel. Cryomill rinseate blank data are provided in Appendix B.

No target metal analyte was detected above reporting limits in the rinseate samples, with the exception of lead. Both blank samples contained trace amounts of lead (ppb levels). The levels of lead found in product samples were more than 10 times greater than the rinseate blank amounts. Several target phthalate analytes were detected in the rinseate blanks, but also at trace (ppb) levels. All detected compounds in the product samples were greater than 10 times the levels quantified in the cryomill rinseate blanks. No qualifications were added to sample data based on the cryomill rinseate blank results, in accordance with EPA national functional guidelines for organic data review (EPA, 1999).

Metals

MEL performed the following QC tests in association with metals analyses: method blanks, laboratory control samples (LCS), laboratory replicates, matrix spikes (MS), and MS duplicates. All QC data were within measurement quality objectives (MQOs), with the exception of one MS recovery for cobalt. This MS recovery was greater than upper acceptance limits due to problems with the matrix (potential high bias). However, the source sample was not detected above reporting limits, and no action was taken. See Appendix A for full QC data and MQOs. Written case narratives describing the methods used and an assessment of QC and quality assurance (QA) tests are available upon request.

Instruments were calibrated with NIST traceable standards and were verified to be in calibration with a second source standard. Instrument calibration (initial and continuing) verification checks and standard residuals were within acceptance limits.

Two samples for antimony and six samples for cadmium had to be diluted due to matrix interference. The reporting limits were raised from 1 ppm to 5 ppm. None of the samples were detected above the reporting limit.

Phthalates

Laboratory QC tests for phthalates analysis included LCS, MS, MS duplicates, laboratory duplicates, and method blanks. Samples were analyzed in four batches: cryomilled samples,

non-cryomilled samples, sample #37, and sample #71. Sample #37 was analyzed separately because the extract container broke and the sample had to be re-extracted. Sample #71 was analyzed in its own batch because QC policy limits batches to 20 samples.

All samples were diluted 10 times before analysis due to high levels of hydrocarbons inherent in the samples, thus raising reporting limits accordingly. Eleven samples did not have this interference and were concentrated and re-analyzed to achieve lower reporting limits. The reanalysis took place after extract holding times and all associated samples were qualified J or UJ, as estimates. All other analyses were completed within holding times. Case narratives describing the laboratory analysis and QA/QC tests in detail are available upon request.

Laboratory QA

Issues with initial instrument calibrations, back calculations, and continuing calibration verifications resulted in the majority of samples being qualified J or UJ as estimates for DnHP, BBP, DEHP, and DINP. Instrument tuning using decafluorotriphenylphosphine (DFTPP) was within acceptance limits for all batches.

The DIDP spectra for samples #1306041-40 and #1306041-71 did not match reference spectra, and results were rejected for DIDP in these samples.

Laboratory Control Samples

LCS recoveries were within MQOs, with the exception of DIDP, for all batches. High recoveries of DIDP were due to an interfering peak native to the spike mix. LCS duplicate recoveries were high for the non-cryomilled samples batch, resulting in relative percent differences (RPDs) greater than 40%. Affected samples were qualified as estimates.

Matrix Spikes

MS and MS duplicates were generally within MQOs. The following exceptions resulted in qualifications of the data:

- DIDP was not recovered in the MS or MS duplicates for the non-cryomilled batch or sample #37 due to matrix interferences. Associated sample results for the source sample were rejected.
- DINP was not recovered in samples #37 and #71, resulting in rejection of the source sample DINP data.

High recoveries of DIDP occurred due to the interfering peak in the spike mix. DIDP was not detected in the associated samples, and no qualifications were made. MS and MS duplicate recoveries could not be calculated for DnOP in sample #71 MS due to the high native amount in the source sample.

Laboratory Duplicates

All laboratory duplicate relative percent differences (RPDs) were within acceptance limits except for DnOP in sample #1306041-71. The source sample was qualified J as an estimate.

Method Blanks

No method blanks contained target phthalate concentrations above the reporting limit.

Results

Metals

Thirty-five product samples were analyzed by the laboratory for seven metal analytes. A statistical summary of laboratory results is displayed in Table 3. Complete analytical results are presented in Appendix A.

Ninety-one percent (32 out of 35) of the samples contained one or more of the target metals. Concentrations ranged from below detection limits (< 1 ppm) to 499 ppm. Antimony, arsenic, cobalt, lead, and molybdenum were detected above the reporting limit (1 ppm) in the majority of samples selected for laboratory testing. Less than a quarter of the samples were found to contain cadmium (17%), and no samples had mercury levels above 1 ppm.

Table 3. Statistical Summary of Detected Laboratory Results for Analysis of Metals.

Analyte	n	# > RL	% > RL	Min (ppm)*	Max (ppm)*	Mean (ppm)*	Median (ppm)
Antimony	35	22	63%	1	239	44	4.75
Arsenic	35	27	77%	1	122	43	20.10
Cadmium	35	6	17%	2	494	92	1 U
Cobalt	35	19	54%	2	177	46	1.82
Lead	35	20	57%	1	432	49	1.33
Mercury	35	0	0%	---	---	---	1 U
Molybdenum	35	27	77%	1	499	40	6.35

*Non-detects excluded from min, max, and mean calculations.
RL = Reporting Limit.

Fourteen products contained a concentration of at least one of the metals above 100 ppm (the threshold for reporting to Ecology if a contaminant is present). Of the 14, three were particularly high, measuring 432, 494, and 499 ppb of lead, cadmium, and molybdenum, respectively. The

product high in lead was a silver-colored metal toy badge. The high level of cadmium was measured in a blue painted metal toy car and the high molybdenum concentration was present in a purple modeling clay.

