# Formaldehyde, D4, MEK, and Styrene in Children's Products

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## Overview

In 2016, the Washington State Department of Ecology (Ecology) began an assessment of the data reported in the Children's Safe Products Act (CSPA) Manufacturer Reporting Database. Under CSPA (Chapter 70.240 Revised Code of Washington (RCW)), manufacturers of children's products offered for sale in Washington State are restricted from using certain chemicals. They are also required to report to Ecology if a product contains any Chemicals of High Concern to Children (CHCC) (Chapter 173-334 Washington Administrative Code (WAC)).

Using a study performed by Smith et al. (2016) to characterize, rank, and prioritize chemicals reported in children's products based on chemical toxicity and the potential exposure pathways, Ecology identified four priority chemicals for this study: formaldehyde, octamethylcyclotetrasiloxane (D4), methyl ethyl ketone (MEK), and styrene. These chemicals ranked high in either chemical toxicity, exposure potential, number of manufacturer reports, or a combination of these criteria. Ecology frequently performs testing on CHCCs in children's products to verify compliance, to further understand chemical usage and presence in products, and for making policy decisions.

In 2016, Ecology purchased 137 children's products and submitted 97 component samples to the laboratory for analysis of one or more of the four priority chemicals. Figure 1 displays the types and distribution of products purchased. Manufacturer-reported data and research on the use and application of these chemicals in product-manufacturing processes helped guide product selection.

Data gathered from this study were used to enhance our understanding of chemicals used in children's products and assess compliance with CSPA. This report describes the presence and levels of four chemicals found in a select set of children's products. This report does not attempt to assess potential exposures or impacts to human health related to the tested products.

Complete laboratory results for this study can be requested from the author / project manager, Sara Sekerak.

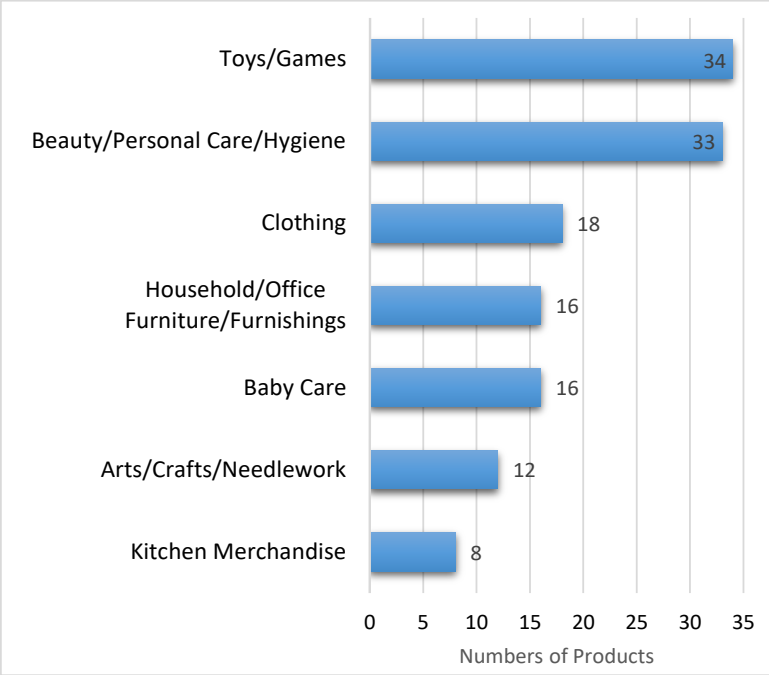


**Figure 1. Types and Distribution of Purchased Products, listed by Global Product Classification (GPC) Segment.**

## For More Information

**Ecology's CSPA website:** Children's Safe Products Act

**CSPA Manufacturer Reporting Database:** https://fortress.wa.gov/ecy/cspareporting

**Rational for Reporting List of CHCCs (2011 Rule):** https://fortress.wa.gov/ecy/publications/documents/1704023.pdf

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# Methods

## Product Collection and Processing, and Laboratory Sample Selection

This study followed a Quality Assurance Project Plan (QAPP) and QAPP addendum (Sekerak, 2016a; Sekerak, 2016b). Ecology purchased 137 children's products and one product labeled as 'KEEP OUT OF THE REACH OF CHILDREN'. This product was available for sale amongst other children's products, on a low shelf, in a store selling predominately children's products. Most products were purchased from 16 Puget Sound retail stores, and a small set of products were purchased from four online retailers. The standard practice of purchasing from larger chain stores was used to represent products sold and available to customers across Washington State. It is assumed that statewide each chain store mostly receives the same distribution of products. Products purchased online are also assumed to be equally accessible by most state residents.

