Cadmium and Other Metals in Children's Jewelry 2018, Follow-up Study

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Abstract

The Washington State Department of Ecology (Ecology) frequently tests children's products in support of the Children's Safe Products Act (CSPA), Chapter 70.240 RCW. The CSPA restricts the use of cadmium and lead in children's products to levels below 40 parts per million (ppm) and 90 ppm, respectively. Manufacturers are required to report the presence of chemicals of high concern to children (CHCCs) in children's products. Ecology conducts follow-up studies to assess continued compliance.

In 2015, Ecology evaluated cadmium, lead, and five other toxic metals (antimony, arsenic, cobalt, mercury, molybdenum) in children's jewelry. All jewelry tested in that study contained at least one of the targeted metals. Typically, the highest levels of toxic metals were found in children's jewelry sold as an accessory with an article of children's clothing. Four necklaces sold with children's apparel were identified with extremely high levels of cadmium, a suspected carcinogen. Lead, known particularly for neurotoxic effects on children, was detected in 97% of the samples submitted to the laboratory.

In 2018, Ecology conducted a follow-up study to assess compliance for specific jewelry identified in the 2015 study. The quality assurance project plan (QAPP) outlined additional criteria for selecting products when prioritized jewelry was not available. This included assessing jewelry from the same manufacturer (and same brand when available). Products prioritized for collection included jewelry variety packs, earrings, bracelets, necklaces, jewelry sold with apparel, and a watch.

A total of 38 samples from 33 products were tested. Eleven samples contained cadmium above the 40 ppm restriction limit, and seven samples contained lead above the 90 ppm restriction limit. All study results were submitted to Ecology's CSPA compliance lead for further assessment.

Publication Information

This report is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/SummaryPages/2303004.html.

Data for this project are available in Ecology's Product Testing Database at:
https://apps.ecology.wa.gov/ptdbreporting/
Study: *Cadmium and Other Metals in Children's Jewelry 2018 – Follow-up Study*

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Background

Ecology frequently conducts product studies to confirm compliance with Washington State's Children's Safe Products Act (CSPA), Chapter 70.240 Revised Code of Washington (RCW). CSPA restricts the use of cadmium and lead in children's products to levels below 40 parts per million (ppm) and 90 ppm, respectively. Manufacturers are required to report the presence of chemicals of high concern to children (CHCCs) in children's products (Chapter 173-334 Washington Administrative Code (WAC)).

In 2015, Ecology conducted a study to evaluate the presence of cadmium, lead, and five other toxic metals (antimony, arsenic, cobalt, mercury, molybdenum) in children's jewelry (Sekerak, 2016). Children's jewelry is defined as products designed and intended as an ornament primarily worn by children 12 years or younger. The jewelry considered for this study includes jewelry (1) labeled for children, (2) marketed for children (e.g., lower product placement on display shelves, consisting of bright colors, and/or incorporated designs attractive to children), or (3) sold with children's apparel.

A broad range of jewelry product types were targeted for collection. These included anklets, arm cuffs, bracelets, brooches, chains, crowns, cuff links, decorated hair accessories, earrings, necklaces, pins, rings, and body piercing jewelry, or any bead, chain, link, pendant, or other component of such an ornament.

Findings from the 2015 study showed that necklaces sold along with children's dresses contained high percent levels of cadmium, ranging from 39.7% to 98.4%. Lead, known particularly for neurotoxic effects on children, was detected in 97% of the samples. The highest concentration of lead, at 5%, was also found in a necklace component sold with a child's dress. In all, 13 of the 38 children's jewelry items (34%) tested contained a concentration of at least one of the target metals above 100 ppm (the threshold for reporting to Ecology if a contaminant is present).

Methods

Product Collection

The project plan for this 2018 follow-up study is *Addendum to Quality Assurance Project Plan: Product Testing Program, Version 1.0 – Product Testing Follow-up Study 2018-2019* (Sekerak, 2018).

In October, November, and December of 2018, Ecology purchased 78 children's products from 17 retailers: 11 south Puget Sound retail stores and six online retailers. As in the 2015 study, the products purchased encompassed a broad a range children's jewelry, including a watch, jewelry variety packs, earrings, bracelets, necklaces, and jewelry with apparel. The jewelry includes a variety of charms and pendants which adorn bracelets and necklaces.