Figure 2 displays the metals data grouped by product material type. All metal toy samples that were tested, except for one, contained arsenic. Five of these samples were above 100 ppm, with different colored paint coatings on each (green, orange, black, and grey/silver). Cobalt was also frequently detected in metal toys but exceeded 100 ppm in only one product, a silver metal toy pot. Molybdenum was present in all but two metal toys in small amounts. No pattern emerged linking the color of the coating material and metal detected. Antimony was most commonly detected in plastic toys and present above 100 ppm in three products – all of which were white, red, or black hard plastic toys.

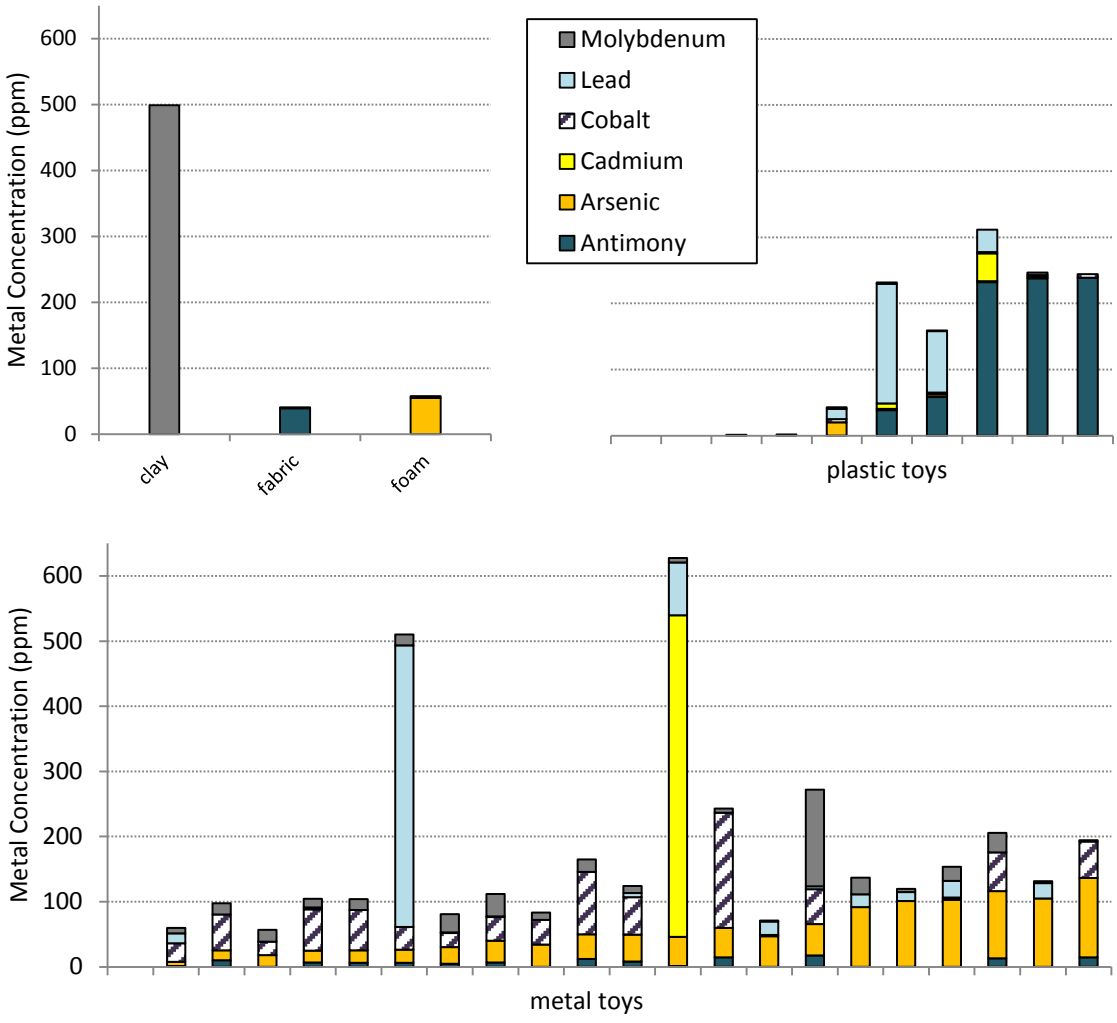

Figure 2. Total Metal Concentrations in Products Grouped by Type of Material.

Metals Compliance

Fourteen out of 35 products (40%) contained a concentration of at least one of the metal analytes above 100 ppm. Ecology's CSPA enforcement official reviewed these data to determine whether the manufacturers were in compliance with the reporting rule.

Two samples were above the state criteria for cadmium (40 ppm), and three samples exceeded the state threshold for lead (90 ppm). Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission, the federal agency that enforces the CPSIA.

Phthalates

Forty samples were analyzed for each of the nine phthalates listed in Table 4. A statistical summary of the detected phthalates and number of detections is presented in Table 4. Complete laboratory results are included in Appendix A.

Table 4. Statistical Summary of Detected Laboratory Results for Analysis of Phthalates.

Analyte	n	# > RL	% > RL	Min (ppm)*	Max (ppm)*	Mean (ppm)*	Median (ppm)
DEHP	40	4	10%	240	16,000	6,310	45.5 U
BBP	40	0	0%	---	---	---	44.5 U
DEP	40	0	0%	---	---	---	44.5 U
DnHP	40	0	0%	---	---	---	89 U
DIDP	40	1	3%	25,000	25,000	25,000	225 U
DINP	40	2	5%	63,000	190,000	126,500	93 U
DMP	40	0	0%	---	---	---	44.5 U
DBP	40	1	3%	210	210	210	44.5 U
DnOP	40	13	33%	19	42,000	20,939	390

RL = Reporting Limit; * Non-detects excluded from min, max, and mean calculations.
DEHP = di-2-ethylhexyl phthalate; BBP = butyl benzyl phthalate; DEP = diethyl phthalate; DnHP = di-n-hexyl phthalate; DIDP = diisodecyl phthalate; DINP = diisononyl phthalate; DMP = dimethyl phthalate; DBP = dibutyl phthalate; DnOP = Di-n-octyl phthalate.

