



Summary of Findings on DTSC's Information Call-in on Nail Products

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Prepared by

**DEPARTMENT OF TOXIC SUBSTANCES CONTROL
SAFER CONSUMER PRODUCTS PROGRAM**

California Environmental Protection Agency



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EXECUTIVE SUMMARY

The Department of Toxic Substances Control's (DTSC's) [Safer Consumer Products \(SCP\) Program](#) evaluates consumer products sold or offered for sale in California that may contain one or more [Candidate Chemicals](#) (CCs) to determine whether to designate them as Priority Products. CCs are chemicals that have been identified to have the potential to cause adverse impacts to human health or the environment. Priority Products are consumer products that contain one or more CCs and have been formally listed in the California Code of Regulations through rulemaking.

DTSC's goal is to advance the design, development, and use of products that are safer for people and the environment. To accomplish this goal, DTSC has been evaluating nail products for more than ten years based on concerns that nail salon workers, salon patrons, and nail product consumers – including women of childbearing age and pregnant women – may be exposed to harmful chemicals in nail products and may experience significant adverse health impacts. As part of this effort, in 2020, DTSC conducted an [information call-in](#) request from nail product stakeholders to gather information on chemicals that are used as ingredients in nail products. This report summarizes the information reported to DTSC by those nail product stakeholders that responded to the information call-in request. Only 33 of the 186 stakeholders responded to DTSC's request, and two of those responders indicated that they did not have the information requested. DTSC has a limited enforcement authority on stakeholders that are contacted for an information call-in request. Therefore, the response rate was low for this information call-in request from nail product stakeholders. Due to the low response rate, the information in this report may not represent all nail products being sold or offered for sale in California. Data is presented in an aggregated form in this report to protect confidential business information regarding specific nail product formulations.

The 31 stakeholders that provided information to DTSC reported 97 chemicals by Chemical Abstracts Service Registry Numbers (CAS RNs) in nail products that were identified as CCs on [DTSC's Candidate Chemicals List \(CC List\)](#). These 97 CCs make up the 11% of all the chemicals reported by stakeholders. Several of these CCs are carcinogens, neurotoxicants, reproductive toxicants, developmental toxicants, endocrine toxicants, respiratory toxicants, and dermatotoxicants.

Some CCs were reported as having various functional uses in formulations, some were reported as contaminants or residuals, and some were reported without any functional use information. The most prevalently reported functions for all reported chemicals were colorants, film formers, solvents, plasticizers, UV absorbers, and opacifying agents. Among those prevalently reported functions, colorants, solvents, and plasticizers had the highest percentage of instances

where the functional use was fulfilled by a CC. Some of the functional uses in the reported formulations were fulfilled without the use of a CC. This finding may suggest that there are chemicals that are not on the CC List are being used to fulfill some of these functions, indicating that there may be safer alternatives to CCs for those functional uses in nail products. Only five of the 31 stakeholders reported contaminants or residuals in their submittals. This may indicate that other stakeholders either failed to report contaminants or residuals in their submittals or may not have the analytical data for trace chemicals that could be contaminants or residuals in their products. Moreover, only five of the 31 stakeholders responded to DTSC's questions regarding alternative formulations in nail products marketed as "green" or "safer" and how those products may differ from other nail products without such claims. The responses indicated that there may be no basis for describing these products as "safer" than nail products that do not make such claims.

A summary of the findings in this report provides insight into potentially harmful chemicals found in nail products based on their presence on DTSC's CC List. In addition, information in this report on the functional uses of chemicals that are not on the CC List may be helpful in seeking safer alternatives to CCs that are currently fulfilling those functions in nail products. Further, this information can help DTSC prioritize the future evaluation of additional CCs in nail products.

INTRODUCTION

The Department of Toxic Substances Control's (DTSC's) [Safer Consumer Products \(SCP\) Program](#)'s goal is to advance the design, development, and use of products that are chemically safer for people and the environment. To accomplish this goal, the SCP Program evaluates consumer products that contain one or more [Candidate Chemicals](#) (CCs) to determine whether to designate them as Priority Products. Priority Products are consumer products that contain one or more CCs and have been formally listed in the California Code of Regulations through rulemaking. Manufacturers of Priority Products may be required to conduct an [Alternatives Analysis](#) to identify potential safer alternatives to the use of CCs in the Priority Product. To designate a product as a Priority Product, DTSC must determine that there are potential human or aquatic, avian, or terrestrial animal, or plant organism exposure to the CC in the product; and that there is potential for one or more of these exposures to contribute to or cause significant or widespread adverse impacts. The [Safer Consumer Products Regulations](#) define the science-driven process and criteria that DTSC uses to designate Priority Products.

As part of this process, DTSC may request information from product or chemical manufacturers, importers, assemblers, or retailers via an information call-in, pursuant to [Title 22, section 69501.4, subdivision \(b\) of the California Code of Regulations \(CCR\)](#). DTSC may use the information gathered through such information call-ins to facilitate its product and chemical evaluation activities to designate Priority Products. For information call-ins, DTSC is required to maintain a [Response Status List \(RSL\)](#) on its website, pursuant to 22 CCR 69501.4(c). The RSL identifies the stakeholders that responded to information call-in requests and those that failed to respond. A stakeholder that provides the requested information to DTSC is also identified on DTSC's [Safer Consumer Products Partner Recognition List \(PRL\)](#), pursuant to 22 CCR 69501.4(d).

BACKGROUND

DTSC is concerned that the use of nail products in salons and homes has the potential to cause or contribute to adverse impacts to nail technicians and other salon workers, salon patrons, and nail product consumers from exposure to harmful chemicals found in nail products (DTSC 2020a; DTSC 2020b).

Nail salon workers have daily exposures to the chemicals in nail products, and they often work more than the 40 hours per week typical of employees in other occupations (Quach et al. 2008). Studies have indicated that nail salon workers may suffer from higher incidents of certain health problems than the general population (Ford 2014). The nail salon workers surveyed in a 2008 study were identified as predominantly females of Vietnamese ethnicity who worked long hours at work places with poor air quality (Roelofs et al. 2008). In this study, salon workers reported adverse health effects including musculoskeletal disorders, respiratory symptoms, skin problems, and headaches (Roelofs et al. 2008). In addition, nail technicians who

work while pregnant may risk exposing their fetuses to harmful chemicals (DTSC 2020b). Salon workers who bring their infants and children to work may also expose them to harmful chemical vapors present in indoor air (Ford 2014; DTSC 2020a; DTSC 2020b). For instance, toluene, which is a volatile (i.e., airborne) developmental toxicant, has been detected in the breast milk of nursing mothers who work in nail salons (Fabietti et al. 2004; DTSC 2013; DTSC 2020b; DTSC 2022a). Fetuses, infants, and children may be especially vulnerable to harmful chemical exposures from nail products because their bodies are still developing (U.S. EPA 2011; DTSC 2020a; DTSC 2020b).

In 2011, DTSC performed a study to analyze 25 nail products sold or offered for sale in California (DTSC 2012). The effort focused on three harmful chemicals used in nail products – formaldehyde, toluene, and dibutyl phthalate (DBP) – which are commonly referred as the “toxic trio” (DTSC 2012). The study found that several products advertised as not containing the toxic trio actually contained DBP, toluene, or both (DTSC 2012). Toluene and DBP can interfere with the growth and development of children (DTSC 2013; DTSC 2020b; DTSC 2022a). This 2011 study also detected other chemicals that are on DTSC’s CC List in the tested nail products (DTSC 2012). In 2017, DTSC held a public workshop to learn more about the potential health and safety impacts of these other chemicals (DTSC 2017). As a result of these efforts, DTSC proposed adding two new products to its Priority Product list – [nail products containing toluene](#) and [nail products containing methyl methacrylate](#) (DTSC 2020a; DTSC 2020b).

Notwithstanding the work already done, DTSC still has concerns about the use of CCs in nail products. DTSC has prepared a [Chemicals in Nail Products Background Document](#) summarizing its findings on chemicals found in nail products and identifying data gaps regarding these chemicals (DTSC 2022b). Generally, there is a lack of publicly available, comprehensive data for ingredients in nail products. Therefore, in 2020, DTSC conducted an [information call-in request](#), formally requesting information from industry stakeholders that make or sell nail products in California, in an effort to gather additional information on nail product ingredients and to improve understanding of the potential exposure to chemicals found in nail products (DTSC 2021a). This report summarizes the findings of the information call-in. The data is presented in an aggregated form to protect confidential business information related to specific nail product formulations. The findings of this information call-in can help DTSC identify product-chemical combinations to be evaluated as potential Priority Products and identify and analyze safer alternatives to harmful chemicals in nail products to reduce or eliminate potential exposures or adverse impacts from harmful chemicals found in nail products. Further, the findings in this report can provide clarification on the presence of potentially harmful chemicals in nail products.

NAIL PRODUCTS INFORMATION CALL-IN PROCESS

DTSC requested information on nail product formulations from stakeholders that sell or offer for sale nail products in California. The stakeholder questions for this information call-in are listed in Appendix 2. To protect confidential business information, DTSC provided a guidance table allowing stakeholders to report the concentrations of chemicals in their nail product formulations in a range rather than reporting exact concentrations (see Table A2.1 in Appendix 2). Stakeholders did not specify whether they reported concentration ranges by weight or by volume.

DTSC defined four main nail product categories for this information call-in, each of which includes several subproduct categories:

- 1. Liquid-powder system artificial nail products:** Artificial nails sold in two separate parts – an acrylic powder and a liquid acrylic monomer (sometimes labeled as “acrylic liquid” or “liquid”). The powder and liquid are combined immediately prior to application to fingernails or toenails. This category excludes products that are cured with an ultraviolet (UV) or a light-emitting diode (LED) lamp. Subproduct categories include:
 - a. acrylic liquid monomers,
 - b. acrylic powders (including dipping powders), and
 - c. other.

- 2. UV gel nail products:** Any clear or colored gel nail product that is marketed or sold for application to fingernails or toenails and is cured by exposing the product to low levels of UV light from a UV or an LED lamp after it has been applied to the nail. Subproduct categories include:
 - a. UV gel artificial nail,
 - b. UV gel polish,
 - c. UV gel top coat,
 - d. UV gel base coat,
 - e. hard gel, and
 - f. other.

- 3. Solvent-based nail coatings:** Any clear or colored paint, polish, lacquer, or enamel marketed or sold for application to fingernails or toenails. These products do not require UV light to cure; they form a hard coating upon evaporation of their solvents. Subproduct categories include:
 - a. traditional nail polish (aka varnish, lacquer, enamel),

- b. top coat,
 - c. base coat,
 - d. water-based polish,
 - e. gel polish/gel-like polish (no UV required), and
 - f. other.
- 4. Other nail products:** Nail products that do not fall under the categories defined above (categories 1, 2, or 3). Subproduct categories include:
- a. thinners,
 - b. removers,
 - c. hardeners,
 - d. nail glues/resins/dipping resins,
 - e. primers/bonders/bond-aid products,
 - f. nail drying agents/sprays/aerosols/drops,
 - g. nail stickers/stamps,
 - h. airbrush nail art paint,
 - i. nail art paint,
 - j. skin/cuticle cream and other lotions,
 - k. nail oils, and
 - l. other.

Stakeholder Distribution

DTSC compiled a nail products stakeholder list from a variety of sources including Dun & Bradstreet Hoovers (D&B Hoovers) database and nail product company websites. To ensure our stakeholder list was comprehensive, we also collaborated with trade associations and agencies that had previously conducted surveys with nail product stakeholders, such as the California Air Resources Board (CARB) and the California Department of Public Health. Prior to conducting the information call-in request, we contacted the trade associations, such as the Personal Care Products Council and Independent Cosmetic Manufacturers and Distributors, to share DTSC's nail product definitions and stakeholder questions. This was done to help ensure that the requested information would be as clear as possible to trade association members.

DTSC contacted 256 nail product stakeholders for this information call-in request – 28 trade associations, 206 manufacturers, 11 retailers, five distributors, four importers, and two assemblers (see Figure 1). The trade associations were excluded from the Response Status List (RSL), as they were solely contacted to notify their members. Forty-two additional stakeholders were excluded from the RSL because they either went out of business, owned multiple brands that were merged under a parent brand as a single entity, or no longer make or sell nail

products in California. In total, 186 of the 256 stakeholders were subsequently published on the RSL.