Table 1 displays the types and number of children's jewelry products purchased for this study.

Table 1. Types and Number of Purchased Children's Jewelry Products, 2018.

Product Type	Number of Products
Apparel with Jewelry	38
Necklaces	16
Bracelets	13
Earrings	7
Jewelry Variety Packs	6
Watches	1
Total	**78**

Sample Processing

The 78 products were separated into 555 individual components. A total of 38 component samples from 33 of the 78 products were sent to Ecology's Manchester Environmental Laboratory (MEL analysis. Component samples for metals analysis were prioritized using X-Ray fluorescence (XRF) then submitted to MEL for analysis of antimony, arsenic, cobalt, mercury, cadmium, and lead. The highest priority was for component samples with screening data indicating the presence of lead or cadmium. Following the QAPP addendum (Sekerak, 2018), the follow-up component sample that produced the original study violation would be submitted for lab testing.

Ecology headquarter staff sent component samples from 38 products to MEL for testing:

- None of the components sent were follow-up samples because no products were purchased with the exact same Universal Product Code (UPC) as the 2015 study. Although, comparable component samples were sent from similar products as supported by XRF screening results.
- Five products had multiple components, such as (1) an earring set with different decorations and backings and (2) a bracelet with its metal bracelet chain and a metal back of rhinestone decorations.
- Two glass component samples were not selected for metals analysis based on elevated XRF screening results for lead. These samples were not analyzed as indicated in the Laboratory Procedures section below. The samples are identified in the chain of custody discussion.
- Two composite samples contained two components combined prior to being sent to the lab. The composite approach was used to reach the required sample weight for testing. Components combined as a composite sample appeared to be similar in composition. For example, the original silver-colored microphone decoration (CP-7-2-9) from an earring set was composited with a silver-colored star earring decoration (CP-7-2-17) from the same set. The other component sample was from a necklace, as part of a lace top with leggings. From the necklace, the back of a silver-colored design pendant (JC-8-7-7) was composited with the front (JC-8-7-6) of the pendant.
- Thirty-two of the 38 component samples were a metals matrix. Four of the component samples were a plastic matrix. Two component samples were a fabric matrix.

Chain of custody was maintained throughout the product collection, sample processing, and transfer of samples to MEL for analysis. MEL's courier transported one cooler of 40 samples from Ecology headquarters to MEL on April 1, 2019. A second cooler of one sample was transported to MEL on April 3, 2019.

The one fabric sample (1903043-41) was a replacement for the plastic sample 1903043-08. Both samples were from a Word Wear Personalized Jewelry Set (AM-30-6). The source code for sample 1903043-06 was changed from plastic to glass after the project manager confirmed the glass matrix with the distributor on April 2, 2019. This glass sample along with a second glass sample (1903043-02) were eventually not tested (see laboratory procedures below for details). No replacements were identified for the glass samples that were not tested.

Finally, sample 1903043-27 had a discrepant field station identification of FM-34-4-3 on the chain of custody. The sample tags on the bottles were matched to the chain of custody paperwork upon receipt and no discrepancies were noted. The project manager confirmed the correct identification as FM-35-4-3. The chain of custody, case narrative, and electronic data deliverable (EDD) package were updated with the correct identification.

Laboratory Procedures

MEL prepared samples for metals analyses in three batches, using the microwave digestion technique following the U.S. Environmental Protection Agency (EPA) Method 3052. Analyses were performed on the inductively coupled plasma mass spectrometer (ICP-MS) following EPA Method 6020B. One of the three batches were all component samples of a metal's matrix, one was all plastic matrices, and a batch was a mixture of metals and fabrics.

Glass component samples were not digested and analyzed because MEL does not use hydrofluoric acid as part of the digestion process. Also, Ecology did not select a contract laboratory for the analysis of these two glass component samples.

MEL prepared written case narratives assessing the quality of the data, and the case narratives are available upon request. The case narrative was updated May 13, 2019, to reflect the chain of custody issues noted above.

Data Quality

Quality control (QC) requirements and measurement quality objectives (MQOs) are outlined in the QAPP addendum (Sekerak, 2018).