Target phthalates were detected in 14 of the 40 samples, at concentrations ranging from 19 ppm (0.0019%) to 190,000 ppm (19%). DnOP was the phthalate detected most frequently, in 13 samples. Four samples contained DEHP above the reporting limit. DINP, DIDP, and DBP were detected infrequently (1-2 samples).

The relatively low molecular weight phthalates BBP, DEP, DnHP, and DMP were not detected in any of the samples above the reporting limit. Lighter phthalates, such as DEP, are primarily used in perfumes and personal care products as fragrance stabilizers (Guo and Kannan, 2013).

DINP was reported at the highest levels in the samples (6.3% - 19%), followed by DnOP. DnOP ranged from 0.5 - 4.2% in 10 of the samples and three samples had much lower levels (0.0019% - 0.0054%). The presence of DnOP at these low levels indicates that its presence is likely due to a chemical impurity or residual contamination from the product packaging.

Most of the products containing the target phthalates were in one of two categories: bendable figurines and vinyl textiles (Figure 3). Only two out of nineteen toys tested that were made of soft plastic contained substantial phthalate concentrations. Several products were analyzed that consisted of "slimy" or "sticky" material; none of these samples contained phthalates above the reporting limit. However, complications in laboratory analysis of these samples may have hindered identification of target analytes. These samples could not be cryomilled and contained high levels of hydrocarbons making the isolation of individual phthalate peaks difficult.

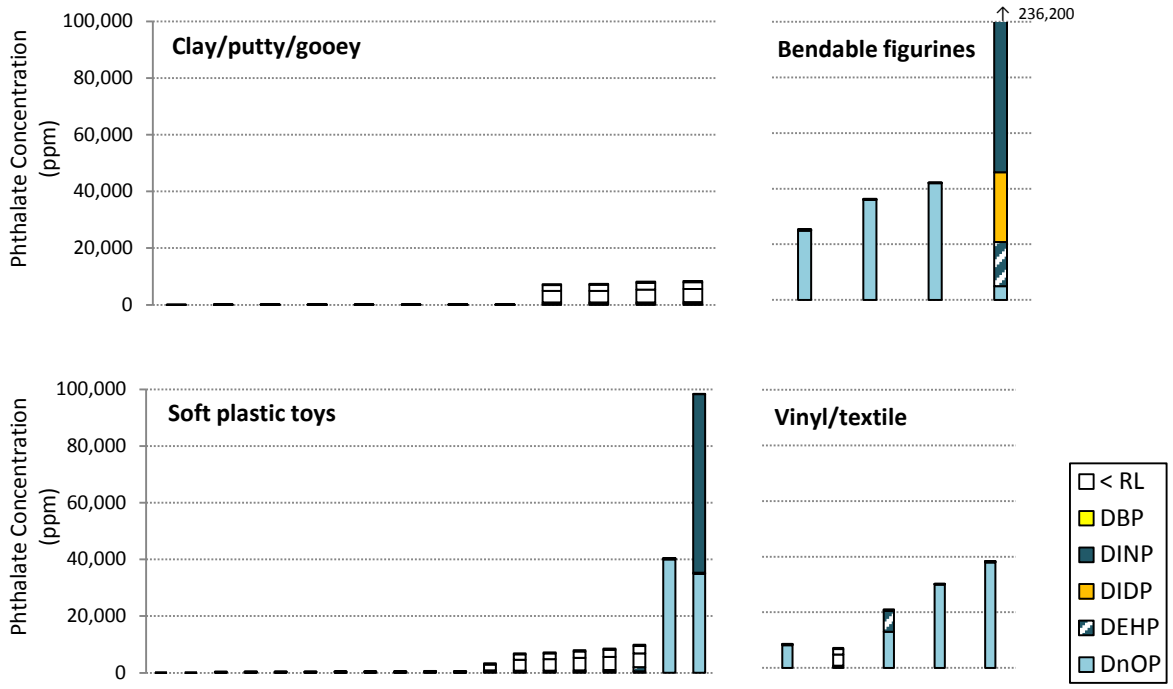

Figure 3. Total Phthalate Concentrations in Products Grouped by Type of Material.

DnOP was the single phthalate detected in most of the samples. Only one sample had multiple phthalates detected. A bendable plastic figurine that came encased in a putty-like medium totaled 23.6% of DEHP, DIDP, DINP, and DnOP. Another sample, a vinyl pencil case, contained DEHP and DnOP at 0.75% and 1.3%, respectively, with trace amounts of DBP. This product was also analyzed for metals and contained 181 ppm of lead. A soft plastic swim toy consisted of DINP (at 6.3%) and DnOP (3.5%).

The laboratory tentatively identified alternative plasticizers in five of the products. Evidence of citrate, adipate, and cycloaliphatic-based alternative plasticizers was found, though the lab did not quantify or confirm these compounds. Citrate and cycloaliphatic alternatives appeared to act as replacement plasticizers in two samples, while three of the samples contained DnOP as well as the alternative plasticizers.

Phthalates Compliance

Washington's CSPA law requires all children's products for sale in the state not to exceed 1,000 ppm total of any of six phthalates (DEHP, DBP, BBP, DINP, DIDP, and DnOP). The Washington law is substantially preempted by federal law which prohibits the sale of a child's toy or child-care article[4] containing DEHP, DBP, or BBP, or a mouthable child's toy or child care article that contains DINP, DIDP, and/or DnOP, in any amount greater than 1,000 ppm each.

Eleven out of 40 products (28%) contained phthalates above 1,000 ppm. Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission.

Three samples were below the 1,000 ppm action limit of the state or federal ban, but may be subject to the CSPA Reporting Rule. Ecology's CSPA enforcement official reviewed these data to determine whether these manufacturers are in compliance with the reporting rule.