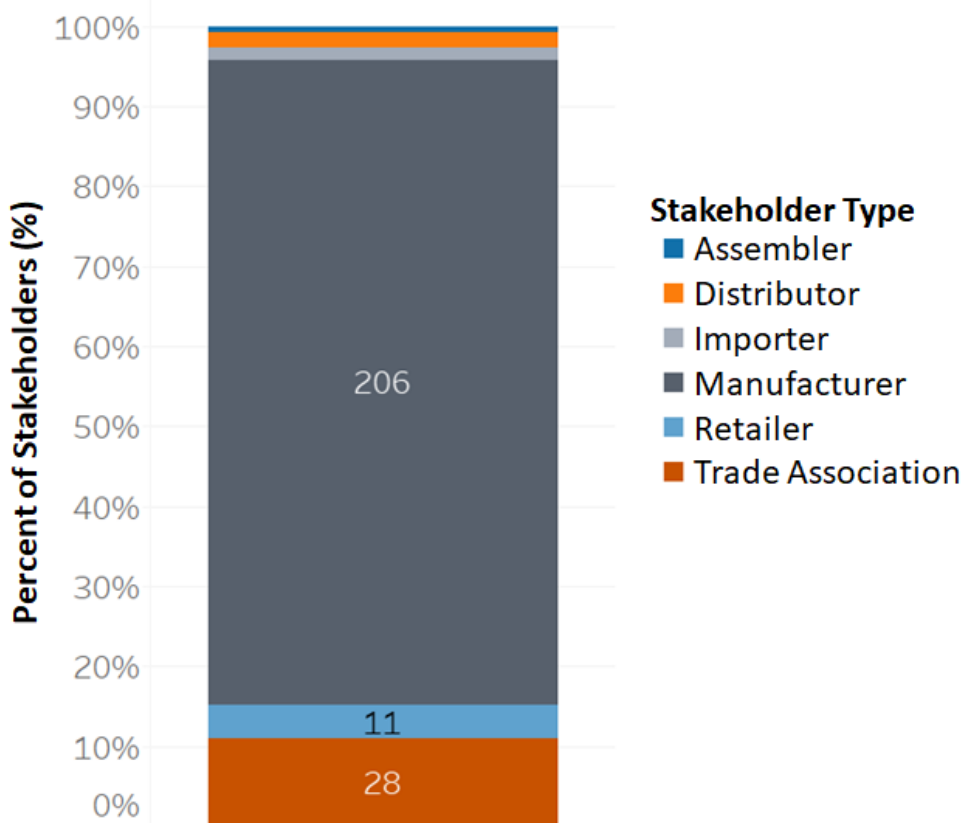


Figure 1. Distribution of stakeholders contacted for the nail products information call-in. The numbers of stakeholders contacted are indicated for manufacturer (206), retailer (11), and trade association (28) and are not labeled for assembler (2), distributor (5), and importer (4).

Response Rate

DTSC identified 186 stakeholders to be published on [DTSC's nail products information call-in Response Status List \(RSL\)](#) (DTSC 2021a). Of these 186, we received responses from 33 (17.7%) stakeholders, while 153 (82.3%) failed to respond. Two of the stakeholders that did respond provided no data, indicating that they did not have the requested information. As a result, only 31 stakeholders provided the requested information to DTSC (see Figure 2). DTSC has a limited enforcement authority on stakeholders that are contacted for an information call-in request. Therefore, the response rate was low for this information call-in request from nail product stakeholders. Due to the low response rate, the information in this report may not represent all nail products being sold or offered for sale in California. Stakeholders that provided the requested information were also published on the [Safer Consumer Products Partner Recognition List \(PRL\) for Nail Products Information Call-in](#).

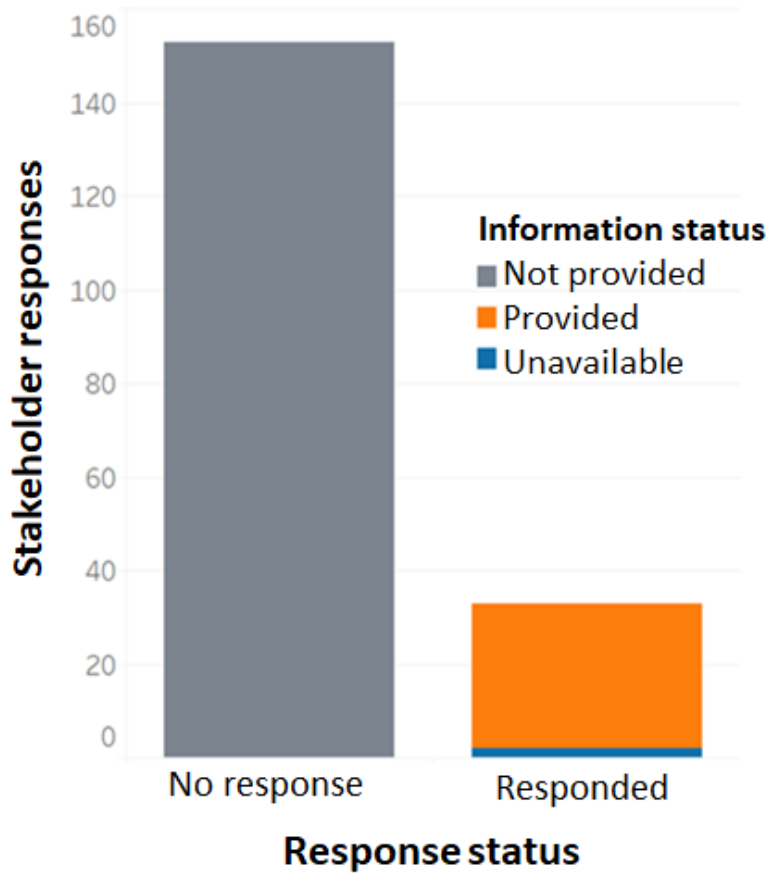


Figure 2. Nail products information call-in response rate for stakeholders that were published on the Response Status List (RSL). For stakeholders that responded but did not provide the requested information, the response status was considered “unavailable.”

RESULTS AND DISCUSSION

This report summarizes the information reported by nail product stakeholders in an aggregated form to protect confidential business information related to chemical ingredients in specific nail product formulations. The focus of this report is on the reported ingredients that may be potentially harmful based on their presence on DTSC’s Candidate Chemicals List (CC List). The following sections summarize the overall findings after analysis of the aggregated data. However, because some of the submittals contained incomplete or incorrectly reported data, DTSC made data adjustments and assumptions, as needed, to allow us to analyze the data. Details of the data analysis and a summary of the assumptions relied on are provided in Appendix 3.

Reported Formulations and Products

This section summarizes the formulations and products reported through this information call-in. Individual companies are not identified by name to protect confidential business

information. The information DTSC requested included the total number of nail product formulations and products that a given company sells or offers for sale and the respective formulation and product ingredients. Some nail products that belong to the same product category are sold in several variants (e.g., different colors of solvent-based nail coatings). These types of products typically share a common base formulation and contain additional ingredients that make up the unique product. For instance, when a manufacturer has one formulation for a nail polish and makes ten different colors of that nail polish, that manufacturer has one formulation for that nail polish and ten different nail polish products, each containing additional unique ingredients.

In this report, formulation and product are defined as follows:

- **Formulation** contains common ingredients reported for a particular subproduct type (e.g., nail polish).
- **Product** contains common ingredients of a formulation for a particular subproduct type and additional ingredients (e.g., colorants) that make up the unique product.

Thirty-one stakeholders reported a total of 1,384 formulations and 13,108 products for all nail product categories. Some companies reported much higher numbers of products than numbers of formulations. This resulted in higher numbers of products than formulations in the overall data set. However, approximately 50% of the companies did not provide the number of unique products they make or sell for each formulation they reported. For the stakeholders that provided product numbers, DTSC accepted an estimated number of unique products for each formulation they reported. Therefore, the reported numbers of products are estimates in this report.

The reported numbers of formulations and products, and their corresponding main product categories and subproduct categories, are listed in Table 1. The UV gel nail products category had the highest number of reported products (5,847), and the solvent-based nail coatings product category had the highest number of reported formulations (963).

Table 1. Number of reported formulations and products by main product category and corresponding subproduct categories.

	Subproduct category	Number of formulations	Number of products
UV gel nail products	UV gel polish	96	5,551
	hard gel	19	98
	UV gel artificial nail	21	76
	UV gel top coat	21	46
	UV gel base coat	14	37
	other	14	39
	total	185	5,847
Solvent-based nail coatings	traditional nail polish (aka varnish, lacquer, enamel)	879	4,410
	top coat	38	69
	base coat	30	51
	water-based polish	3	31
	gel polish/gel-like polish (no UV required)	2	2
	other	11	11
	total	963	4,574
Liquid-powder system artificial nail products	acrylic powders (including dipping powders)	27	2,213
	acrylic liquid monomers	16	29
	other	3	6
	total	46	2,248
Other nail products	hardeners	7	7
	removers	30	53
	nail glues/resins/dipping resins	15	47
	nail oils	19	44
	skin/cuticle cream and other lotions	19	42
	nail art paint	1	41
	airbrush nail art paint	1	33
	primers/bonders/bond-aid products	15	24
	nail drying agents, sprays/aerosols/drops	12	13
	thinners	9	9
	other	62	126
	total	190	439

In this report, DTSC focused on analyzing the reported chemicals in nail product formulations and products that may be potentially harmful based on their presence on DTSC’s Candidate Chemicals List (CC List). Candidate Chemicals (CCs) are those chemicals that can be found on one of the lists enumerated in Article 2 of the Safer Consumer Products regulations. These lists (i.e., Authoritative Lists) are compiled by authoritative bodies, such as the U.S. EPA, and identify chemicals that have particular hazard traits or exposure pathways. DTSC’s CC List is a dynamic list, and the most up-to-date hazard trait information for these chemicals can be found on the specific Authoritative Lists upon which each chemical appears. This report only discusses chemicals reported with Chemical Abstracts Service Registry Numbers (CAS RNs) that were identified as CCs on [DTSC’s CC List](#). For this information call-in, there were 97 chemicals reported with their associated CAS RNs in nail products that were identified as CCs on DTSC’s CC List (see “Reported Chemicals Identified as Candidate Chemicals by CAS Registry Number” section for the list of these 97 CCs reported with CAS RNs). These 97 CCs reported with CAS RNs make up 11% of all the chemicals stakeholders reported. This report excludes the chemicals reported by stakeholders that could be considered CCs by virtue of their membership in a named chemical class that is present on the CC List. DTSC may further evaluate reported chemicals that belong to a chemical class in the future.

The number of reported formulations for the four main product categories, and whether they were reported to contain a Candidate Chemical (CC), are shown in Figure 3. The 95% of the reported formulations and 99% of the reported products contained at least one CC that was reported with a CAS RN.