The CSPA Manufacturer Reporting Database was used to focus on categories of products to purchase. Product universal product codes (UPCs) are not entered into the database; therefore, no specific products were targeted. Supplementary literature reviews of the use of formaldehyde, D4, MEK, and styrene in manufacturing processes were used to help with the selection of products and product components to be evaluated in this study. When available, product ingredient labels were used to prioritize testing based on listings of a target chemical, synonym, or a secondary chemical known to form or decompose to release one of the four study target chemicals.

All personal care products and other products sold in sealed bottles or containers were sent to the laboratories in their original sealed bottles. Containers were opened just prior to analysis preparation. Component samples from solid material matrices (e.g., fabrics, plastics, bio-based materials) were hand-reduced or cryomilled by product testing and laboratory standard operating procedures (SOPs; Wiseman et al., 2016; MEL, 2016).

## Laboratory Procedures

Ecology's Manchester Environmental Laboratory (MEL) analyzed component samples of formaldehyde, MEK, and styrene. A contract laboratory performed the analysis of D4. Table 1 outlines the preparation and analysis methods and instrumentation for all analyses.

For this study MEL developed a method for the extraction and analysis of formaldehyde in consumer products based on EPA 8315A. The performance-based modifications to the preparation technique included a reduction in sample size and extraction fluids, as well as the addition of surrogates to monitor extraction efficiency. Analysis was performed by gas chromatography/mass spectrometry (GC/MS; EPA 8270DSIM) as an alternative to high-performance liquid chromatography—ultraviolet/visible spectroscopy (HPLC-UV/Vis).

**Table 1. Laboratory Methods^.**

| Analyte (CAS Number) | Preparation Method | Analysis Method | Analysis Instrument |
|---|---|---|---|
| Formaldehyde (50-00-0) | EPA 8315AP | EPA 8270DSIM | GC/MS |
| D4 (556-67-2) | ALS SOP SVM-D4SO | ALS SOP SVM-D4SO | GC/MS |
| MEK (78-93-3) | EPA 5030B | EPA 8260C | GC/MS |
| Styrene (100-42-5) | EPA 5030B | EPA 8260C | GC/MS |

*^Method names are specific to the lab that performed the analysis.*
*GC/MS: gas chromatography/mass spectrometry*

The D4 analysis was performed following a sediments and Biosolids GC/MS method modified for testing consumer products. MEK and styrene were analyzed using established product testing methods, based on EPA Method 8260C.

All MEL data were reviewed and verified as prescribed in MEL's *Lab Users Manual– Tenth Edition (*Ecology, 2016). The MEL Quality Assurance coordinator validated the D4 contract lab data following EPA's *National Functional Guidelines for Superfund Organics Methods Data Review* (EPA, 2014).

Discussions of the data quality for all datasets were summarized in written case narratives prepared by MEL. These case narratives are available upon request.

## Data Quality and Usability

Quality control (QC) tests and measurement quality objectives (MQOs) are outlined in the study plan (Sekerak, 2015). With few exceptions, the results met acceptance criteria for all analyses. There are no limitations on the use of the data as reported. Qualifiers were assigned to some data within this study:

"J" indicating that the associated result is an estimate.
"U" indicating that the analyte was not detected at the quantitation limit.
"UJ" signifying that the quantitation limit is an estimate.
"NJ" where the analyte was tentatively identified in the sample but the result value reported is an estimate.

Method blanks (MBs), laboratory control samples (LCSs), LCS duplicates, duplicates (DUPs), matrix spikes (MSs), and MS duplicates were analyzed with each batch of samples.

No analytes were detected above the method reporting limits (RLs) in the MBs associated with each sample batch. Due to the persistent presence of low background levels of formaldehyde, the reporting limit was raised to 10 parts per million (ppm) for the first batch of samples analyzed. In subsequent batches, procedure modifications were successful in reducing contamination and a reporting limit of 5 ppm was obtained. For D4, a reporting limit of 0.026 ppm was achieved by the contract laboratory. The contract laboratory originally reported data below the RL and flagged these results as estimates. "J" flagged data below the reporting limit were changed by the project manager to 0.026 ppm "U", indicating that the analyte was not detected at or above the quantitation limit. This change does not affect the quality of the data reported. A range of actual reporting limits are displayed in Table 2.