[4] "child-care article" refers to a product that is designed to facilitate sleeping, feeding, sucking, or teething for a child who is 3 years old or younger.

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Summary

Ecology's Environmental Assessment Program conducted a study in 2013 to assess compliance with Washington State's Children's Safe Products Act (CSPA) legislation. Ecology purchased 226 children's toys from 12 retailers and screened the product components for metals with an XRF analyzer. Thirty-five samples were selected for laboratory analysis of metal analytes, and 40 samples were sent to the laboratory for analysis of phthalates.

Results of this 2013 study support the following conclusions:

- Ninety-one percent (32 out of 35) of the samples selected for metals analysis contained one or more of the target metal analytes. Concentrations ranged from below the reporting limit (< 1 ppm) to 499 ppm. Antimony, arsenic, cobalt, lead, and molybdenum were detected above the reporting limit (1 ppm) in the majority of samples selected for laboratory testing. Less than one-quarter of the samples were found to contain cadmium (17%), and no samples had mercury levels above 1 ppm.
- Fourteen products tested by the laboratory contained a concentration of one or more metals above 100 ppm. Ecology's CSPA enforcement official has reviewed these data to determine whether these manufacturers are in compliance with the reporting rule.
- Two samples were above the state criteria for cadmium (>40 ppm), and three samples were above the state level for lead (>90 ppm). Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission, the federal agency that enforces the Consumer Product Safety Improvement Act (CPSIA).
- Fourteen out of 40 product samples contained one or more of the target phthalates. Levels of individual phthalates ranged from 19 ppm (0.0019%) to 190,000 ppm (19%). Eleven samples exceeded 1,000 ppm of at least one restricted phthalate. Where appropriate, Ecology submitted these results to the Consumer Product Safety Commission.
- DnOP was the most frequently detected phthalate (13 samples), followed by DEHP (4 samples), DINP (2 samples), DIDP (1 sample), and DBP (1 sample). Phthalates were detected primarily in bendable figurines and vinyl children's products.

Recommendations

Results of this 2013 study support the following recommendations:

- Future study should include phthalates and metals in children's products made of vinyl material, such as footwear, backpacks, and pencil pouches. This study tested a limited amount of these product types, but four out of the five vinyl samples contained restricted phthalates over 1,000 ppm. One sample was tested for metals in addition to phthalates and contained lead at 181 ppm. Additional samples would support assessment of manufacturer compliance with state and federal regulations.
- Study design considerations for upcoming product testing should include a review of manufacturer-reported data prior to selection of analytes and products. An emphasis should be made on testing for chemicals that are reported in many products or present at high concentrations. Manufacturers that appear not to have reported in time with the Children's Safe Products Act (CSPA) Reporting Rule schedule should be targeted.

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Appendices

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Appendix A. Laboratory Data

Table A-1. Laboratory Metals Results.

Lab ID	Product Description	Sb (ppm)	As (ppm)	Cd (ppm)	Co (ppm)	Pb (ppm)	Hg (ppm)	Mo (ppm)
1306041-01	Green metal toy taxi	1U	**91.8**	1U	1U	**19.6**	1U	**25.3**
1306041-02	Keepsake tin	**9.86**	**15.3**	5U	**55.3**	1U	1U	**17**
1306041-03	Metal novelty toy	**17.5**	**48.3**	1U	**53.6**	**4.39**	1U	**148**
1306041-04	Watering can	**6.76**	**33.2**	4.95U	**36.3**	**1.33**	1U	**34**
1306041-05	Letter/number magnets	**1.47**	**6.15**	1U	**28.6**	**15.2**	1U	**8.51**
1306041-06	Blue metal toy SUV	**1.4**	**44.4**	**494**	1U	**80.8**	1.01U	**7.04**
1306041-07	Toy car plastic wheels	**232**	**1.34**	**42.2**	**1.82**	**33.9**	1U	1U
1306041-08	Foam sheets	1U	**55.2**	1U	1U	1U	0.996U	**2.69**
1306041-09	Modeling clay	1U	1U	1U	1U	1U	0.996U	**499**
1306041-10	Magnetic rolling toy	**238**	**2.04**	1U	1U	**2.48**	1U	**4.08**
1306041-11	Twirler toy	**8.16**	**41.3**	1U	**57.2**	**6.6**	1.01U	**10.8**
1306041-12	Plastic toy bike	1U	**20.1**	1U	**4.63**	**15.5**	0.992U	**2.68**
1306041-13	Metal toy badge	**6.23**	**20.2**	1U	**34.9**	**432**	1U	**16.6**
1306041-14	Plastic ball pawn	**1.84**	1U	1U	1U	1U	1U	1U
1306041-15	Metal toy van	1U	**47.1**	**1.6**	1U	**20.7**	1.01U	**1.75**
1306041-16	Berret clip	**14.5**	**122**	4.85U	**56**	**1.81**	1U	**115**
1306041-17	Dress-up purse	**39.6**	1U	1U	1U	**1.31**	1U	1U
1306041-18	Vinyl pencil case	**38.7**	**1.5**	**8.55**	1U	**181**	0.992U	**1.72**
1306041-19	Magnetic hitch on toy train	1U	1U	1U	1U	1U	1U	1U
1306041-20	Metal toy truck	1U	**101**	1U	1U	**13.7**	1U	**4.99**
1306041-21	Tin candy case	4.9U	**34.3**	4.9U	**37.9**	1U	1U	**11**
1306041-22	Plastic toy dog figure	**1.2**	1U	1U	1U	1U	1U	1U
1306041-23	Tin box	4.85U	**18.2**	4.85U	**20.3**	1U	1U	**18.5**