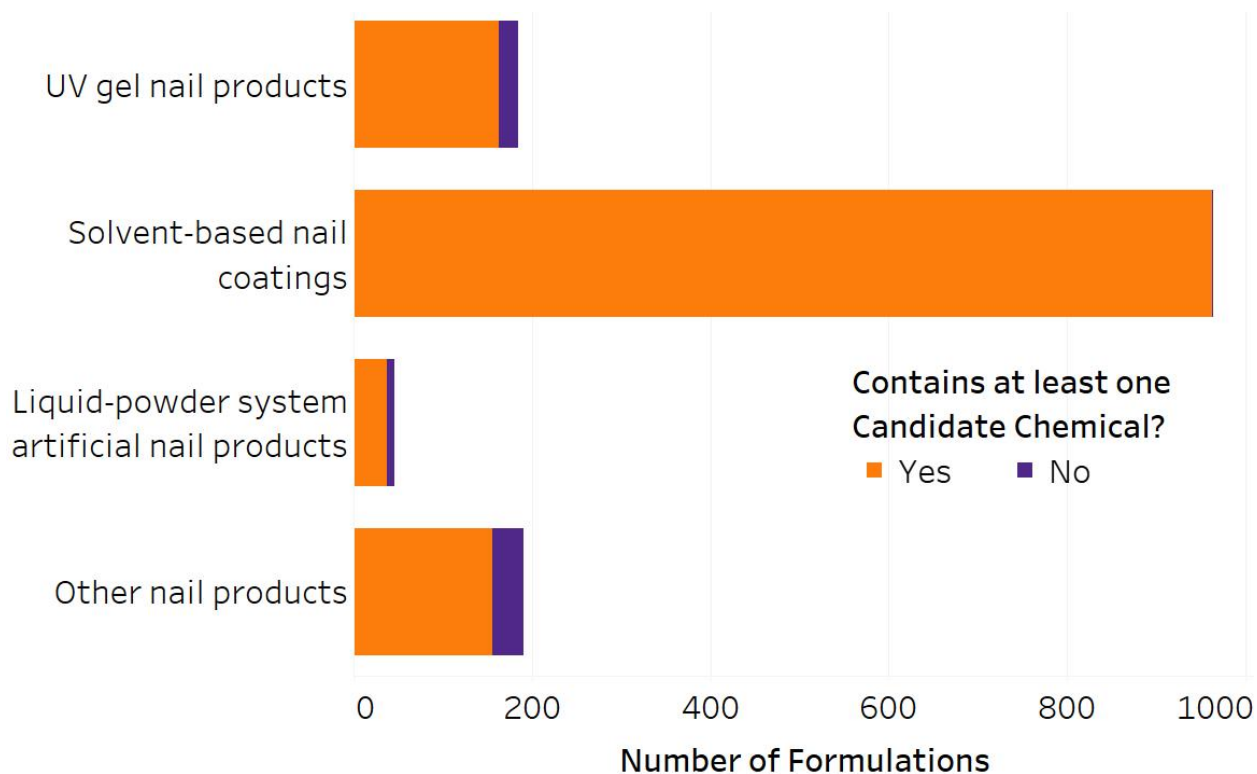


Figure 3. Number of reported formulations by four main product categories. Formulations that reported at least one Candidate Chemical (CC) are shown in orange bars, and formulations that did not report any CCs are shown in purple bars. For solvent-based nail coatings, only one formulation did not contain any CCs.

Reported Chemicals Identified as Candidate Chemicals by CAS Registry Number

There were 97 chemicals reported in various nail products with their associated Chemical Abstracts Service Registry Numbers (CAS RNs) that are on [DTSC's CC List](#) (see Table 2).

Table 2. List of Candidate Chemicals reported in nail products.

Candidate Chemical name	CAS RN
2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)	25973-55-1
2-(4-tert-Butylbenzyl)propionaldehyde	80-54-6
2,5-Dimethylfuran	625-86-5
2-Butoxyethanol	111-76-2
2-Naphthalenol, 1-[(2-chloro-4-nitrophenyl)azo]-	2814-77-9
2-Naphthalenol, 1-[4-(phenylazo)phenyl]azo-	85-86-9
Acetaldehyde	75-07-0
Acetone	67-64-1
Acrylic Acid	79-10-7
Aluminum	7429-90-5
Alpha-methyl styrene	98-83-9
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Benzaldehyde	100-52-7
Benzene	71-43-2
Benzene-1,2:4,5-tetracarboxylic dianhydride	89-32-7
Benzo[a]pyrene	50-32-8
Benzophenone	119-61-9
Benzophenone-3	131-57-7
Benzyl violet 4B	1694-09-3
Butylated hydroxyanisole (BHA)	25013-16-5
Butylbenzyl phthalate (BBP)	85-68-7
Butylparaben	94-26-8
C. I. Pigment Red	6410-41-9
Cadmium	7440-43-9
Carbon black	1333-86-4

Candidate Chemical name	CAS RN
Chromium	7440-47-3
Cobalt	7440-48-4
Coconut oil diethanolamine condensate	68603-42-9
Copper	7440-50-8
Cumene	98-82-8
Cyclohexane	110-82-7
D & C Red No. 21	15086-94-9
D & C Red No. 27	2134-15-8
D & C Red No. 30	2379-74-0
Decamethylcyclopentasiloxane (D5)	541-02-6
Dibenzo[a,h]anthracene	53-70-3
Dibutyl phthalate (DBP)	84-74-2
Dibutyltin dilaurate	77-58-7
Diethyl hexyl adipate	103-23-1
Diisobutyl phthalate (DIBP)	84-69-5
Distillates (petroleum), hydrotreated middle	64742-46-7
Dodecamethylcyclohexasiloxane (D6)	540-97-6
Ethyl acetate	141-78-6
Ethyl paraben	120-47-8
Formaldehyde	50-00-0
Ginkgo biloba extract	90045-36-6
Heptane	142-82-5
Hexanaldehyde	66-25-1
Hydroquinone	123-31-9
Iron	7439-89-6
Isobutane	75-28-5
Isopropanol	67-63-0
Lead	7439-92-1
Mercury	7439-97-6
Methanol	67-56-1
Methyl ethyl ketone	78-93-3
Methyl isobutyl ketone	108-10-1
Methyl methacrylate (MMA)	80-62-6
Methylparaben	99-76-3
N,N-Dimethyl-p-toluidine (DMPT)	99-97-8
Naphtha (petroleum), light alkylate	64741-66-8
n-Butane	106-97-8
n-Butanol	71-36-3
n-Hexane	110-54-3

Candidate Chemical name	CAS RN
Nickel	7440-02-0
Nickel carbonyl	13463-39-3
n-Propylparaben	94-13-3
Octamethylcyclotetrasiloxane (D4)	556-67-2
Petrolatum	8009-03-8
Petrolatum (petroleum), alumina-treated	85029-74-9
Phenol	108-95-2
Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-	6300-37-4
Phosphoric acid	7664-38-2
Platinum	7440-06-4
Propionaldehyde	123-38-6
Propylene oxide	75-56-9
Propyleneglycol monomethyl ether	107-98-2
Selenium	7782-49-2
Silica	14808-60-7
Siloxanes and Silicones, di-Me, hydrogen-terminated	70900-21-9
Silver	7440-22-4
Sodium hydroxide	1310-73-2
Sodium N-(hydroxymethyl)glycinate	70161-44-3
Styrene	100-42-5
Tert-butyl alcohol (TBA)	75-65-0
Tin	7440-31-5
Titanium dioxide	13463-67-7
Toluene	108-88-3
Triclosan	3380-34-5
Tricresyl phosphate	1330-78-5
Trimethylolpropane triacrylate	15625-89-5
Triphenyl phosphate (TpHP)	115-86-6
Vanadium	7440-62-2
Xylenes	1330-20-7
Zinc	7440-66-6

Functions of Candidate Chemicals Reported in Nail Products

This section summarizes the functions of Candidate Chemicals (CCs) reported in nail product formulations. There were 39 different functions reported (excluding the contaminants and residuals) for the CCs in formulations (see Appendix 4). Some CCs were reported to have several functional uses, some were reported as contaminants or residuals, and some were reported without any functional use information.

The most prevalently reported functions for all reported chemicals were colorants, film formers, solvents, plasticizers, UV absorbers, and opacifying agents (see Figure 4a). Among those prevalently reported functions, colorants, solvents, and plasticizers had the highest percentage of instances where the functional use was fulfilled by a CC (see Figure 4b). Of the 1,161 reported formulations that contained solvents, 1,111 (95.7%) reported using at least one CC as a solvent. Of the 1,190 reported formulations that contained colorants, 998 (83.9%) reported using at least one CC as a colorant. Of the 907 reported formulations that contained plasticizers, 84 (9.3%) reported using at least one CC as a plasticizer (see Appendix 4).

Some reported formulations fulfilled some of the functional uses without the use of a CC (see Appendix 4). This finding may suggest that there are chemicals that are not on the CC List being used to fulfill some of these functions. Therefore, there may be safer alternatives to CCs for those functional uses. However, DTSC has not evaluated the safety of chemicals that are not on the CC List, which may fulfill these functions in nail product formulations.

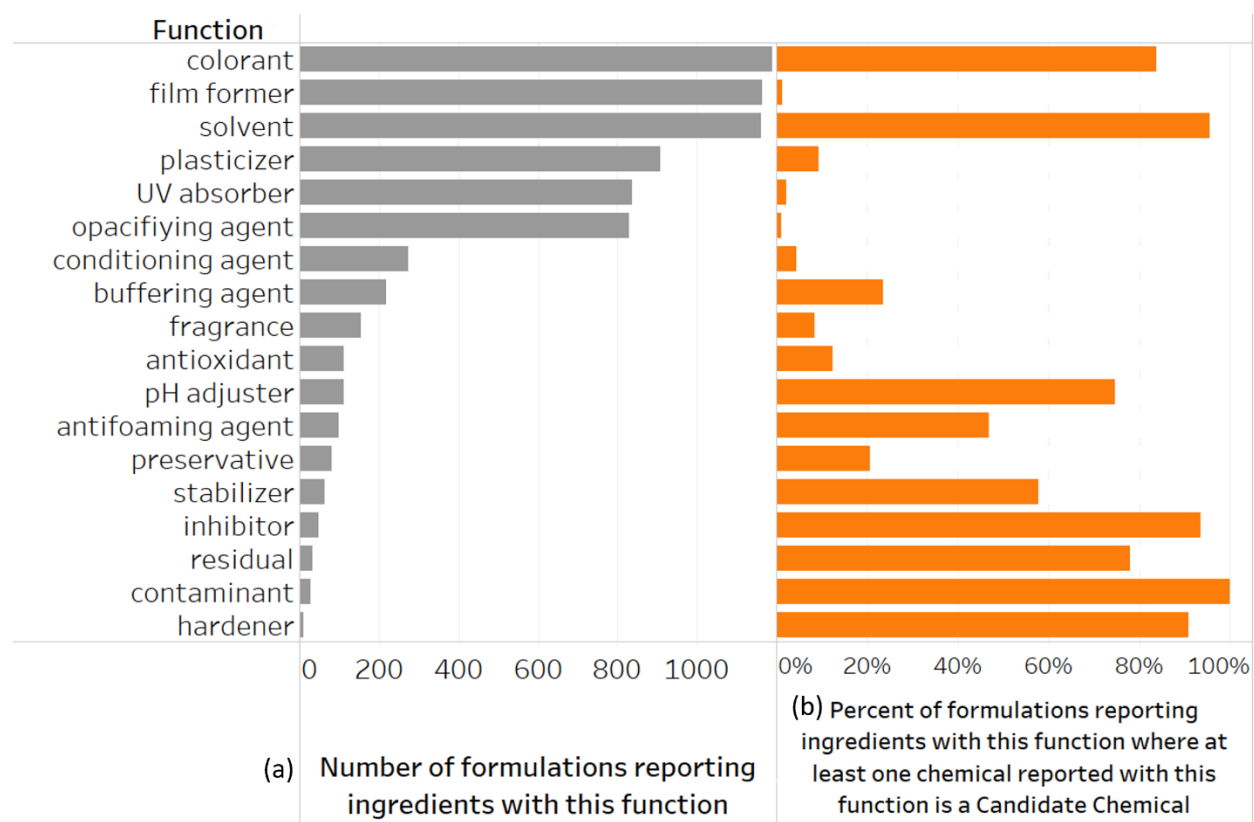


Figure 4. Number of formulations reported for various functions in nail products (a). Percent of formulations that contain at least one Candidate Chemical (CC) reported with that function (b). Number of formulations with that reported function that were less than ten are not shown in this figure.

Solvents

There were 1,161 reported formulations that contained solvents. Of those, 1,111 (95.7%) reported using at least one CC as a solvent, and 50 (4.3%) reported using solvents that are not on the CC List (see Appendix 4). There were 18 CCs reported as solvents in various nail product formulations (see Table 3). There were some formulations that reported more than one CC as a solvent. The most prevalently reported CCs used as solvents were ethyl acetate and isopropanol (IPA) (see Table 3).

Table 4. List of Candidate Chemicals (CCs) reported as solvents in various nail products.