All LCS and LCS duplicates were extracted and analyzed as appropriate and met acceptance criteria. Matrix spikes for one sample exhibited poor recovery of the concentration of added formaldehyde; the source sample was qualified as an estimate. All other precision and bias criteria were met.

**Table 2. Summary Statistics of Priority Chemicals in Children's Products.**

| Analyte | Formaldehyde | D4 | MEK | Styrene |
|---|---|---|---|---|
| Number (n) | 84 | 43 | 60 | 60 |
| RL* (ppm) | 4.19 - 20.1 | 0.026 | 0.77 - 43.1 | 0.77 - 43.1 |
| (ppm)* | 31 | 22 | 0 | 9 |
| % > RL | 37% | 51% | 0% | 15% |
| Minimum (ppm)* | 5.91 | 0.027 | - | 0.89 |
| Maximum (ppm)* | 3390 | 6230 | - | 540 |

** Actual reporting limits (RLs) of individual samples vary by mass of sample used, volume of extraction fluids, and dilution factors.*

*^ Statistic includes only detected results.*

For D4, one duplicate sample was reported slightly above the range of the calibration curve and was qualified as an estimate. The source sample was analyzed within the calibration curve and not qualified as a result of the qualification assigned to the duplicate.

As the method requires, all surrogates and internal standards were performed as specified. Four formaldehyde samples were reported as estimates due to low surrogate recoveries (<50%). This was due to severe matrix interferences. Two additional formaldehyde QC samples (MB and DUP) also had low surrogate recoveries. All results associated with this MB and the source sample for the DUP were qualified as estimates. All other surrogates and internal standards met acceptance criteria.

Several additional formaldehyde samples were qualified as estimates due to calibration or continuing calibration verification issues.

# Results

## Formaldehyde

Formaldehyde was detected in 37% (31 of 84; Table 2) of the products tested. Concentrations ranged from 4.19 - 3,390 ppm. Formaldehyde detections by category are illustrated in Figure 2.

The highest concentration of formaldehyde, 3,390 ppm, was found in a child's bowl marketed as made from durable and break-resistant melamine. Melamine is nitrogen-rich triazine primarily used in the synthesis of melamine-formaldehyde resins (MFR) for manufacture of laminates, plastics, coating commercial filters, glues or adhesives, and molding compounds (dishware and kitchen ware) (Bizzari and Yokose, 2008). Six additional kitchen merchandise products (bowls or plates) did not show detections of formaldehyde. These products were marketed as plastic.

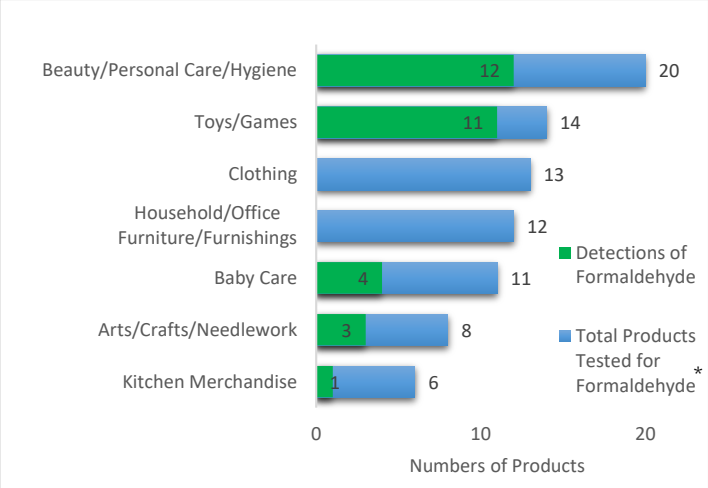


**Figure 2. Detections of Formaldehyde.**

** Includes product marketed as 'KEEP OUT OF REACH OF CHILDREN' and four Reporting Rule exempted sunscreen products that are regulated by the Federal Department of Agriculture (FDA).*

The next highest concentrations, 3,230 ppm, 1,200 ppm, and 995 ppm, were detected in toys/games component samples labeled as composed of wood or wooden construction. Formaldehyde is commonly used in resins (glues) used in the manufacture of composite wood products (e.g. hardwood plywood, particle board, and medium-density fiberboard). Eight additional toy or game component samples had concentrations ranging from 5.91 - 320 ppm, including six samples of bubble blowing liquid.