Lab ID	Product Description	Sb (ppm)	As (ppm)	Cd (ppm)	Co (ppm)	Pb (ppm)	Hg (ppm)	Mo (ppm)
1306041-24	Metal toy car	1U	**103**	**1.75**	**1.64**	**25.3**	1U	**22**
1306041-25	Green metal toy car	1U	**105**	1U	1U	**23.4**	1U	**3.11**
1306041-26	Plastic chess piece	**58.2**	**3.95**	**3.03**	1U	**92.7**	0.991U	**1.17**
1306041-27	Toy cookware pot	**14.6**	**45.1**	1U	**177**	1U	1U	**6.35**
1306041-28	Plastic magnet body	1U	1U	1U	1U	1U	1U	1U
1306041-29	Tin horn	**6.55**	**18.5**	4.95U	**63.2**	**3.04**	1U	**13.2**
1306041-30	Tin noise maker	**6.23**	**19.2**	1U	**61.8**	1U	1U	**16.5**
1306041-31	Xylophone key	**13.1**	**103**	1U	**59.5**	1U	1U	**29.8**
1306041-32	Plastic head of tin drum	**239**	1U	1U	**4.99**	1U	1U	1U
1306041-33	Metal building piece	**12.3**	**37.5**	1U	**95.7**	1U	1U	**19.1**
1306041-34	Tin crayon case	**4.75**	**25.6**	1U	**21.5**	**1.1**	1U	**28.1**
1306041-35	Glow-in-the-dark stars	1U	1U	1U	1U	1U	0.996U	1U

Bolded values indicate analyte was detected.
U = Analyte not detected at or above the reported limit.

Table A-2. Laboratory Phthalates Results.

Lab ID	Product Description	DEHP (ppm)	BBP (ppm)	DEP (ppm)	DnHP (ppm)	DIDP (ppm)	DINP (ppm)	DMP (ppm)	DBP (ppm)	DnOP (ppm)
1306041-09	Modeling clay	4 UJ	4 UJ	4 UJ	7.9 UJ	40 UJ	20 UJ	4 UJ	4 UJ	4 UJ
1306041-17	Dress-up purse	46 UJ	46 UJ	46 U	93 UJ	230 U	93 U	46 U	46 U	**8,200 J**
1306041-18	Vinyl pencil case	**7,500 J**	48 UJ	48 U	96 UJ	240 U	96 U	48 U	**210 J**	**13,000 J**
1306041-36	Yellow slime	2.5 UJ	2.5 UJ	2.5 UJ	5 UJ	25 UJ	13 UJ	2.5 UJ	2.5 UJ	2.5 UJ
1306041-37	Gooey jellyfish	4.6 UJ	4.6 U	4.6 U	9.2 UJ	REJ	REJ	4.6 U	4.6 U	4.6 UJ
1306041-38	Slimy ball	440 UJ	440 UJ	440 U	870 UJ	4,400 UJ	2,200 U	440 U	440 U	440 UJ
1306041-39	Bendable alien figure	**16,000 J**	50 UJ	50 U	100 UJ	**25,000**	**190,000 J**	50 U	50 U	**4,900 J**
1306041-40	Bendable animal figure	50 UJ	50 UJ	50 U	99 UJ	REJ	99 U	50 U	50 U	**42,000 J**
1306041-41	Soft plastic bracelet	420 UJ	420 UJ	420 U	840 UJ	REJ	2,100 U	420 U	420 U	420 UJ
1306041-42	Swimming flipper	47 UJ	47 UJ	47 U	95 UJ	240 U	95 U	47 U	47 U	**38,000 J**
1306041-43	Swim dive toy	50 UJ	50 UJ	50 U	99 UJ	250 U	**63,000 J**	50 U	50 U	**35,000 J**
1306041-44	Gel stickers	400 UJ	400 UJ	400 U	790 UJ	4,000 UJ	2,000 U	400 U	400 U	400 UJ
1306041-45	Erasers	45 UJ	45 UJ	45 U	90 UJ	230 U	90 U	45 U	45 U	45 UJ
1306041-46	Slimy toy - egg	380 UJ	380 UJ	380 U	760 UJ	3,800 UJ	1,900 U	380 U	380 UJ	380 UJ
1306041-47	Sticky creature	410 UJ	410 UJ	410 U	820 UJ	4,100 UJ	2,000 U	410 U	410 U	410 UJ
1306041-48	Novelty teeth	46 UJ	46 UJ	46 U	93 UJ	230 U	93 U	46 U	46 U	**40,000 J**
1306041-49	Black slime	3.8 UJ	3.8 UJ	3.8 UJ	7.5 UJ	38 UJ	19 UJ	3.8 UJ	3.8 UJ	3.8 UJ
1306041-50	Glow in the dark putty	4 UJ	4 UJ	4 U	8 UJ	40 UJ	20 UJ	4 UJ	4 UJ	4 UJ
1306041-51	Sticky eyeball	470 UJ	470 UJ	470 U	930 UJ	4,700 UJ	2,300 U	470 U	470 U	470 UJ
1306041-52	Plastic popper	4.5 UJ	4.5 UJ	4.5 UJ	4.5 UJ	4.5 UJ	4.5 UJ	4.5 UJ	4.5 UJ	**19 J**
1306041-53	Plastic "egg" shell	3.7 UJ	3.7 UJ	3.7 UJ	7.4 UJ	37 UJ	19 UJ	3.7 UJ	3.7 UJ	3.7 UJ
1306041-54	Sticky hand	450 UJ	450 UJ	450 U	900 UJ	4,500 UJ	2,300 U	450 U	450 U	450 UJ
1306041-55	Blue slime	3.8 UJ	3.8 UJ	3.8 UJ	7.6 UJ	38 UJ	19 UJ	3.8 UJ	3.8 UJ	3.8 UJ
1306041-56	Vinyl sandal straps	27 UJ	27 UJ	27 U	53 UJ	130 U	53 U	27 U	27 U	**30,000 J**
1306041-57	Soft plastic bear	34 UJ	34 UJ	34 U	69 UJ	170 U	69 U	34 U	34 U	34 UJ
1306041-58	Bath toy squirter	44 UJ	44 UJ	44 U	88 UJ	220 U	88 U	44 U	44 U	44 UJ
1306041-59	Green slimy toy	3.9 UJ	3.9 UJ	3.9 UJ	7.7 UJ	39 UJ	19 UJ	3.9 UJ	3.9 UJ	3.9 UJ