Candidate Chemical name	CAS RN	Percent of formulations containing this Candidate Chemical (CC) as a solvent out of all formulations where a CC is used as a solvent *
Ethyl acetate	141-78-6	96.0%
Isopropanol (IPA)	67-63-0	87.4%
n-Butanol	71-36-3	23.2%
Acetone	67-64-1	5.0%
Triphenyl phosphate (TPhP)	115-86-6	4.4%
Heptane	142-82-5	1.4%
Methyl ethyl ketone (MEK)	78-93-3	1.4%
Xylenes	1330-20-7	0.3%
2-Butoxyethanol	111-76-2	0.2%
Benzaldehyde	100-52-7	0.2%
Decamethylcyclopentasiloxane (D5)	541-02-6	0.2%
Methyl isobutyl ketone	108-10-1	0.2%
Toluene	108-88-3	0.2%
Distillates (petroleum), hydrotreated middle	64742-46-7	0.1%
Dodecamethylcyclohexasiloxane (D6)	540-97-6	0.1%
Naphtha (petroleum), light alkylate	64741-66-8	0.1%
Propyleneglycol monomethyl ether	107-98-2	0.1%
Tert-butyl alcohol (TBA)	75-65-0	0.1%

**Some formulations contained more than one CC as a solvent. As a result, total percent of formulations containing CCs reported as solvents exceeds 100%.*

All of the solvent-containing formulations for six subproduct categories contained at least one CC as a solvent (see Table 4). These subproduct categories are traditional nail polish, top coat, base coat, primers/bonders/bond-aid products, hardeners, and gel polish/gel-like polish (no UV required). This finding suggests that companies may not currently formulate these subproduct categories without using CCs as solvents.

In contrast, some of the solvent-containing formulations for 13 subproduct categories did not report using any CCs as solvents (see Table 4). These subproduct categories are UV gel polish, removers, thinners, hard gel, UV gel top coat, UV gel base coat, nail glues/resins/dipping resins, skin/cuticle cream and other lotions, nail drying agents, sprays/aerosols/drops, nail oils, UV gel artificial nail, and water-based polish. This finding suggests that at least some of the products in these categories are manufactured without using CCs as solvents and may represent the availability of safer alternatives to fulfill the functional need for solvents in these products. However, DTSC has not evaluated the safety of potential alternative nail product solvent chemicals that are not on the CC List (see Appendix 5).

Table 5. Solvent-containing formulations by subproduct type. Subproducts that are categorized as “other” in the “Nail Products Information Call-in Process” section are excluded from this table.

Subproduct type	Number of solvent-containing formulations that reported at least one CC as a solvent	Number of solvent-containing formulations that did not report any CCs as solvents	Number of CCs reported as a solvent for a subproduct type
traditional nail polish (aka varnish, lacquer, enamel)	874	0	7
top coat	35	0	8
base coat	28	0	6
primers/bonders/bond-aid products	12	0	4
hardeners	6	0	5
gel polish/gel-like polish (no UV required)	2	0	4
UV gel polish	59	4	6
removers	22	2	5
thinners	7	1	6
hard gel	5	1	1
UV gel top coat	4	1	2
UV gel base coat	4	2	4
nail glues /resins/dipping resins	3	1	2
skin/cuticle cream and other lotions	2	11	2
nail drying agents, sprays/aerosols/drops	2	5	2
nail oils	2	5	3
UV gel artificial nail	2	3	1

Subproduct type	Number of solvent-containing formulations that reported at least one CC as a solvent	Number of solvent-containing formulations that did not report any CCs as solvents	Number of CCs reported as a solvent for a subproduct type
water-based polish	1	2	4
airbrush nail art paint	0	1	0

Colorants

There were 1,190 reported formulations that contained colorants. Of those, 998 (83.9%) reported using at least one CC as a colorant, and 192 (16.1%) reported using colorants that are not on the CC List (see Appendix 4). There were 16 CCs reported with a functional use as a colorant in various nail product formulations (see Table 5). Some formulations reported more than one CC as a colorant. The most prevalently reported CC used as a colorant was titanium dioxide (see Table 5). Other CCs that were prevalently reported as colorants were carbon black and aluminum.

Table 6. List of Candidate Chemicals (CCs) reported as colorants in various nail products.

Candidate Chemical name	CAS RN	Percent of formulations containing this Candidate Chemical (CC) as a colorant out of all formulations where a CC is used as a colorant *
Titanium dioxide	13463-67-7	92.5%
Carbon black	1333-86-4	28.9%
Aluminum	7429-90-5	21.0%
D & C Red No. 30	2379-74-0	12.3%
Silver	7440-22-4	5.7%
2-Naphthalenol, 1-[4-(phenylazo)phenyl]azo-	85-86-9	4.2%
Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-	6300-37-4	3.2%
2-Naphthalenol, 1-[(2-chloro-4-nitrophenyl)azo]-	2814-77-9	1.9%
Copper	7440-50-8	1.3%
D & C Red No. 21	15086-94-9	1.0%
Iron	7439-89-6	0.3%
D & C Red No. 27	2134-15-8	0.2%
C. I. Pigment Red	6410-41-9	0.1%
Benzyl violet 4B	1694-09-3	0.1%
Phosphoric acid	7664-38-2	0.1%
Tin	7440-31-5	0.1%

**Some formulations contained more than one CC as a colorant. As a result, total percent of formulations containing CCs reported as colorants exceeds 100%.*

The traditional nail polish and UV gel polish subproduct categories had the highest number of formulations that contained at least one CC functioning as a colorant (824 and 92, respectively). Four subproduct categories – acrylic liquid monomers, nail drying agents, sprays/aerosols/drops, and nail glues/resins/dipping resins formulations – did not contain any CCs as colorants (see Table 6). Some subproduct categories – such as traditional nail polish (aka varnish, lacquer, enamel), UV gel polish, and UV gel top coat – contained as many as 10 different CCs reported as colorants across all formulations, whereas other subproduct categories – such as nail oils, removers, hardeners, primers/bonders/bond-aid products, and skin/cuticle cream and other lotions – contained only one or two CCs reported as colorants.

Table 7. Colorant-containing formulations by subproduct type. Subproducts that are categorized as “other” in the “Nail Products Information Call-in Process” section are excluded from this table.

Subproduct type	Number of colorant-containing formulations that reported at least one CC as a colorant	Number of colorant-containing formulations that did not report any CCs as colorants	Number of CCs reported as a colorant for a subproduct type
gel polish/gel-like polish (no UV required)	2	0	6
water-based polish	2	0	6
traditional nail polish (aka varnish, lacquer, enamel)	824	49	13
UV gel polish	92	2	12
acrylic powders (including dipping powders)	19	2	9
hard gel	12	5	9
base coat	10	15	7
UV gel artificial nail	6	5	7
nail oils	4	5	2
UV gel top coat	3	12	10
removers	3	10	2
top coat	2	26	6
hardeners	2	3	2
primers/bonders/bond-aid products	2	1	2
UV gel base coat	1	7	7
skin/cuticle cream and other lotions	1	9	1
acrylic liquid monomers	0	12	0

Subproduct type	Number of colorant-containing formulations that reported at least one CC as a colorant	Number of colorant-containing formulations that did not report any CCs as colorants	Number of CCs reported as a colorant for a subproduct type
nail drying agents, sprays/aerosols/drops	0	2	0
nail glues/resins/dipping resins	0	1	0

Plasticizers

There were 907 reported nail product formulations that contain plasticizers. Of those, 84 (9.3%) reported using at least one CC as a plasticizer, and 823 (90.7%) reported using plasticizers that are not on the CC List (see Appendix 4). There were only four CCs – diethyl hexyl adipate, n-butanol, tricresyl phosphate, and triphenyl phosphate (TPhP) – reported as plasticizers in various nail product formulations. The most prevalently reported CC used as a plasticizer was TPhP (see Table 7). Some formulations contained more than one CC reported as a plasticizer (see Table 7).

Table 8. List of Candidate Chemicals (CCs) reported as plasticizers in various nail products.

Candidate Chemical (CC) name	CAS RN	Percent of formulations containing this Candidate Chemical (CC) as a plasticizer out of all formulations where a CC is used as a plasticizer *
Triphenyl phosphate (TPhP)	115-86-6	96.4%
Diethyl hexyl adipate	103-23-1	3.6%
n-Butanol	71-36-3	1.2%
Tricresyl phosphate	1330-78-5	1.2%

**Some formulations contained more than one CC as a plasticizer. As a result, total percent of formulations containing CCs reported as plasticizers exceeds 100%.*

Some plasticizer-containing formulations in seven subproduct categories did not contain any CCs as plasticizers (see Table 8). These subproduct categories are traditional nail polish (aka varnish, lacquer, enamel), UV gel polish, top coat, base coat, hardeners, gel polish/gel-like polish (no UV required), and water-based polish. All of the plasticizer-containing formulations in five subproduct categories – hard gel, UV gel base coat, UV gel top coat, primers/bonders/bond-aid products, and skin/cuticle cream and other lotions – did not contain any CCs as plasticizers. These findings suggest that some products may be manufactured without the need for CCs as plasticizers. However, DTSC has not evaluated the safety of potential alternative nail product plasticizer chemicals that are not on the CC List (see Appendix 6).

Table 9. Plasticizer-containing formulations by subproduct type. Subproducts that are categorized as “other” in the “Nail Products Information Call-in Process” section are excluded from this table.

Subproduct type	Number of plasticizer-containing formulations that reported at least one CC as a plasticizer	Number of plasticizer-containing formulations that did not report any CCs as plasticizers	Number of CCs reported as a plasticizer for a subproduct type
traditional nail polish (aka varnish, lacquer, enamel)	33	726	3
UV gel polish	24	29	1
top coat	9	20	2
base coat	7	19	1
hardeners	2	3	2
gel polish/gel-like polish (no UV required)	1	1	1
water-based polish	1	1	1
hard gel	0	2	0
UV gel base coat	0	2	0
UV gel top coat	0	3	0
primers/bonders/bond-aid products	0	3	0
skin/cuticle cream and other lotions	0	1	0

Contaminants and Residuals

Only five of the 31 companies that responded to the information call-in reported that their formulations contain contaminants and residuals. Four of those companies reported that their formulations contain CCs as contaminants or residuals. Some stakeholders reported a CC as a contaminant, and some stakeholders reported the same CC as a residual in their formulations. However, stakeholders did not report what they considered to be the distinctions between residuals and contaminants.

There were 28 formulations reported with contaminants, all of which contained at least one CC. There were 32 formulations reported with residuals, and 25 (78.1%) of them contained at least one CC (see Appendix 4). There were 49 CCs reported as contaminants or residuals in various nail product formulations (see Appendix 7). Dibutyl phthalate (DBP), formaldehyde, toluene, and xylenes were reported as contaminants or residuals in more than 40% of the formulations that contain at least one CC as a contaminant or a residual (see Appendix 7).

Summary of Findings on Reported Candidate Chemicals

In total, there were 97 CCs reported across all nail products (see Table 2). In most formulations, these CCs were reported as having several different functional uses. In some formulations, some of these CCs were also reported as contaminants or residuals (see “Functions of Candidate Chemicals Reported in Nail Products” section). Several of these CCs are carcinogens, neurotoxicants, reproductive toxicants, developmental toxicants, endocrine toxicants, respiratory toxicants, and dermatotoxicants.

DTSC previously evaluated 38 chemicals in various nail products – 33 of those chemicals are CCs and five of them are not on the CC List – and summarized its findings in [Chemicals in Nail Products Background Document](#) (DTSC 2022b). In this information call-in, stakeholders reported 22 of those 33 CCs. The remaining 11 CCs previously evaluated by DTSC were not reported in this information call-in. As a result of that evaluation, DTSC proposed nail products containing toluene and methyl methacrylate (MMA) as Priority Products (DTSC 2020a; DTSC 2020b). In addition, DTSC has proposed listing nail products containing triphenyl phosphate (TPHP) as a Priority Product and is currently drafting a Product-Chemical Profile to support this proposal (DTSC 2022b).