The largest number of samples submitted for testing were personal care products that are applied to skin, nails, or hair, or intended for oral use such as dental cleansing products. Formaldehyde is used as a preservative to prolong shelf life in products. Twelve of 20 (60%) samples tested contained concentrations of formaldehyde ranging from 12.1 - 436 ppm. The highest concentration, 463 ppm, was in a sample of a component from a body tattoo kit. This product's packaging contained an ingredient list which listed a formaldehyde-containing compound: cyclohexanone-formaldehyde copolymer. One additional body tattoo sample contained 178 ppm of formaldehyde in the ink of the tattoo pen. This product did not list formaldehyde as an ingredient. In total, 11 personal care product packaging labels contained ingredient lists that included a formaldehyde compound or a formaldehyde releaser (Page 5; Table 3a).

Formaldehyde was detected in four of the 11 (36%) baby care products at 897 ppm, 453 ppm, 458 ppm, and 13 ppm. These four baby hygiene/grooming products, like the personal care products, all had ingredients listed on their product packaging. The products with the three highest formaldehyde levels in this category listed a formaldehyde releaser (DMDM hydantoin or diazolidinyl urea) on the product ingredient labels.

Formaldehyde was detected in 38% (3 of 8) of the arts and crafts products tested. These detections included 348 ppm in moldable foam, 201 ppm in a composited 4-color finger paint set, and 107 ppm in modeling clay. None of the tested arts and crafts products contained ingredient lists.

No clothing or bedding textiles (within the household furnishings category) tested contained formaldehyde. No clothing or bedding were labeled as permanent-press (i.e., chemical treatment used to aid in wrinkle resistance), but some were labeled as wrinkle resistant, wash and wear, or easy care.

Manufacturers have reported formaldehyde 975 times from June 2012 to the present. Thirty-five percent of the reports were for clothing, and 30% were for toys/games. Only 4% of the reports were for personal care/cosmetics, and 3% of the reports were for kitchen merchandise and baby feeding, combined.

[1, 2] Baby shampoo product was purchased and analyzed in duplicate (453 ppm and 458 ppm). [3] References hereinafter to numbers of reports in the CSPA Manufacturer Reporting Database are those reported to Ecology from June 1, 2012 to September 1, 2017 (present).

## Ingredient Listings

**Table 3a - 3c. Product, Chemical Concentrations, and Ingredients Listed on Product.**

**3a. Formaldehyde**

| Product *(Category)* | Concentration (ppm) | Ingredient Listed |
|---|---|---|
| Baby Body Wash *(Baby Care)* | 897 | Diazolidinyl urea |
| Baby Shampoo *(Baby Care)* # | 458 | DMDM Hydantoin |
| Baby Shampoo *(Baby Care)* # | 453 | DMDM Hydantoin |
| Body Tattoo Kit *(Personal Care)* | 436 | Cyclohexanone-Formaldehyde copolymer |
| Face Cream *(Personal Care)* | 329 | Diazolidinyl urea |
| Leave-in Hair Tamer *(Personal Care)* | 310 | Diazolidinyl urea |
| Colored Hair Spray * *(Personal Care)* | 306 | Formaldehyde/Melamine/Tosylamide |
| Deep Cleaning Face Mask *(Personal Care)* | 280 | Diazolidinyl urea |
| Leave-in Hair Detangler *(Personal Care)* | 243 | DMDM Hydantoin |
| Body Tattoo Kit *(Personal Care)* | 178 | Imidazolidinyl urea |
| Leave-in Conditioner *(Personal Care)* | 117 | DMDM Hydantoin |
| Bubble Bath *(Personal Care)* | 93 | DMDM Hydantoin |
| Bubble Bath *(Personal Care)* | 79 | DMDM Hydantoin |
| Nail Polish *(Personal Care)* | 62.3 | Melamine-Formaldehyde resin |