Lab ID	Product Description	DEHP (ppm)	BBP (ppm)	DEP (ppm)	DnHP (ppm)	DIDP (ppm)	DINP (ppm)	DMP (ppm)	DBP (ppm)	DnOP (ppm)
1306041-60	Soft plastic worm	470 UJ	470 UJ	470 U	950 UJ	4,700 UJ	2,400 U	470 U	470 U	470 UJ
1306041-61	Soft plastic black bug	39 UJ	39 UJ	39 U	77 UJ	190 U	77 U	39 U	39 U	39 UJ
1306041-62	Sticky bugs	410 UJ	410 UJ	410 U	830 UJ	4,100 UJ	2,100 U	410 U	410 U	410 UJ
1306041-63	Bendable figure - yellow	41 UJ	41 UJ	41 U	81 UJ	200 U	81 U	41 U	41 U	**25,000 J**
1306041-64	Red squeeze toy	**1,500 J**	490 UJ	490 U	990 UJ	4,900 UJ	2,500 U	490 U	490 U	490 UJ
1306041-65	Soft plastic dinosaur	50 UJ	50 UJ	50 U	99 UJ	250 U	99 U	50 U	50 U	**54 NJ**
1306041-66	Soft plastic truck	31 UJ	31 UJ	31 U	62 UJ	160 U	62 U	31 U	31 U	31 UJ
1306041-67	Soft plastic orb	4.7 UJ	4.7 UJ	4.7 UJ	9.4 UJ	24 UJ	9.4 UJ	4.7 UJ	4.7 UJ	4.7 UJ
1306041-68	Bath toy - duck	**240 J**	34 UJ	34 U	69 UJ	170 U	69 U	34 U	34 U	**39 NJ**
1306041-69	Flashing ball	39 UJ	39 UJ	39 U	79 UJ	200 U	79 U	39 U	39 U	39 UJ
1306041-70	Rubber duck	34 UJ	34 UJ	34 U	68 UJ	170 U	68 U	34 U	34 U	34 UJ
1306041-71	Bendable figure - green	43 UJ	43 UJ	43 U	86 UJ	REJ	220 U	43 U	43 U	**36,000 J**
1306041-72	Rubber chicken	400 UJ	400 UJ	400 U	800 UJ	4,000 UJ	2,000 U	400 U	400 U	400 UJ

Bolded values indicate analyte was detected.
U = Analyte not detected at or above the reported limit.
UJ = Analyte not detected at or above the estimated reported limit.
J = Reported result is an estimate.
NJ = The analyte was tentatively identified and reported result is an estimate.
REJ = Result was rejected.

Appendix B. Quality Assurance Data

Measurement Quality Objectives

The following measurement quality objectives (MQOs) were outlined in the Quality Assurance Project Plan:

Table B-1. Measurement Quality Objectives.

Analyte	Laboratory control samples (recovery)	Matrix Spikes (recovery)	Matrix Spike Duplicates (RPD)	Laboratory Duplicates (RPD)
Phthalates	50 - 150%	50 - 150%	≤ 40%	≤ 40%
Metals	85 - 115%	75 - 125%	≤ 20%	≤ 20%

RPD = Relative percent difference.

Cryomill Rinseate Blank Data

Table B-2. Cryomill Rinseate Metals Results.

Analyte	1306041-99 (ppb)	1306041-AB (ppb)
Antimony	0.2 U	0.2 U
Arsenic	0.1 U	0.1 U
Cadmium	0.1 U	0.1 U
Cobalt	0.1 U	0.1 U
Lead	0.41	0.3
Mercury	0.05 UJ	0.05 UJ
Molybdenum	0.1 U	0.1 U

U = Analyte not detected at or above the reported limit.
UJ = Analyte not detected at or above the estimated reported limit.

Table B-3. Cryomill Rinseate Phthalate Results.

Analyte	1306041-AM (ppb)	1306041-BE (ppb)
BBP	2.2 NJ	2.4 NJ
DBP	3.4 UJ	3.1 UJ
DEHP	2.9 NJ	5.7 J
DEP	3.4 UJ	3.1 UJ
DIDP	17 UJ	58 J
DINP	6.8 UJ	24 J
DMP	3.4 UJ	3.1 UJ
DnHP	6.8 UJ	5.3 J
DnOP	3.4 UJ	8.4 NJ

UJ = Analyte not detected at or above the estimated reported limit.
J = Reported result is an estimate.
NJ = The analyte was tentatively identified and reported result is an estimate.

Metals QC Tests

Tables B-4 through B-7 present QC data for metals analyses. Batch numbers B13G155, B13H083, and B13H084 represent product sample QC; Batch number B13H002 and B13H116 represent QC for the cryomill rinseate data.

Table B-4. Laboratory Control Samples.

Analyte	B13G155-BS1	B13H083-BS1	B13H084-BS1	B13H002-BS1/B13H116-BS1
	% recovery	% recovery	% recovery	% recovery
Antimony	104	104	105	105
Arsenic	97	102	112	100
Cadmium	100	99	105	100
Cobalt	104	108	112	102
Lead	103	105	111	102
Mercury	113	100	100	96
Molybdenum	100	98	107	100

Table B-5. Matrix Spikes and Matrix Spike Duplicates.