Acceptance criteria were met for metals analysis with the following exceptions. The Continuing Calibration Blank (CCB) and Continuing Calibration Verification (CCV) checks were outside of the acceptance limits for cadmium for the following five samples:

- Metal matrix samples – 1903043-12
- Fabric matrix sample – 1903043-20
- All plastic matrix samples – 1903043-03 (and its corresponding duplicate), 1903043-22, and 1903043-36

One of those samples (1903043-03) also had a duplicate matrix spike sample digested and analyzed. The relative percent difference (RPD) for the matrix spike duplicates of antimony were above QC limits; therefore, only the source sample antimony result was qualified as an estimate by MEL. Sample 1903043-28 (and its corresponding duplicate) also had RPDs that

exceeded QC limits for cobalt and cadmium; those results were also qualified as estimates, "J", by MEL. These samples (1903043-03 and 1903043-28) also had matrix spike recoveries that were not evaluated for antimony (1903043-03 only) and for lead (1903043-20 only). The standard spiking level was insufficient for the elevated concentrations of antimony and lead, respectively, in the source samples.

Due to dilution prior to analysis to mitigate matrix interferences, the reporting limit (RL) for 1903043-29 was raised from 1 to 9.80 ppm. Except for cadmium and mercury, all metals had detected results above the 9.80 ppm reporting limit.

The reporting limit for another sample, 1903043-30, was raised from 1 to 9.33 ppm, also due to dilution prior to analysis. For this sample, concentrations of lead, antimony, arsenic, and cobalt were detected above the 9.33 ppm reporting limit.

The reporting limit for sample 1903043-11 was raised to 2.40 ppm due to a limited amount of sample available for testing. Concentrations of lead, cadmium, and antimony were detected above 2.40 ppm.

Seven of the samples did not completely digest during sample preparation. These samples were qualified as estimates, "J". The associated qualified results may be biased low:

- Metal matrix samples – 1903043-11 and 1903043-30
- Fabric matrix sample – 1903043-20 (and matrix spikes)
- Plastic matrix samples – 1903043-01, 1903043-03, 1903043-22, and 1903043-36

Metals Results

Table 2 displays the summary statistics of laboratory results for target metals detected in component samples of children's jewelry products. Of the 38 samples tested, 37 had at least one metal above the laboratory reporting limits.

Complete lab results for this study can be downloaded from Ecology's Product Testing Database at https://apps.ecology.wa.gov/ptdbreporting/ by selecting Download Data/Study: *Cadmium and Other Metals in Children's Jewelry 2018 – Follow-up Study*.

Lead was detected in 36 of the 38 component samples. Present in 95% of the laboratory samples, lead had the highest detection frequency of all analytes, with concentrations ranging from 1.13 ppm to over 510,00 ppm (51.0%). Of the 36 samples, 17 were from children's apparel with jewelry, seven from children's bracelets, six from children's necklaces, five from children's earrings, and one from children's jewelry variety pack. The highest detections of lead were found in metal components of necklaces and bracelets.

Table 2. Summary Statistics of Detected Metals in Children's Jewelry Products, 2018.

Analyte	Antimony	Arsenic	Cadmium	Cobalt	Lead	Mercury
Number of samples (n)	38	38	38	38	38	38
n > RL	16	12	30	16	36	0
% > RL	42%	32%	79%	42%	95%	0%
Minimum (ppm)*	2.52	9.64	1.59	1.22	1.13	---
Maximum (ppm)*	3,720	58.3	966,000	65.0	510,000	---

RL = Reporting (quantitation) limit of 1 ppm, or as noted in the Data Quality section.
*Statistic includes only detected results.

Cadmium was detected in 30 of 38 (79%) of component samples. Cadmium detections ranged from 1.59 to 966,000 ppm (96.6%). Of the 30 samples, 14 were from children's apparel with jewelry, five from children's bracelets, five from children's necklaces, five from children's earrings, and one from children's jewelry variety packs.

Antimony was detected in 16 of 38 samples of children's jewelry products. Of the 16 samples, seven were from children's apparel with jewelry, four from children's bracelets, three from children's necklaces, and two from children's earrings. Antimony concentrations ranged from 2.52 to 3,720 ppm.

Arsenic was detected in 12 of 38 component samples, ranging from 9.64 to 58.3 ppm.

Cobalt was detected in 16 of 38 component samples, ranging from 1.22 to 65.0 ppm.