**3b. Octamethylcyclotetrasiloxane (D4)**

| Product *(Category)* | Concentration | Ingredient(s) Listed |
|---|---|---|
| Sunscreen *(Personal Care)*^ | 6,230 | Cyclopentasiloxane (D5) |
| Baby Leave-in Hair Conditioner *(Baby Care)* | 1,990 | Cyclotetrasiloxane (D4) |
| Glow-in-the-Dark Craft Dough *(Arts/Crafts)* | 798 | Silicone |
| Leave-in Hair Detangler *(Personal Care)* | 130 | Cyclopentasiloxane (D5), Cyclohexasiloxane (D6) |
| Teething Necklace *(Baby Care)* | 104 | 100% Silicone |
| Leave-in Conditioner *(Personal Care)* | 102 | Cyclopentasiloxane (D5) |
| Sunscreen *(Personal Care)*^ | 55.7 | Cyclopentasiloxane (D5), Cyclohexasiloxane (D6) |
| Leave-in Hair Styling Lotion *(Personal Care)* | 36.2 | Cyclopentasiloxane (D5), Cyclohexasiloxane (D6) |
| Leave-in Hair Tamer *(Personal Care)* | 29.9 | Cyclopentasiloxane (D5) |
| Leave-in Hair Detangler *(Personal Care)* | 18.6 | Cyclopentasiloxane (D5) |
| Pacifier *(Baby Care)* | 0.125 | Silicone |

**3c. Methyl Ethyl Ketone (MEK) and Styrene**

| Product *(Category)* | Concentration (ppm) | | Ingredient(s) Listed |
|---|---|---|---|
| | MEK | Styrene | |
| False Nails *(Personal Care)* | < RL | 540 | Acrylonitrile-Butadiene-Styrene-Resin |
| Lip Gloss *(Personal Care)* | < RL | < RL | Hydrogenated styrene/Isoprene copolymer |
| Baby Sunscreen *(Personal Care)*^ | < RL | < RL | Styrene/Acrylates copolymer |
| Sunscreen *(Personal Care)*^ | < RL | < RL | Styrene/Acrylates copolymer |
| Lip Gloss *(Personal Care)* | < RL | < RL | Butylene/Ethylene/Styrene copolymer, Ethylene/ Propylene/Styrene copolymer |

*# Product tested in duplicate. * Product labeled as 'KEEP OUT OF THE REACH OF CHILDREN' ^ Product ingredients regulated by the FDA.*

# Results - *continued*

## Octamethylcyclotetrasiloxane (D4)

D4 was detected in just over half of the products tested (23 of 43). The highest concentrations and detection frequencies occurred in personal care/hygiene and baby care products (Figure 3).

In personal care and cosmetic products, cyclic siloxanes are used to provide antistatic, emollient, humectant, solvent, viscosity controlling, and hair conditioning qualities. Eleven of 14 personal care products tested contained D4. Concentrations ranged from 2.12 to 6,230 ppm. Six of those products had ingredient labels showing one or more cyclic siloxanes in each product: i.e., cyclopentasiloxane (D5), or both D5 and cyclohexasiloxane (D6), in the ingredients; Page 5, Table 3b.). The product with the highest concentration (6,230 ppm), a sunscreen, listed cyclopentasiloxane on the ingredient label. With the similar structures of cyclic siloxanes, D4 has the potential to be present in products containing D5, D6, or cyclomethicone, a technical mixture of compounds, with the general formula $(CH)_{2n}O_nSi_n$ where n = 3-7.