Analyte	B13G155-MS1	B13G155-MSD1	RPD (%)
	% Recovery	% Recovery	
Antimony	94	92	2
Arsenic	91	85	4
Cadmium	93	89	5
Cobalt	107	101	6
Lead	106	101	4
Mercury	97	105	8
Molybdenum	100	95	4

Analyte	B13H083-MS1	B13H083-MSD1	RPD (%)
	% Recovery	% Recovery	
Antimony	96	96	0.2
Arsenic	95	98	3
Cadmium	103	104	1
Cobalt	112	114	2
Lead	110	111	1
Mercury	99	99	0.2
Molybdenum	93	92	0.3

Analyte	B13H084-MS1	B13H084-MSD1	RPD (%)
	% Recovery	% Recovery	
Antimony	105	103	1
Arsenic	113	119	6
Cadmium	106	113	7
Cobalt	119	168	35
Lead	114	121	7
Mercury	100	97	2
Molybdenum	104	103	0.5

Analyte	B13H002-MS1
	% Recovery
Antimony	103
Arsenic	98
Cadmium	97
Cobalt	103
Lead	103
Molybdenum	101

Table B-6. Laboratory Duplicates.

Analyte	B13G155-DUP1	Source	RPD (%)
	mg/kg	mg/kg	
Antimony	232	232	0.09
Arsenic	1.37	1.34	3
Cadmium	41.9	42.2	0.6
Cobalt	1.81	1.82	0.4
Lead	34.6	33.9	2
Mercury	0.5 U	0.182 U	NC
Molybdenum	1 U	0.594 U	NC

Analyte	B13H083-DUP1	Source	RPD (%)
	mg/kg	mg/kg	
Antimony	14	13.1	7
Arsenic	106	103	3
Cadmium	1 U	0.115 U	NC
Cobalt	60.9	59.5	2
Lead	1 U	0.305 U	NC
Mercury	1 U	1 U	NC
Molybdenum	29.4	29.8	1

Analyte	B13H084-DUP1	Source	RPD (%)
	mg/kg	mg/kg	
Antimony	6.27	6.23	0.6
Arsenic	18.7	20.2	8
Cadmium	1 U	1 U	NC
Cobalt	32.4	34.9	7
Lead	400	432	8
Mercury	1 U	1 U	NC
Molybdenum	16.9	16.6	1

Analyte	B13H002-DUP1	Source	RPD (%)
	ug/L	ug/L	
Antimony	0.2 U	0.123 U	NC
Arsenic	0.1 U	0.1 U	NC
Cadmium	0.1 U	0.1 U	NC
Cobalt	0.08 U	0.026 U	NC
Lead	0.395	0.409	3
Mercury*	1.03	0.955	7
Molybdenum	0.08 U	0.086 U	NC

NC = not calculated

*LCS duplicate

Table B-7. Laboratory Blanks.

Analyte	B13G155-BLK1	B13H083-BLK1	B13H084-BLK1	B13H002-BLK1/ B13H116
	mg/kg	mg/kg	mg/kg	ug/L
Antimony	1 U	1 U	1 U	0.2 U
Arsenic	1 U	1 U	1 U	0.1 U
Cadmium	1 U	1 U	1 U	0.1 U
Cobalt	1 U	1 U	1 U	0.08 U
Lead	1 U	1 U	1 U	0.1 U
Mercury	0.5 U	1 U	1 U	0.05 U
Molybdenum	1 U	1 U	1 U	0.08 U

U = Analyte not detected at or above the reported limit.

Phthalates QC Tests

Tables B-8 through B-11 present QC data for phthalates analyses. Product sample QC include batch numbers B13I179 (cryomilled samples), B13I215 (non-cryomilled samples), B13I216 (Sample #71), and B13K015 (Sample #37); Batch number B13I165 represents QC for the rinseate data.

Table B-8. Laboratory Control Samples.

Analyte	B13I179-BS1	B13I179-BSD1	RPD (%)
	% Recovery	% Recovery	
BBP	110	103	1
DBP	120	116	4
DEHP	116	109	1
DEP	93	96	11
DIDP	2790	2890	11
DINP	119	118	6
DMP	92	95	11
DnHP	124	113	3
DNOP	124	126	9

Analyte	B13I215-BS1	B13I215-BSD1	RPD (%)
	% Recovery	% Recovery	
BBP	78	113	63
DBP	100	120	46
DEHP	80	117	64
DEP	96	97	30
DIDP	2820	2850	30
DINP	104	117	39
DMP	96	95	27
DnHP	78	126	74
DNOP	105	127	46

Analyte	B13I216-BS1	B13I216-BSD1	RPD (%)
	% Recovery	% Recovery	
BBP	127	109	7
DBP	128	126	7
DEHP	134	115	7
DEP	98	94	5
DIDP	2930	2850	6
DINP	123	109	3
DMP	97	92	4
DnHP	148	121	11
DNOP	143	123	6

Analyte	B13K015-BS1	B13K015-BSD1	RPD (%)
	% Recovery	% Recovery	
BBP	102	122	20
DBP	91	92	3
DEHP	87	99	15
DEP	99	105	8
DIDP	100	161	49
DINP	65	88	33
DMP	98	106	10
DnHP	100	118	19
DNOP	109	126	17

Analyte	B13I165-BS1	B13I165-BSD1	RPD (%)
	% Recovery	% Recovery	
BBP	88	92	4
DBP	95	99	4
DEHP	78	82	5
DEP	90	93	3
DIDP	108	132	20

Analyte	B13I165-BS1	B13I165-BSD1	RPD (%)
	% Recovery	% Recovery	
DINP	69	76	10
DMP	91	91	0.06
DnHP	89	92	4
DNOP	91	101	11

Table B-9. Matrix Spikes and Matrix Spike Duplicates.