The information received from this information call-in for those 22 previously evaluated CCs is provided in Table 9. The associated hazard traits and exposure potential from the use of these 22 CCs in nail products, as previously reported by DTSC, are summarized in the “Summary of Findings on Reported Candidate Chemicals that were Previously Evaluated by DTSC” section of this report. Before this information call-in, DTSC was unaware of the presence of 75 of the 97 reported CCs in nail products. Forty-four of those 75 CCs were identified to have human health hazard traits, as documented by the Authoritative Lists that make up DTSC’s CC List (see Table 9). DTSC has not evaluated the hazard traits and exposure potential of these 44 CCs. The most up-to-date hazard trait information for these chemicals can be found on the Authoritative Lists upon which each chemical appears. DTSC may evaluate these 44 CCs for human health hazard traits and relevant exposure routes from various nail product types in the future. The remaining 31 of those 75 CCs are on the CC List because they are either on an exposure-based list or have environmental hazard traits but do not have human health hazard traits that have been documented by the Authoritative Lists as referenced by the CC List (see Appendix 8).

Table 10. List of reported Candidate Chemicals (CCs) in nail products that have human health hazard traits as documented by the Authoritative Lists that are referenced by [DTSC's CC List](#). DTSC's CC List is a dynamic list and should be referred to for the most up-to-date hazard trait information for the CCs listed in this table. Formulation information contains common ingredients reported for a particular subproduct type (e.g., nail polish). Product information contains common ingredients of a formulation for a particular subproduct type and additional ingredients (e.g., colorants) that make up the unique product (see section "Reported Formulations and Products"). See Table A2.1 in Appendix 2 for concentration ranges defined by DTSC. Stakeholders did not report whether these percentages of concentration ranges were by weight or volume. Some stakeholders reported a CC as a contaminant in their formulations, while some stakeholders reported the same CC as a residual. Stakeholders did not report what they considered to be the distinctions between the residual CC and contaminant CC.

*These are the 22 CCs that were previously evaluated by DTSC in nail products.

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
2-(4-tert-Butylbenzyl)propionaldehyde	80-54-6	7	13	37	more than zero but less than 5%	fragrance	other nail products and solvent-based nail coatings
2-Butoxyethanol	111-76-2	2	3	12	more than 0.1% but less than 5%	solvent	other nail products and solvent-based nail coatings
Acetaldehyde	75-07-0	1	1	1	more than zero but less than 0.1%	residual	other nail products
Acetone *	67-64-1	16	63	850	more than zero up to 100%	solvent and denaturant	other nail products, solvent-based nail coatings, and UV gel nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Acrylic acid *	79-10-7	5	7	72	more than 0.5% but less than 25%	artificial nail builder, binder/adhesive, and conditioning agent	UV gel nail products
Alpha-methyl styrene	98-83-9	1	1	1	more than zero but less than 0.1%	residual	other nail products
Aluminum *	7429-90-5	23	225	10,995	more than zero but less than 50%	colorant, filler, bulking agent, opacifying agent, buffering agent, and shimmer effect	liquid-powder system artificial nail products, other nail products, solvent-based nail coatings, and UV gel nail products
Arsenic	7440-38-2	1	13	629	more than zero but less than 0.1%	contaminant and residual	other nail products, solvent-based nail coatings, and UV gel nail products
Benzene	71-43-2	2	4	35	more than zero but less than 0.1%	contaminant and residual	other nail products, solvent-based nail coatings, and UV gel nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Benzene-1,2:4,5-tetracarboxylic dianhydride	89-32-7	1	1	1	more than zero but less than 0.1%	residual	UV gel nail products
Benzo[a]pyrene	50-32-8	1	3	375	more than zero but less than 0.1%	contaminant	solvent-based nail coatings
Benzophenone*	119-61-9	5	9	39	more than zero but less than 10%	UV absorber, color protector, and initiator	other nail products, solvent-based nail coatings, and UV gel nail products
Benzophenone-3 *	131-57-7	10	20	1,279	more than zero but less than 5%	UV absorber, preservative, light stabilizer, and stabilizer	other nail products and solvent-based nail coatings
Benzyl violet 4B	1694-09-3	1	1	1	more than 0.1% but less than 0.5%	colorant	other nail products
Butylated hydroxyanisole (BHA) *	25013-16-5	4	4	33	more than 0.1 but less than 0.5%	preservative, antioxidant, and fragrance	other nail products
Butylbenzyl phthalate (BBP)	85-68-7	1	1	45	more than zero but less than 0.1%	contaminant	solvent-based nail coatings

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Butylparaben	94-26-8	1	2	2	more than 0.5% but less than 1%	not reported	other nail products
Cadmium	7440-43-9	1	6	571	more than zero but less than 0.1%	contaminant	other nail products, solvent-based nail coatings, and UV gel nail products
Carbon black *	1333-86-4	21	290	11,124	more than zero but less than 50%	colorant	liquid-powder system artificial nail products, solvent-based nail coatings, and UV gel nail products
Chromium	7440-47-3	1	6	527	more than zero but less than 0.1%	contaminant	liquid-powder system artificial nail products, solvent-based nail coatings, and UV gel nail products
Cobalt	7440-48-4	1	3	196	more than zero but less than 0.1%	contaminant	other nail products, solvent-based nail coatings, and UV gel nail products
Coconut oil diethanolamine condensate	68603-42-9	1	1	1	more than 0.5% but less than 1%	not reported	other nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Copper	7440-50-8	4	16	7,569	more than zero but less than 50%	colorant and contaminant	liquid-powder system artificial nail products, solvent-based nail coatings, and UV gel nail products
Cumene	98-82-8	1	1	1	more than zero but less than 0.1%	residual	other nail products
Dibenzo[a,h]anthracene	53-70-3	1	3	375	more than zero but less than 0.1%	contaminant	solvent-based nail coatings
Dibutyl phthalate (DBP) *	84-74-2	3	18	217	more than zero but less than 0.1%	residual and contaminant	other nail products, solvent-based nail coatings, and UV gel nail products
Dibutyltin dilaurate	77-58-7	1	4	177	more than zero but less than 0.1%	residual	UV gel nail products
Diisobutyl phthalate (DIBP)	84-69-5	1	1	45	more than zero but less than 0.1%	contaminant	solvent-based nail coatings
Distillates (petroleum), hydrotreated middle	64742-46-7	1	1	13	more than 0.1% but less than 0.5%	solvent	other nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Ethyl acetate *	141-78-6	27	1,093	9,335	more than zero up to 100%	solvent, fragrance, and residual	other nail products, solvent-based nail coatings, and UV gel nail products
Formaldehyde *	50-00-0	4	21	213	more than zero but less than 5%	residual, contaminant, hardener, and cross-linker	other nail products, solvent-based nail coatings, and UV gel nail products
Ginkgo biloba extract	90045-36-6	2	2	438	more than zero but less than 0.1%	conditioning agent	other nail products and solvent-based nail coatings
Isobutane *	75-28-5	2	2	2	more than 75% up to 100%	propellant	other nail products
Isopropyl alcohol (isopropanol or IPA) *	67-63-0	27	1,045	9,299	more than zero up to 100%	solvent, antifoaming agent, cleansing, and residual	other nail products, solvent-based nail coatings, and UV gel nail products
Lead	7439-92-1	1	15	631	more than zero but less than 0.1%	contaminant	liquid-powder system artificial nail products, other nail products, solvent-based nail

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
							coatings, and UV gel nail products
Mercury	7439-97-6	1	13	629	more than zero but less than 0.1%	contaminant	other nail products, solvent-based nail coatings, and UV gel nail products
Methanol	67-56-1	1	3	167	more than zero but less than 0.5%	residual	other nail products and solvent-based nail coatings
Methyl ethyl ketone (MEK) *	78-93-3	10	19	53	more than zero up to 100%	solvent and residual	other nail products, solvent-based nail coatings, and UV gel nail products
Methyl isobutyl ketone	108-10-1	3	3	4	more than 0.5% but less than 5%	denaturant and solvent	other nail products
Methyl methacrylate (MMA) *	80-62-6	4	5	5	more than zero but up to 100%	binder/ adhesive and residual	liquid-powder system artificial nail products, and solvent-based nail coatings
N,N-dimethyl-p-toluidine (DMPT) *	99-97-8	10	21	39	more than zero but less than 5%	accelerator, activator/ curing catalyst, artificial nail	liquid-powder system artificial nail products and other nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
						builder, binder/ adhesive, conditioning agent, contaminant, and film former	
Naphtha (petroleum), light alkylate	64741-66-8	1	1	2	more than 25% but less than 50%	solvent	other nail products
n-Butane *	106-97-8	1	1	1	more than 0.5 but less than 1%	residual	other nail products
n-Butanol	71-36-3	20	273	2,363	more than zero but less than 10%	solvent, film former, plasticizer, denaturant, conditioning agent, fragrance, and residual	other nail products, solvent-based nail coatings, and UV gel nail products
n-Hexane	110-54-3	1	1	1	more than zero but less than 0.1%	residual	other nail products
Nickel	7440-02-0	1	6	363	more than zero but less than 0.1%	contaminant	liquid-powder system artificial nail products, other nail

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
							products, solvent-based nail coatings, and UV gel nail products
Nickel carbonyl	13463-39-3	1	1	165	more than zero but less than 0.1%	contaminant	solvent-based nail coatings
Petrolatum	8009-03-8	2	2	2	more than 1% but less than 10%	conditioning agent and resin	other nail products
Petrolatum (petroleum), alumina-treated	85029-74-9	1	5	5	more than 1% but less than 25%	not reported	other nail products
Phenol	108-95-2	1	2	24	more than zero but less than 0.1%	residual	other nail products and solvent-based nail coatings
Phosphoric acid *	7664-38-2	16	137	1,413	more than zero but less than 1%	pH adjuster, viscosity controller, buffering agent, abrasive, and colorant	other nail products, solvent-based nail coatings, and UV gel nail products
Propionaldehyde	123-38-6	1	1	1	more than zero but less than 0.1%	residual	other nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Propylene oxide	75-56-9	1	4	186	more than zero but less than 0.1%	contaminant and residual	UV gel nail products
Propyleneglycol monomethyl ether	107-98-2	1	1	4	more than 0.5% but less than 1%	solvent	other nail products
Selenium	7782-49-2	1	1	30	more than zero but less than 0.1%	contaminant	solvent-based nail coatings
Silica *	14808-60-7	1	1	1	more than 1% but less than 5%	not reported	UV gel nail products
Sodium hydroxide	1310-73-2	4	5	17	more than zero but less than 0.5%	buffering agent and pH adjuster	other nail products
Sodium N-(hydroxymethyl)glycinate	70161-44-3	1	1	1	more than 0.5% but less than 1%	conditioning agent	other nail products
Styrene	100-42-5	1	2	24	more than zero but less than 0.1%	residual	other nail products and solvent-based nail coatings
Tert-butyl alcohol (TBA) *	75-65-0	4	8	29	more than zero but less than 0.1%	solvent, residual, and denaturant	other nail products, solvent-based nail coatings, and UV gel nail products

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
Titanium dioxide *	13463-67-7	26	947	12,287	more than zero but less than 50%	colorant, UV absorber, sun-screening agent, and buffering agent	liquid-powder system artificial nail products, other nail products, solvent-based nail coatings, and UV gel nail products
Toluene *	108-88-3	4	19	183	more than zero but less than 25%	contaminant, residual, and solvent	other nail products, solvent-based nail coatings, and UV gel nail products
Trimethylolpropane triacrylate	15625-89-5	3	13	500	more than 1% but less than 50%	film former	liquid-powder system artificial nail products, and UV gel nail products
Triphenyl phosphate (TPhP) *	115-86-6	10	142	1,154	more than zero but less than 10%	contaminant, plasticizer, and solvent	other nail products, solvent-based nail coatings, and UV gel nail products
Vanadium	7440-62-2	1	1	1	more than zero but less than 0.1%	contaminant	other nail products
Xylenes	1330-20-7	6	22	178	more than zero but less than 50%	contaminant, residual, and solvent	other nail products, solvent-based nail

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC	Main product categories that reported this CC
							coatings, and UV gel nail products

Summary of Findings on Reported Candidate Chemicals that were Previously Evaluated by DTSC

This section summarizes the findings on the 22 CCs reported via this information call-in that DTSC has previously evaluated in nail products. Before this information call-in request, detailed findings of that evaluation were published in the [Chemicals in Nail Products Background Document](#) (DTSC 2022b).