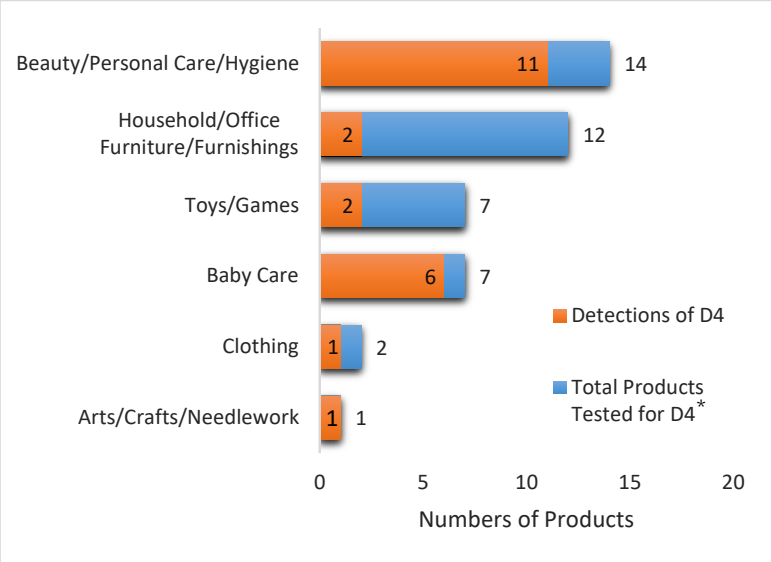


**Figure 3. Detections of D4**

** Includes three Reporting Rule exempted sunscreen products that are regulated by the FDA.*

Eighty-six percent (6 of 7) of the baby care products tested contained D4. One product, a leave-in baby hair conditioner, contained 1,190 ppm of D4. This product was the only tested product to list cyclotetrasiloxane in the ingredients. Two other products, a teething necklace (104 ppm) and a pacifier (0.125 ppm), were labeled as being constructed of silicone.

The arts/crafts product tested, a glow-in-the-dark craft dough, labeled as constructed of 'hygienic and safe silicone', contained 798 ppm of D4. Both D4 and D5 are used as intermediates in the manufacture of silicone polymers.

D4 was detected in one item of clothing and also in two products each in toys/games and household furnishings (bedding textiles) at levels less than 1 ppm.

Since 2012, manufacturers have reported D4 in children's products 2,496 times in the database with nearly 96% (n = 2,392) of those reports indicating D4 present as a contaminant serving no function. Only one report was for a hair care item, 12 were for cosmetic/fragrance items, and only 20 reports were for hygiene-type baby care items. All hair care, cosmetic/fragrance, and baby care reports show D4 present only as a contaminant.

*D4 is used in hair care products for its antistatic properties.*

# Results - *continued*

## Methyl Ethyl Ketone (MEK)

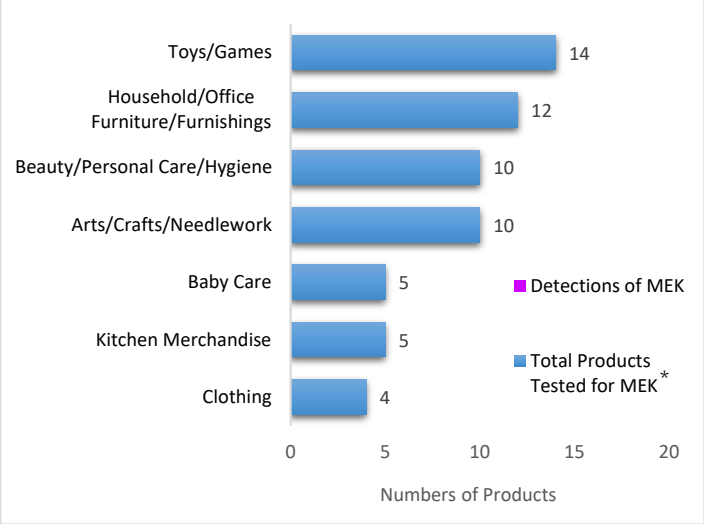


**Figure 4. Detections of MEK.**

** Includes two Reporting Rule exempted sunscreen products that are regulated by the FDA.*

MEK was not detected in any of the product component samples submitted for testing. MEK has been reported in the CSPA Manufacturer's Reporting Database 3,221 times since reporting began in 2012. Nearly 91% of the records classified MEK as a contaminant that serves no function, and reported concentrations greater than 100 ppm. Another 5% of the reports indicated that MEK was used in the product as a solvent, with more than half of those reports showing levels ≥ 100 ppm. MEK, a fairly volatile solvent, is commonly used in vinyl films, paint removers, lacquers, varnishes, adhesives, and cleaning fluids. It is also used in the synthetic rubber industry and in the production of paraffin wax.

A 2015 study tested clothing, footwear, and accessories and found similar results. Out of 50 product component samples tested, only one low level detection of MEK was found in a plastisol (vinyl) print on pajamas (Mathieu and Sekerak, 2015). MEK has been reported in the database by manufacturers 2,462 times in items of clothing and footwear and 143 times in fabric/textile furnishings.

No ingredient lists for the products tested contained MEK (Page 5, Table 3c.)