Mercury was not detected in any samples.

Compliance Summary

Table 3 shows the results when compared to limits set by the Children's Safe Products Act (CSPA). The CSPA limits include:

- Cadmium restriction limit of 40 ppm.
- Lead restriction limit of 90 ppm.
- CSPA reporting threshold for CHCCs above 100 ppm.

Table 3. Metals Concentrations Above CSPA Limits in Children's Jewelry Products, 2018.

Lab Sample ID (Component ID)	Cadmium (ppm)	Lead (ppm)	Antimony (ppm)	Matrix Type
1903043-05 (CL-16-6-4)	96.8	< 90	< 100	Metal
1903043-07 (FM-35-4-5)	75.9	< 90	< 100	Metal
1903043-27 (FM-35-4-3)	94.8	< 90	< 100	Metal
1903043-15 (NR-1-1-6)	51.1	< 90	< 100	Metal
1903043-18 (CP-7-2-14)	63.1	< 90	< 100	Metal
1903043-28 Ω (CP-7-2-9)	79.7 J	< 90	< 100	Metal
1903043-25^ (JC-8-7-7)	966,000 (96.6%)	< 90	< 100	Metal
1903043-26 (JC-8-3-4)	109	< 90	< 100	Metal
1903043-32 (SK-17-5-4)	567,000 (56.7%)	< 90	< 100	Metal
1903043-35 (WM-39-5-7)	72	< 90	< 100	Metal
1903043-34 (SK-17-7-7)	588,000 (58.8%)	1,020	122	Metal
1903043-12 (AM-30-1-5)	< 40	94,100 (9.41%)	< 100	Metal
1903043-29 (JC-7-3-3)	< 40	173,000 (17.3%)	< 100	Metal
1903043-30 (JC-7-3-5)	< 40	510,000 (51.0%) J	< 100	Metal
1903043-20 (AM-29-2-9)	< 40	1,280 J	< 100	Fabric
1903043-22 (DT-24-3-1)	< 40	314 J	2,800 J	Plastic
1903043-36 (DT-24-2-1)	< 40	402 J	1,670 J	Plastic
1903043-03 (AM-30-3-4)	< 40	< 90	3,720 J	Metal

Ω Composited with component CP-7-2-17.

^ Composited with component JC-8-7-6.

J: Analyte was positively identified. The reported result is an estimate.

Cadmium was detected in 11 samples level above the 40 ppm CSPA restriction limit. Lead was detected in seven samples above the 90 ppm CSPA restriction limit. Only antimony, detected in four component samples, was above the 100 ppm CSPA threshold.

- Cadmium had the highest frequency of results above its restriction limit, with 11 of 38 (29%) component samples above 40 ppm.
- Cadmium was detected in three component samples above 50% (500,000 ppm): the metal horse charm (SK-17-5-4) from the necklace of a pink unicorn multi-piece set at 56.7%, the metal back of a charm (SK-17-7-7) from the necklace of a blue floral print multi-piece set at 58.8%, and the silver colored metal pendant (JC-8-7-7, composite with JC-8-7-6) from the necklace of a lace top with leggings at 96.6%.
- Lead was detected in seven component samples above the restriction limit of 90 ppm. Lead was detected in three component samples above 9,000 ppm: the gold-colored metal pendant cube (AM-30-1-5) from the necklace of a chevron dress at 94,100 ppm, the metal chain (JC-7-3-3) from the bracelet of a coral dress at 173,000 ppm, and the metal back of the rhinestone decorations (JC-7-3-5) from the same bracelet at 510,000 ppm.
- Antimony was detected in 4 of 38 samples of children's jewelry products above 100 ppm: the metal back of a charm (SK-17-7-7) from the necklace of a blue floral print multi-piece set, a plastic gold colored bead (DT-24-3-1) of a bracelet, a plastic green colored bead (DT-24-2-1) of a bracelet, and a silver-colored metal charm (AM-30-3-4) from the necklace of a zig-zag print dress.
- Neither cobalt nor arsenic was detected above the 100 ppm CSPA reporting threshold in any component samples.
- Mercury was not detected above the restriction limit in any of the samples.

The lab data for this project were submitted to Ecology's CSPA compliance lead for assessment of compliance with Washington State and Federal laws.

References

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