Analyte	B13I179-MS1	B13I179-MSD1	RPD (%)
	% Recovery	% Recovery	
BBP	91	119	13
DBP	134	142	7
DEHP	100	140	20
DEP	119	103	28
DIDP	8490	3100	103
DINP	103	95	22
DMP	121	97	35
DnHP	96	138	23
DNOP	110	142	12

Analyte	B13I215-MS1	B13I215-MSD1	RPD (%)
	% Recovery	% Recovery	
BBP	93	123	27
DBP	204	219	6
DEHP	84	110	26
DEP	130	139	5
DIDP	0	0	NC
DINP	55	51	8
DMP	112	121	7
DnHP	110	150	30
DNOP	100	127	23

Analyte	B13I216-MS1	B13I216-MSD1	RPD (%)
	% Recovery	% Recovery	
BBP	91	98	7
DBP	132	140	7
DEHP	95	101	7
DEP	111	108	2
DIDP	8160	7610	6
DINP	0	0	NC
DMP	110	111	1
DnHP	97	110	13
DNOP	0	0	9

Analyte	B13K015-MS1	B13K015-MSD1	RPD (%)
	% Recovery	% Recovery	
BBP	87	96	4
DBP	87	90	11
DEHP	32	45	18
DEP	106	108	12
DIDP	0	0	NC
DINP	0	0	NC
DMP	114	115	14
DnHP	42	51	7
DNOP	8	28	98

NC = not calculated

Table B-10. Laboratory Blanks.

Analyte	B13I179-BLK1	B13I215-BLK1	B13I216-BLK1	B13K015-BLK1	B13I165-BLK1
	mg/kg	mg/kg	mg/kg	mg/kg	ug/L
DEHP	4.5 UJ	4.4 UJ	4.7 UJ	4.7 UJ	2.5 U
BBP	4.5 UJ	4.4 UJ	4.7 UJ	4.7 U	2.5 U
DEP	4.5 UJ	4.4 UJ	4.7 UJ	4.7 U	2.5 U
DnHP	9 UJ	8.8 UJ	9.4 UJ	9.4 UJ	5 U
DIDP	23 UJ	44 UJ	47 UJ	47 UJ	12 UJ
DINP	9 UJ	22 UJ	24 UJ	9.4 U	5 U
DMP	4.5 UJ	4.4 UJ	4.7 UJ	4.7 U	2.5 U
DBP	4.5 UJ	4.4 U	4.7 UJ	4.7 U	**0.79 J**
DNOP	4.5 UJ	4.4 UJ	4.7 UJ	4.7 U	2.5 U

U = Analyte not detected at or above the reported limit. UJ = Analyte not detected at or above the estimated reported limit. J = Reported result is an estimate.

Table B-11. Laboratory Duplicates.

Analyte	B13K015-DUP1 (ppm)		1306041-37 (source) (ppm)		RPD
DEHP	32	UJ	4.6	UJ	NC
BBP	32	U	4.6	U	NC
DEP	32	U	4.6	U	NC
DnHP	64	UJ	9.2	UJ	NC
DIDP		REJ		REJ	NC
DINP		REJ		REJ	NC
DMP	32	U	4.6	U	NC
DBP	32	U	4.6	U	NC
DNOP	32	UJ	4.6	UJ	NC

Analyte	B13I179-DUP1 (ppm)		1306041-52 (ppm)		RPD
DEHP	4.8	UJ	4.5	UJ	NC
BBP	4.8	UJ	4.5	UJ	NC
DEP	4.8	UJ	4.5	UJ	NC
DnHP	9.7	UJ	4.5	UJ	NC
DIDP	24	UJ	4.5	UJ	NC
DINP	9.7	UJ	4.5	UJ	NC
DMP	4.8	UJ	4.5	UJ	NC
DBP	4.8	UJ	4.5	UJ	NC
DNOP	23	J	19	J	16

Table B-11 (cont.)

Analyte	B13I216-DUP1 (ppm)		1306041-71 (ppm)		RPD
DEHP	47	UJ	43	UJ	NC
BBP	47	UJ	43	UJ	NC
DEP	47	U	43	U	NC
DnHP	94	UJ	86	UJ	NC
DIDP	2500	NJ	3400	NJ	29
DINP	230	U	220	U	NC
DMP	47	U	43	U	NC
DBP	47	U	43	U	NC
DNOP	75000	J	36000	J	70

Analyte	B13I215-DUP1 (ppm)		1306041-72 (ppm)		RPD
DEHP	41	UJ	400	UJ	NC
BBP	41	UJ	400	UJ	NC
DEP	41	U	400	U	NC
DnHP	82	UJ	800	UJ	NC
DIDP	410	UJ	4000	UJ	NC
DINP	210	U	2000	U	NC
DMP	41	U	400	U	NC
DBP	41	UJ	400	U	NC
DNOP	41	UJ	400	UJ	NC

U = Analyte not detected at or above the reported limit.
UJ = Analyte not detected at or above the estimated reported limit.
J = Reported result is an estimate.
NC = not calculated.
NJ = The analyte was tentatively identified and reported result is an estimate.
REJ = Result was rejected.

Appendix C. Acronyms and Abbreviations

Acronyms and Abbreviations

BBP	Benzyl butyl phthalate
CHCC	Chemicals of high concern for children
CPSIA	Consumer Product Safety Improvement Act
CSPA	Children's Safe Products Act
DBP	Dibutyl phthalate
DEHP	Di-2-ethylhexyl phthalate; bis(2-ethylhexyl) phthalate
DEP	Diethyl phthalate
DIDP	Diisodecyl phthalate
DINP	Diisononyl phthalate
DMP	Dimethyl phthalate
DnHP	Di-n-hexyl phthalate
DNOP	Di-n-octyl phthalate
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
MEL	Manchester Environmental Laboratory
RPD	Relative percent difference
SOP	Standard operating procedures
WAC	Washington Administrative Code
XRF	X-ray fluorescence

Units of Measurement

mg/Kg	milligrams per kilogram (parts per million)
ppb	parts per billion
ppm	parts per million
ug/L	micrograms per liter (parts per billion)