## Styrene

Styrene was detected in nearly 12% (9 of 60) of product samples submitted for testing. The highest two concentrations (540 ppm and 416 ppm) were detected in two separate sets of false nails. The product with the highest level of styrene listed the main nail ingredient acrylonitrile-butadiene-styrene (ABS) resin; the other product listed no ingredients. ABS plastic is widely used in appliances, sporting equipment, and automotive parts due to its tough heat-resistant qualities. Styrene, a monomer, is most widely known for its use in the production of polystyrene. It is also used in the production of synthetic rubber, various reinforced-polyester plastics, and in adhesives, paints, and waxes. Copolymers made with styrene were listed on two tested sunscreens and two lip gloss products (Page 5, Table 3c.). Styrene was not found in those product samples.

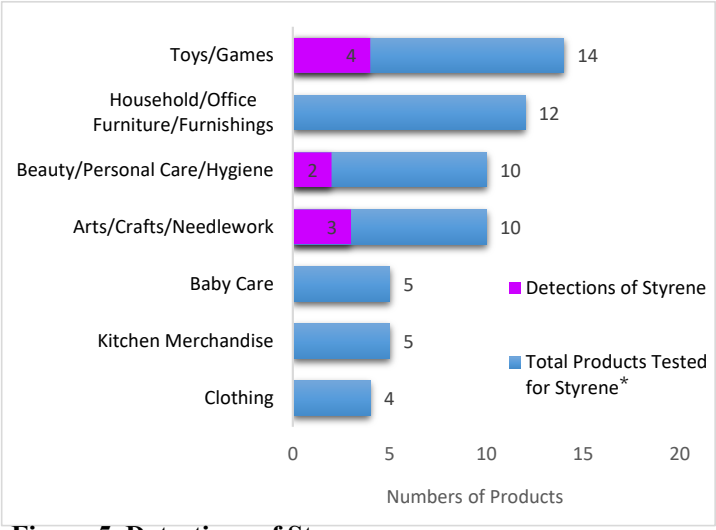


**Figure 5. Detections of Styrene.**

** Includes two Reporting Rule exempted sunscreen products that are regulated by the FDA.*

Two of the three toys/games products containing styrene were in toy building blocks, made by the same company. One product was designed for small children (140 ppm) and the other designed for older children (296 ppm). Two other toys/game component samples had levels of less than 1 ppm. Arts/crafts products resulted in concentrations in two molded foam products at 107 ppm and 15.8 ppm, and 45.4 ppm in marker ink pens. Nearly 37% (1,459 of 3,945) of the reporting of styrene in the manufacturer database is in the toys/games category, mostly as components of plastic resin or polymer process (n = 638) or as serving no function/contaminant (n = 679).

# Summary and Conclusions

In 2016, Ecology evaluated children's products for the presence of four priority chemicals from Washington State's CHCC list. The four chemicals - formaldehyde, D4, MEK, and styrene - were selected from a supplementary evaluation of the data reported into the CSPA Manufacturer Reporting Database based on an examination of chemical toxicity and potential exposure pathways. A total of 137 products were purchased, and a subset of those were sent to the laboratory for analysis for one or more of the target chemicals.

- Formaldehyde was detected in 31 out of the 84 product component samples tested, with the highest concentration, 3,320 ppm, found in a melamine child's bowl.
- 60% of the personal care products tested contained formaldehyde levels ranging from 12.1 - 436 ppm. The highest concentration was found in a component of a body tattoo kit listing cyclohexanone-formaldehyde copolymer on the ingredient label.
- Four baby care hygiene/grooming products had formaldehyde levels from 13 - 897 ppm. The highest three products listed either diazolidinyl urea or DMDM hydantoin on their ingredient labels.
- No products' ingredient labels listed formaldehyde (CAS Number 50-00-0). All 13 of the products labeled as containing a formaldehyde compound or identified formaldehyde releaser contained detectable levels formaldehyde.
- Manufacturers reported formaldehyde in children's products 975 times from June 2012 to the present. This accounts for only 1.8% of the total reports (n = 55,255) entered into the database.
- D4 had a detection frequency of 53%. This was the highest concentration recovered, 6,230 ppm, over all product components tested.
- D4 was listed on only one product ingredient label and was found to contain 1,190 ppm of D4 (CAS Number 556-67-2). Eight products listed similarly structured cyclic siloxanes (D5, or D5 and D6) on product labeling. Each of these products were found to contain D4 though lab analysis. Products displaying silicone as an ingredient also had detectable levels of D4.
- Nearly 96% (2,392 of 2,496) of manufacturer reports indicate D4 is only in children's products as a contaminant.
- Only one report of D4 in a hair care product and 12 reports of D4 in cosmetic/fragrance products have been entered into the reporting database. Eleven of the 14 personal care products tested contained D4; this includes all eight of the hair care products. For baby care products, only 20 reports of hygiene items have been reported; six of seven baby care products tested contained D4.
- MEK was not detected in any product component samples. MEK has been reported 3,221 times by manufacturers.
- Styrene was detected in 12% (9 of 60) of the product component samples, with concentrations ranging from < 1 - 540 ppm.
- The highest two concentrations of styrene were found in two set of false nails, at 540 ppm and 416 ppm. Only one of the products listed a compound containing styrene on the ingredients.
- Four toys/games product component samples analyzed contained styrene, two of which were toy building blocks (140 and 296 ppm). Nearly 37% of the styrene reports in the reporting database classify styrene as present in toys/games.