Acetone was most prevalently reported as a solvent in more than 800 products, with concentrations up to 100%. Acetone is identified as a neurotoxicant by the Agency for Toxic Substances and Disease Registry (ATSDR), and exposure to acetone may cause headaches, dizziness, and eye irritation (ATSDR 2022; ECHA 2022a). Adverse impacts from exposure to acetone are generally observed at high concentrations (ATSDR 2022). Further, U.S. EPA exempted acetone from its definition of volatile organic compound (VOC) due to its low reactivity (U.S. EPA 1995).

Acrylic acid was reported by five companies in 72 UV gel nail products. Major reported functions for acrylic acid include conditioning agent (with concentrations ranging from 10% up to 25%) and artificial nail builder (with concentrations ranging from 0.5% up to 5%). Acrylic acid is a respiratory irritant and a dermatotoxicant, and exposure to acrylic acid vapors can cause eye and respiratory irritation (PubChem 2019; ECHA 2022b). Direct skin contact with acrylic acid can cause severe burns and allergic skin reactions (PubChem 2019; ECHA 2022b).

Aluminum was reported in more than 10,000 products as a colorant. While exposure to aluminum from nail products that are not in powder form is unlikely, aluminum exposure may be a concern from products that are powders (e.g., acrylic powders). Aluminum was reported in more than 1,500 acrylic powders, with concentrations up to 50%. Repeated or prolonged inhalation of aluminum dust may cause adverse impacts on the lungs and nervous system (ATSDR 2008; IPCS 2019).

Benzophenone (BP) and benzophenone-3 (BP-3) were reported as UV absorbers, light stabilizers, and color protectors. BP was reported by five companies in 39 products, with concentrations up to 10%. BP-3 was reported by ten companies in more than 1,200 products, with concentrations up to 5%. The International Agency for Research on Cancer (IARC) has listed BP as a possible human carcinogen, and it has also been listed on the Office of Environmental Health Hazard Assessment's (OEHHA's) Proposition 65 (Prop 65) list for carcinogenicity (OEHHA 2012; IARC 2018a). Primary exposure routes to BP from nail products include inhalation and dermal contact (IARC 2013). BP-3 has been shown to cause weak hormonal activity in laboratory animals (CDC 2017); however, the human health effects of BP-3

exposure have not been well-characterized (CDC 2017). Exposure to BP-3 may occur during product application via dermal contact, and it may cause skin allergy (CDC 2017).

Butylated hydroxyanisole (BHA) was reported as a fragrance, a preservative, or an antioxidant in nail glues. There were 47 nail glues reported for this information call-in, and 33 of them contained BHA, with concentrations up to 0.5%. IARC listed BHA as a possible human carcinogen, and it has also been listed on OEHHA's Prop 65 list for carcinogenicity (IARC 1987; OEHHA 1990). Dermal exposure to BHA may occur during use of nail products (NTP 2021a). Current studies are inadequate to evaluate the carcinogenicity of BHA exposure in humans (NTP 2021a).

Carbon black was reported in more than 10,000 products as a colorant. While exposure to carbon black from nail products that are not in powder form is unlikely, carbon black exposure may be a concern from products that are powders (e.g., acrylic powders). Carbon black was reported in more than 1,500 acrylic powders, with concentrations up to 50%. IARC has listed carbon black as a possible human carcinogen, and it has also been listed on OEHHA's Prop 65 list for carcinogenicity (OEHHA 2003; IARC 2010a).

Dibutyl phthalate (DBP) was reported as a contaminant or residual in more than 200 products, with concentrations up to 0.1%. DBP was listed as a developmental and reproductive toxicant on OEHHA's Prop 65 list (OEHHA 2005). Exposure to DBP can occur via inhalation and dermal routes (ASTDR 2001). DBP has been mostly phased out of nail products (Young et al. 2018). In addition, California's Toxic-Free Cosmetics Act bans intentionally added DBP from cosmetics including nail products, effective January 1, 2025 (Toxic-Free Cosmetics Act 2020).

Ethyl acetate was reported by 27 companies as a solvent in 9,140 products, with concentrations up to 100%. Exposure to ethyl acetate can cause eye, skin, and respiratory irritation (NJ Department of Health 2002a). However, ethyl acetate levels measured in salon indoor air did not exceed the California Office of Safety and Health Administration (Cal/OSHA) Permissible Exposure Limit (PEL) of 400 ppm (Quach et al. 2011; Zhong et al. 2019; Ceballos et al. 2019; Cal/OSHA 2022).

Formaldehyde was reported as a hardener or a cross-linker in more than 30 products, with concentrations ranging from 1% up to 5%. It was also reported as a contaminant or a residual in more than 170 products, with concentrations up to 0.1%. Formaldehyde has been listed on OEHHA's Prop 65 list for carcinogenicity and has been listed as a human carcinogen by IARC (OEHHA 1988; IARC 2018b). Exposure to formaldehyde can occur via inhalation or dermal routes (ATSDR 1999). Exposure to formaldehyde can cause eye and skin irritation, respiratory toxicity, and cancer (ATSDR 1999; IARC 2018b). California's Toxic-Free Cosmetics Act bans

intentionally added formaldehyde from cosmetics including nail products, effective January 1, 2025 (Toxic-Free Cosmetics Act 2020).

Isobutane and n-butane were reported in nail drying agents. Isobutane is a structural isomer of n-butane (TCEQ 2015). There were 14 nail drying agents reported for this information call-in. One of them contained n-butane, while two of them contained isobutane. N-butane was reported as a residual with concentrations up to 1%, and isobutane was reported as a propellant with concentrations above 75%. The main exposure route for n-butane and isobutane is inhalation (TCEQ 2012; TCEQ 2015). Both n-butane (containing 0.1% or more 1,3-butadiene) and isobutane (containing 0.1% or more 1,3-butadiene) have been identified as carcinogens by European Community Annex VI Carcinogens, Mutagens, and Reproductive Toxicants (EC Annex VI CMRs) (ECHA 2019a; ECHA 2019b). However, the concentrations of 1,3-butadiene (also a CC) are unknown in the nail products containing n-butane and isobutane reported in this information call-in.

Isopropyl alcohol (IPA) was reported as a solvent and an antifoaming agent by 27 companies in more than 1,000 products at concentrations up to 100%. Inhalation exposure to IPA can cause respiratory and eye irritation (OEHHA 1999a). IPA has been measured in salon indoor air (OEHHA 2008; Quach et al. 2011; Alaves et al. 2013) in concentration ranges that were far below the California Office of Safety and Health Administration (Cal/OSHA) Permissible Exposure Limit (PEL) of 400 ppm (Cal/OSHA 2022). Further, IPA has been verified to be of low concern by the “EPA Safer Chemicals Ingredient List” (U.S. EPA 2019).

Methyl ethyl ketone (MEK) was reported by ten companies in 49 products as a solvent, with concentrations ranging from 0.1% up to 100%. Exposure to MEK from nail products may occur via inhalation and dermal routes, with inhalation likely being the primary route of exposure (NJ Department of Health 2002b). Inhalation exposure to MEK can cause respiratory and eye irritation, headaches, and dizziness (OEHHA 1999b; ATSDR 2020). The Occupational Safety and Health Administration (OSHA) set an inhalation PEL of 200 ppm for MEK (OSHA 2017). However, studies reported MEK concentrations in salon indoor air ranging from 0.01 to 2.14 ppm, which were orders of magnitude lower than the OSHA PEL of 200 ppm (Gjølstad et al. 2006; Nguyen 2016; Grešner et al. 2016; OSHA 2017).

Methyl methacrylate (MMA) was reported as a binder/adhesive in two acrylic liquid monomers, with concentrations above 75%, and as a residual in two acrylic powders and in one traditional nail polish (without functional use information), with concentrations up to 0.1%. MMA is a dermatotoxicant and a respiratory toxicant (DTSC 2020a). Exposure to MMA may occur from nail products via inhalation and dermal routes (DTSC 2020a). Exposure to MMA can cause skin irritation and inflammation, nail damage, and harm to the respiratory tract (DTSC 2020a). DTSC

has proposed nail products containing MMA as a Priority Product, and more information was provided in the [Product-Chemical Profile on Nail Products Containing MMA](#) (DTSC 2020a).

N,N-dimethyl-p-toluidine (DMPT) was reported by ten companies in 39 products, the majority of which (25) were acrylic liquid monomers. DMPT was reported with several different functions, with concentrations up to 5%. DMPT has been identified as a carcinogen on OEHHA's Prop 65 list and a possible human carcinogen by IARC (NTP 2012; OEHHA 2014; IARC 2018c).

Phosphoric acid was reported with several different functions by 16 companies in more than 1,400 products, with concentrations up to 0.1%. The most prevalent functions reported for phosphoric acid were a buffering agent and a pH adjuster in solvent-based nail coatings, UV gel nail products, and some other nail products. OEHHA set a Chronic Reference Exposure Level (REL) for phosphoric acid for harming the respiratory system (OEHHA 2000). Adverse impacts from exposure to phosphoric acid may include respiratory toxicity and irritation of the skin, eyes, and throat (New Jersey Department of Health 2004; NICNAS 2016; PubChem 2022a).

Silica was reported by one company in one UV gel top coat, with concentrations ranging from 1% up to 5%, without functional use information. Crystalline silica in the form of quartz or cristobalite dust has been identified as a human carcinogen by IARC (IARC 2018d). Adverse impacts from silica exposure depend on its particle size and crystallinity (IARC 2012). Inhalation exposure to silica is a concern from nail products that are in powder form. However, there is insufficient information on particle size and crystallinity of silica-containing nail products and a lack of exposure studies to silica from nail products (IARC 2012; NIOSH 2014).

Tert-butyl alcohol (TBA) was reported by four companies as a solvent, a denaturant, or a residual in 29 products, with concentrations up to 0.1%. TBA was listed on DTSC's CC List because of a 1999 OEHHA interim assessment report of TBA in drinking water, which suggested that TBA is a carcinogen based on a National Toxicology Program (NTP) bioassay on rats and mice (OEHHA 1999c). However, TBA has not been listed in OEHHA's Prop 65 list, and no additional OEHHA assessments have been conducted (DTSC 2022b).

Titanium dioxide was reported in more than 10,000 products as a colorant. While exposure to titanium dioxide from nail products that are not in powder form is unlikely, titanium dioxide exposure may be a concern from products that are powders (e.g., acrylic powders). Titanium dioxide was reported in more than 1,500 acrylic powders, with concentrations up to 50%. Titanium dioxide has been identified as a possible human carcinogen by IARC and has been listed on OEHHA's Prop 65 list for carcinogenicity (IARC 2010b; OEHHA 2011). Adverse impacts from titanium dioxide exposure depend on its particle size and crystallinity (NIOSH 2011). However, there is insufficient information on particle size and crystallinity of titanium dioxide-

containing nail products and a lack of exposure studies to titanium dioxide from nail products (NIOSH 2011).

Toluene was reported by four companies in 183 products, 163 of which were traditional nail polish. Toluene was reported in most products as a residual or a contaminant, with concentrations up to 0.1%, and in ten top coats and one thinner as a solvent, with concentrations ranging from 5% up to 25%. Toluene is a neurotoxicant, a developmental toxicant, a respiratory toxicant, and a dermatotoxicant (DTSC 2020b). Exposure to toluene from nail products may occur via inhalation and dermal routes, with inhalation being the primary route of exposure (DTSC 2020b). Exposure to toluene can cause dizziness, headache, fatigue, decreased birth weight, and respiratory tract and skin irritation (DTSC 2020b). DTSC adopted nail products containing toluene as a Priority Product, effective January 1, 2023, and more information on toluene was provided in the [Product-Chemical Profile on Nail Products Containing Toluene](#) (DTSC 2020b).

Triphenyl phosphate (TPhP) was reported by ten companies in 1,154 products. It was reported in most products as a plasticizer and as a solvent in some products, with concentrations up to 10% for both functional uses. Primary exposure to TPhP from nail products is dermal (PubChem 2022b). TPhP may adversely affect the liver and metabolism (Green et al. 2017; Heindel et al. 2017; ANSES 2019). Animal studies have shown that oral exposure to TPhP caused weight gain, fatty liver, insulin resistance, and increased risk of diabetes (Green et al. 2017; Heindel et al. 2017; ANSES 2019). Further, animal studies indicated that TPhP may also be a developmental toxicant (NTP 2021b; Ma et al. 2021).