# Compliance and Enforcement

The laboratory data for this project were submitted to Ecology's Children's Safe Products Act (CSPA) enforcement coordinator for assessment of compliance with Washington State laws. Responsible parties (manufacturers, distributors, and/or retailers of products) who appear to violate chemical restrictions, or have not reported as required under the CSPA reporting rule, will be notified.

# Glossary of Terms

**CAS Number (or CAS):** Chemical Abstract Service Number, also referred to as CAS Registry Number (CASRN). A CAS Number serves as a unique numerical identifier assigned to each chemical substance identified.

**Formaldehyde Releaser:** Chemicals used in consumer products that are not registered as CAS number 50-00-0 (formaldehyde) but may release formaldehyde during normal use of the product. Examples listed by Occupational Safety and Health Administration (OSHA) are shown in Table 6. A more complete list can be found at: https://www.osha.gov/SLTC/hairsalons/formaldehyde_in_products.html#chemicals.

**Table 6. Examples of Chemicals that Can Release Formaldehyde***

| Chemical Name | Synonym | CAS Number |
|---|---|---|
| Methylene glycol (formaldehyde dissolved in water) | Methanediol | 463-57-0 |
| | formalin | |
| | formaldehyde monohydrate | |
| N,N'-bis(hydroxymethyl)urea | Dimethylol urea | 140-95-4 |
| | dihydroxymethylurea | |
| | dimethylurea | |
| | urea formaldehyde | |
| N-(1,3-bis(hydroxymethyl)2-5-dioxo-4-imidiazolidinyl)-N,N'-bis(hydroxymethyl)urea | Diazolidinyl urea | 78491-02-8 |
| | tetramethylol hydantoin urea | |
| 1,3-bis(hydroxymethyl)-5,5-dimethyl-2,4-imidazolidinedione | DMDM hydantoin | 6440-58-0 |
| | dimethyloldimethylhydantoin | |
| | 1,3-dimethylol-5,5-dimethylhydantoin | |
| | DMDMH | |
| 2,4-imidazolidinedione | Hydantoin | 461-72-3 |
| | glycolylurea | |
| N,N''-methylenebis(N'-(3-(hydroxymethyl)-2,5-dioxo-4-imidazolidinyl)urea) | Imidazolidinyl urea | 39236-46-9 |
| | bis(methylolhydantoin urea) methane | |

*Adapted from OSHA list of recognized formaldehyde releasers considered to affect health in a workplace. (Originally adapted from: Flyvholm, M., P. Andersen, 1993. American Journal of Industrial Medicine, volume 24, issue 5, pages 533-552.)

**GPC**: Global Product Classification (GPC) standard (2013). The CSPA Reporting Rule adopted this convention in which products are categorized according to commonalities.

**Reporting Rule Exempted:** A "children's product" does not include over-the-counter drugs, prescription drugs, food, dietary supplements, packaging, medical devices, or products that are both a cosmetic and a drug regulated by the Food and Drug Administration (FDA).

**Segment:** The broadest categorical level in the hierarchical GPC standard.

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## Publication Information

This report is available on the Department of Ecology's website at:
https://fortress.wa.gov/ecy/publications/SummaryPages/1703020.html

The Quality Assurance Project Plan Addendum for this study is available at:
https://fortress.wa.gov/ecy/publications/SummaryPages/1603121.html

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