Nail Products Marketed as “Green” or “Safer”

Only five of the 31 companies responded to DTSC’s questions regarding alternative formulations in nail products that are marketed as “green,” “safer,” “safer for children or pregnant women,” or “free” of specific chemicals. Three of these companies indicated that they did not use “green” or “safer” marketing claims for their products. One company indicated that its products with “green” or “safer” claims were similar to the nail products marketed without such claims, suggesting there may be no basis for describing the products as “safer.” Another company indicated that it increased the number of ingredients from natural sources in its traditional nail polish formulations and, therefore, claimed those nail polishes were “greener.” This company listed ethyl acetate as one of the “greener” chemicals in its nail polish formulation, a chemical that is on DTSC’s CC List. This finding indicated that some of the nail products that are marketed as “green” or “safer” may contain CCs.

CONCLUSIONS

Thirty-one of the 186 stakeholders on [DTSC's nail products information call-in Response Status List \(RSL\)](#) provided information to DTSC. As a result, the information in this report may not be representative of all nail products on the California market. The 31 stakeholders reported 97 chemicals with their associated CAS RNs in nail products that were identified as CCs on [DTSC's CC List](#). These 97 CCs make up 11% of all the chemicals reported by stakeholders.

DTSC previously evaluated 38 chemicals in various nail products – 33 of those chemicals are CCs and five of them are not on the CC List – and summarized its findings in [Chemicals in Nail Products Background Document](#) (DTSC 2022b). In this information call-in, stakeholders reported 22 of those 33 CCs. The remaining 11 CCs previously evaluated by DTSC were not reported in this information call-in.

Before this information call-in, DTSC was unaware of the presence of 75 of the 97 reported CCs in nail products. Forty-four of those 75 CCs were identified to have human health hazard traits, as documented by the Authoritative Lists that are referenced by the CC List, and DTSC may evaluate them in the future. The remaining 31 of those 75 CCs are either on an exposure-based list or have environmental hazard traits but do not have human health hazard traits that have been documented by the Authoritative Lists that are referenced by DTSC's CC List. Several of these CCs are carcinogens, neurotoxicants, reproductive toxicants, developmental toxicants, endocrine toxicants, respiratory toxicants, and dermatotoxicants. Some CCs were reported with several different functional uses in formulations, some were reported as contaminants or residuals, and some were reported without any functional use information. The most prevalently reported functions for all reported chemicals were colorants, film formers, solvents, plasticizers, UV absorbers, and opacifying agents. Among those prevalently reported functions, colorants, solvents, and plasticizers had the highest percentage of instances where the functional use was fulfilled by a Candidate Chemical. Some nail product formulations used chemicals that are not on the CC List as solvents or plasticizers. This may indicate that those nail product types could be manufactured without using CCs and may be utilizing safer alternatives to fulfill those functions. However, DTSC has not evaluated the safety of those chemicals that are not on the CC List, as compared with the CCs reported with the same functional uses. Only five of the 31 stakeholders reported contaminants or residuals in their submittals. This may indicate that other stakeholders either failed to report contaminants or residuals in their submittals or may not have the analytical data for trace chemicals that could be contaminants or residuals in their products. Moreover, only five of the 31 stakeholders responded to DTSC's questions regarding alternative formulations in nail products marketed as "green" or "safer" and how those formulations may differ from those in other nail products without such claims.

The responses indicated that there may be no basis for describing these products as “safer” than nail products that do not make such claims.

A summary of the findings from this information call-in provides insight into the use of potentially harmful chemicals in nail products, based on their presence on DTSC’s CC List. In addition, these findings increase understanding of the prevalence, functional uses, product types, and concentration ranges of ingredients, contaminants, and residuals that are found in nail products. Therefore, this information can help DTSC in prioritizing the evaluation of additional CCs in nail products in the future. Further, functional use information provided in this report on chemicals that are not on the CC List may be helpful in seeking safer alternatives to CCs that are currently fulfilling those functions in nail products.

ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
BBP	butylbenzyl phthalate
BP	benzophenone
BP-3	benzophenone-3
CA NLS	California Notification Levels
Cal/OSHA	California Office of Safety and Health Administration
CARB	California Air Resources Board
CAS RN	Chemical Abstracts Service Registry Number
CC	Candidate Chemical
CCR	California Code of Regulations
CDC	Centers for Disease Control and Prevention
CECBP	California Environmental Contaminant Biomonitoring Program
CWA	Clean Water Act
D&B	Dun & Bradstreet
DBP	dibutyl phthalate
DIBP	diisobutyl phthalate
DMPT	N,N-dimethyl-p-toluidine
DTSC	Department of Toxic Substances Control
EC	European Community
EC Annex VI CMRs	European Community Annex VI Carcinogens, Mutagens, and Reproductive Toxicants
EDs	Endocrine Disruptors
IARC	International Agency for Research on Cancer
IRIS	Integrated Risk Information System
IPA	isopropanol
INCI name	International Nomenclature Cosmetic Ingredient name
LED	light-emitting diode
MCL	Maximum Contaminant Level
MMA	methyl methacrylate
NTP	National Toxicology Program
NWMP	National Waste Minimization Program
OEHHA	Office of Environmental Health Hazard Assessment
OHAT	Health Assessment and Translation
OSHA	Occupational Safety and Health Administration
PBiT	persistent, bioaccumulative, and inherently toxic to the environment
PBTs	persistent, bioaccumulative, and toxic chemicals
PEL	permissible exposure limit
pH	potential hydrogen
PRL	Partner Recognition List
Prop 65 list	Proposition 65 list
REL	Reference Exposure Level
RoC	Report on Carcinogens

RSL	Response Status List
SCP	Safer Consumer Products
TMPTA	trimethylolpropane triacrylate, technical grade
TPhP	triphenyl phosphate
U.S. EPA	United States Environmental Protection Agency
UV	ultraviolet
WA	Washington

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APPENDIX 1 – REPORT PREPARATION

Report Preparation

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APPENDIX 2 – INFORMATION CALL-IN STAKEHOLDER QUESTIONS

For this information call-in request, nail product stakeholders received a stakeholder notification letter with questions regarding “Nail Product Formulations” and “Nail Products Marketed with Greener or Safer Claims.” The stakeholder letter also included definitions of nail product categories (as provided in the “Nail Products Information Call-in Process” section of this report). Questions provided to stakeholders for this information call-in request are listed below.

A. Nail Product Formulations

Please answer the questions below for each nail product your company manufactures or sells in any of the categories and subcategories as defined by DTSC.

- 1.** For each product covered by this submittal, what are the added ingredients (please specify INCI¹ names and CAS RN), their functional uses (e.g., solvents, plasticizers, initiators, inhibitors, catalysts, colorants, fragrances, etc.), and their concentrations? Please specify whether the reported values represent percentage by weight or percentage by volume. At your option, you may provide an upper and a lower limit for each ingredient’s typical concentration range rather than its exact concentration; please use the range codes listed in Table A2.1, below.
- 2.** For each product covered by this request, what are the typical impurities, if any, that you are aware of (e.g., byproducts, degradants, residuals, or contaminants) and their concentrations? Please specify whether the reported values represent percentage by weight or percentage by volume. At your option, you may provide an upper and a lower limit for each impurity’s typical concentration range rather than its exact concentration; please use the range codes listed in Table A2.1, below.
- 3.** If you have any analytical data from quality control product testing (e.g., analytical data showing presence of byproducts, degradants, residuals, or contaminants) done by your company or a third party, please provide it to DTSC.

¹ **INCI** stands for International Nomenclature of Cosmetic Ingredients. It is a system for naming ingredients used in soaps and cosmetics created by the International Nomenclature Committee.

Table A2.1. DTSC’s concentration range guidance for reporting ingredients and impurities in nail products.

Concentration range	Range code
More than 0% but less than 0.1%	1
Equal to or more than 0.1% but less than 0.5%	2
Equal to or more than 0.5% but less than %1	3
Equal to or more than 1% but less than 5%	4
Equal to or more than %5 but less than 10%	5
Equal to or more than 10% but less than 25%	6
Equal to or more than 25% but less than 50%	7
Equal to or more than 50% but less than 75%	8
Equal to or more than 75% up to 100%	9

B. Alternative Formulations in Nail Products Marketed As “Green,” “Safer,” “Safer for Children or Pregnant Women,” or “Free” of Specific Chemicals

Please answer the following questions for each nail product your company manufacturers or sells in the categories and subcategories defined above that is marketed as “green,” “safer,” “safer for children or pregnant women,” or “free” of specific chemicals:

1. How do these products differ from other products you manufacture or sell without these claims?
2. What are the “safer” alternative chemicals used in these products?
3. What attributes of these chemicals led you to conclude they are safer and functionally acceptable (e.g., hazards, exposure potential, functional use, availability, etc.)?
4. Are these alternatives functionally equivalent to the potentially hazardous chemicals currently used in products without these claims?
5. What are the obstacles to the wider adoption of these alternative chemicals?

APPENDIX 3 – DATA ANALYSIS AND ASSUMPTIONS

A. Data Analysis

Data were submitted to DTSC in various formats, including PDF, excel pivot tables, and a DTSC-provided excel template. Data provided to DTSC in formats other than the DTSC-provided template were transferred to the DTSC template to be made suitable for analysis. Company names and product names were then removed to protect confidential business information (CBI). Once all data were transformed to conform with the DTSC template, data from each company were imported into a software tool called “R” and reviewed and cleaned for incorrect reporting, including:

- running a CAS validation script to ensure the reported CAS RNs were valid for their reported chemical names,
- checking the reported chemical names on ChemIDPlus to ensure the reported CAS RNs matched their reported chemical names,
- cleaning and normalizing categorical variables of interest to DTSC, such as function or range code,
- compiling the data into a format that could be queried and connected to Tableau, a software tool, for data exploration and visualization, and
- comparing the reported chemicals, by CAS RN, to DTSC’s Candidate Chemicals List (CC List) via R to identify the Candidate Chemicals among the reported chemicals.

Since chemical nomenclature can vary substantially, CAS RN was used as the unique identifier, and this report discusses the identified CCs using the CAS RNs listed on the CC List. Additional efforts are underway to review other chemicals reported via this information call-in for potential membership in named chemical classes on the CC List. In the future, DTSC may further evaluate reported chemicals that belong to named chemical classes on the CC List. At this time, DTSC did not evaluate the chemicals that could be considered CCs by virtue of their membership in a named chemical class on the CC List (i.e., chemicals that were not reported with CAS RNs).

B. Assumptions

We made the following data adjustments and assumptions during our analysis to address data gaps due to incomplete data or to correct incorrectly reported data.

- If the Chemical International Nomenclature Cosmetic Ingredient (INCI) name did not match the reported CAS RN, we assumed that the CAS RN was reported incorrectly, and we corrected the CAS RN using the associated Chemical INCI name.

- If there was more than one concentration range reported for the same chemical for a given formulation, we used the upper concentration range, because the upper range code represents the maximum concentration reported for that chemical.
- Some chemicals were reported without a CAS RN. If the chemical was easily identified by an organic chemist to be an individual substance known to have a unique CAS RN, the chemical's CAS RN, as it appeared in ChemIDPlus, was assigned to that chemical.
- If the CAS RN field contained multiple CAS RNs, each CAS RN was separately compared to the CC List to look for matches. If a match was found, the chemical with that CAS RN was excerpted and given its own row in the database and assigned the same categorical data as its parent row of data.
- If a reported CAS RN failed the CAS validation test (e.g., reported CAS RN did not exist), the chemical name was used to look up the chemical's CAS RN on ChemIDPlus and corrected if the CAS number was an obvious typo, such as one digit being off or a letter being included in the CAS number.
- Some CAS RN fields were reported as European Community (EC) numbers instead of CAS RNs. In those instances, the chemical name was used to look up the CAS RN and to confirm that the EC number could be linked to the CAS RN identified for the chemical.
- While some chemicals could be CCs by virtue of belonging to a chemical class included in the CC List, these chemicals were not included in this report.
- Some ingredients were reported as mixtures in product formulations, as proprietary substances, or with names that could not be used to assess or understand anything about the chemical's structure, such as "fragrance" or "chemical A." Ingredients that fit these descriptions were excluded from this evaluation.
- Product data received in response to this information call-in request was only partial. About 50% of the stakeholders did not provide the number of unique products they make or sell for their reported formulations. For stakeholders that provided product numbers, DTSC accepted estimated product numbers. For stakeholders that did not provide product numbers, we assumed the product number as "one" for each unique reported formulation. Therefore, product numbers in this report are estimates.
- Efforts were made to clean and normalize the functional use data reported for chemicals to facilitate analysis. For example, the function described in this report as "colorant" includes functions reported to DTSC as "color," "colorant," "pigment," and "color additive."
- Companies did not consistently report whether the ingredients in the reported formulations were "listed" or whether their products "may contain" those ingredients (e.g., the reported base formulation for a colored nail polish containing all possible colorants that might appear in that nail polish). Because these data were not reported consistently and there was no way to differentiate how the "may contain" ingredients

might be distributed across the products based upon a base formulation, all ingredients were treated as listed.

- About 4% of the data records for reported formulations did not contain functional use information for the reported chemicals. If a company did not report functional use information for a chemical, those records were excluded from the evaluation of functional use.

APPENDIX 4 – FUNCTIONS OF CANDIDATE CHEMICALS REPORTED IN FORMULATIONS

Table A4.1. List of functions of Candidate Chemicals (CCs) reported in various nail product formulations. The most prevalently reported functions for all reported chemicals were colorants, film formers, solvents, plasticizers, UV absorbers, and opacifying agents (see Figure 4a). Among those prevalently reported functions, colorants, solvents, and plasticizers had the highest percentage of instances where the functional use was fulfilled by a CC (see Figure 4b).

Function	Number of formulations reported ingredients performing this function	Number of formulations reported ingredients performing this function where at least one chemical performing this function is a Candidate Chemical	Percent of formulations reported ingredients performing this function where at least one chemical performing this function is a Candidate Chemical
contaminant	28	28	100.0%
accelerator	2	2	100.0%
propellant	1	1	100.0%
solvent	1,161	1,111	95.7%
inhibitor	47	44	93.6%
hardener	11	10	90.9%
shimmer effect	8	7	87.5%
colorant	1,190	998	83.9%
residual	32	25	78.1%
pH adjuster	111	83	74.8%
stabilizer	64	37	57.8%
antifoaming agent	100	47	47.0%
filler	8	3	37.5%
denaturant	19	7	36.8%
sun-screening agent	3	1	33.3%
masking agent	7	2	28.6%
buffering agent	217	51	23.5%
preservative	82	17	20.7%
activator/curing catalyst	20	4	20.0%
color protector	18	3	16.7%
cleansing	6	1	16.7%
light stabilizer	51	8	15.7%
antioxidant	112	14	12.5%
antifungal/antimicrobial	8	1	12.5%
resin	10	1	10.0%

Function	Number of formulations reported ingredients performing this function	Number of formulations reported ingredients performing this function where at least one chemical performing this function is a Candidate Chemical	Percent of formulations reported ingredients performing this function where at least one chemical performing this function is a Candidate Chemical
plasticizer	907	84	9.3%
artificial nail builder	81	7	8.6%
fragrance	154	13	8.4%
flavoring agent	36	3	8.3%
cross-linker	14	1	7.1%
initiator	21	1	4.8%
conditioning agent	275	12	4.4%
viscosity controller	46	2	4.3%
dispersing agent	33	1	3.0%
UV absorber	836	18	2.2%
abrasive	61	1	1.6%
binder/adhesive	218	3	1.4%
film former	1,164	15	1.3%
opacifying agent	829	10	1.2%
emollient	169	1	0.6%
bulking agent	282	1	0.4%

APPENDIX 5 – LIST OF CHEMICALS THAT ARE NOT ON THE CC LIST REPORTED AS SOLVENTS

Table A5.1. List of chemicals that are not on the Candidate Chemicals List (CC List), which are reported as solvents in at least two nail product formulations. DTSC has not evaluated the safety of these chemicals.

Chemical name	CAS RN
Amyl acetate	628-63-7
Butylene glycol	107-88-0
Diacetone alcohol	123-42-2
Dimethicone	9006-65-9
Dimethyl sulfone	67-71-0
Disiloxane	107-46-0
Ethanol	64-17-5
Hexylene glycol	107-41-5
Isobutyl acetate	110-19-0
Methyl acetate	79-20-9
Methyl benzoate	93-58-3
Methylpropanediol	2163-42-0
Methylthiopropylamido acetyl methionine	1258540-06-5
N-butyl acetate	123-86-4
N-propyl acetate	109-60-4
Pentanone	107-87-9
PPG-2 methyl ether	34590-94-8
Propanediol	504-63-2
Propylene carbonate	108-32-7
Propylene glycol	57-55-6
Water	7732-18-5

APPENDIX 6 – LIST OF CHEMICALS THAT ARE NOT ON THE CC LIST REPORTED AS PLASTICIZERS

Table A6.1. List of chemicals that are not on the Candidate Chemicals List (CC List), which are reported as plasticizers in at least two nail product formulations. DTSC has not evaluated the safety of these chemicals.

Chemical name	CAS RN
Acetyl tributyl citrate	77-90-7
Acetyl triethyl citrate	77-89-4
Acetylated hydrogenated castor glyceride	736150-63-3
Camphor	76-22-2
Diisobutyl adipate	141-04-8
Dipropylene glycol dibenzoate	27138-31-4
Ethyl-o-tosylamide	1077-56-1
Ethyl-p-tosylamide	80-39-7
Isosorbide dicaprylate/caprate	1215036-04-6
Sucrose acetate isobutyrate	126-13-6
Sucrose benzoate	12738-64-6
Tributyl citrate	77-94-1
Trimethyl pentanyl diisobutyrate	6846-50-0
Trimethylpentanediyl dibenzoate	68052-23-3
Tripropylene glycol diacrylate	42978-66-5

APPENDIX 7 – LIST OF CANDIDATE CHEMICALS REPORTED AS CONTAMINANTS OR RESIDUALS

Table A7.1. List of Candidate Chemicals (CCs) reported as contaminants or residuals in various nail products.

Candidate Chemical name	CAS RN	Percent of formulations containing this Candidate Chemical (CC) as a contaminant or a residual out of all formulations where a CC is used as a contaminant or a residual *
Dibutyl phthalate (DBP)	84-74-2	42.9%
Formaldehyde	50-00-0	40.5%
Toluene	108-88-3	40.5%
Xylenes	1330-20-7	40.5%
Lead	7439-92-1	35.7%
Mercury	7439-97-6	31.0%
Arsenic	7440-38-2	31.0%
Triphenyl phosphate (TPhP)	115-86-6	28.6%
Hydroquinone	123-31-9	21.4%
Barium	7440-39-3	16.7%
Tin	7440-31-5	16.7%
Cadmium	7440-43-9	14.3%
Chromium	7440-47-3	14.3%
Nickel	7440-02-0	14.3%
Zinc	7440-66-6	14.3%
tert-butyl alcohol (TBA)	75-65-0	11.9%
dibutyltin dilaurate	77-58-7	9.5%
n-Butanol	71-36-3	9.5%
Benzene	71-43-2	9.5%
Propylene oxide	75-56-9	9.5%
Antimony	7440-36-0	7.1%
Benzo[a]pyrene	50-32-8	7.1%
Cobalt	7440-48-4	7.1%
Copper	7440-50-8	7.1%
Dibenzo[a,h]anthracene	53-70-3	7.1%
Methanol	67-56-1	7.1%
Heptane	142-82-5	4.8%
Iron	7439-89-6	4.8%

Candidate Chemical name	CAS RN	Percent of formulations containing this Candidate Chemical (CC) as a contaminant or a residual out of all formulations where a CC is used as a contaminant or a residual *
Methyl methacrylate	80-62-6	4.8%
Phenol	108-95-2	4.8%
Styrene	100-42-5	4.8%
2,5-Dimethylfuran	625-86-5	2.4%
Acetaldehyde	75-07-0	2.4%
Alpha-methyl styrene	98-83-9	2.4%
Benzene-1,2:4,5-tetracarboxylic dianhydride	89-32-7	2.4%
n-Butane	106-97-8	2.4%
Butylbenzyl phthalate (BBP)	85-68-7	2.4%
Cumene	98-82-8	2.4%
Cyclohexane	110-82-7	2.4%
Diisobutyl phthalate (DIBP)	84-69-5	2.4%
Ethyl acetate	141-78-6	2.4%
Isopropanol (IPA)	67-63-0	2.4%
Methyl ethyl ketone (MEK)	78-93-3	2.4%
N,N-Dimethyl-p-toluidine (DMPT)	99-97-8	2.4%
n-Hexane	110-54-3	2.4%
Nickel carbonyl	13463-39-3	2.4%
Propionaldehyde	123-38-6	2.4%
Selenium	7782-49-2	2.4%
Vanadium	7440-62-2	2.4%

**Some stakeholders reported a CC as a contaminant in their formulations, while some stakeholders reported the same CC as a residual. Stakeholders did not report what they considered to be the distinctions between the residual CC and contaminant CC.*

***Some formulations contained more than one CC as a contaminant or a residual. As a result, total percent of formulations containing CCs reported as contaminants or residuals exceeds 100%.*

APPENDIX 8 – OTHER REPORTED CANDIDATE CHEMICALS THAT HAVE NOT BEEN PREVIOUSLY EVALUATED BY DTSC

Table A8.1. List of reported Candidate Chemicals (CCs) in nail products that have not been previously evaluated by DTSC and are either on an exposure-based list or have environmental hazard traits but do not have human health hazard traits that have been documented by the Authoritative Lists that are referenced by [DTSC's CC List](#).*

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC
2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)	25973-55-1	1	4	4	more than 0.1% but less than 1%	UV absorber
2,5-Dimethylfuran	625-86-5	1	1	1	more than zero but less than 0.1%	residual
2-Naphthalenol, 1-[(2-chloro-4-nitrophenyl)azo]-	2814-77-9	5	20	776	more than zero but less than 25%	colorant
2-Naphthalenol, 1-[4-(phenylazo)phenyl]azo-	85-86-9	11	46	1,493	more than zero but less than 5%	colorant
Antimony	7440-36-0	1	3	360	more than zero but less than 0.1%	contaminant
Barium	7440-39-3	6	65	2,276	more than zero but less than 5%	colorant, contaminant, filler, opacifying agent, contaminant, and residual

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC
Benzaldehyde	100-52-7	1	2	3	more than zero but less than 0.1%	solvent
C. I. Pigment Red	6410-41-9	1	1	1	more than 0.5% but less than 1%	colorant
Cyclohexane	110-82-7	1	1	1	more than zero but less than 0.1%	residual
D & C Red No. 21	15086-94-9	5	10	736	more than zero but less than 1%	colorant
D & C Red no. 27	2134-15-8	2	2	426	more than zero but less than 1%	colorant
D & C Red No. 30	2379-74-0	16	126	5,615	more than zero but less than 50%	colorant and UV absorber
Decamethylcyclopentasiloxane (D5)	541-02-6	6	8	9	more than zero but less than 75%	conditioning agent, emollient, and solvent
Diethyl hexyl adipate	103-23-1	3	4	4	more than 0.5% but less than 5%	plasticizer
Dodecamethylcyclohexasiloxane (D6)	540-97-6	4	4	4	more than zero but less than 75%	conditioning agent, emollient, and solvent

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC
Ethyl paraben	120-47-8	3	6	16	more than zero but less than 1%	preservative
Heptane	142-82-5	6	18	812	more than zero but less than 50%	residual and solvent
Hexanaldehyde	66-25-1	9	18	626	more than zero but less than 1%	not reported
Hydroquinone	123-31-9	11	107	4,890	more than zero but less than 0.5%	antioxidant, contaminant, inhibitor, light stabilizer, residual, and stabilizer
Iron	7439-89-6	3	14	4,056	more than zero but less than 10%	colorant, contaminant, and opacifying agent
Methylparaben	99-76-3	5	21	32	more than zero but less than 1%	preservative
n-Propylparaben	94-13-3	5	23	42	more than zero but less than 10%	preservative
Octamethylcyclotetrasiloxane (D4)	556-67-2	1	1	1	more than 0.5% but less than 1%	not reported

Candidate Chemical (CC) name	CAS RN	Number of companies that reported this CC	Number of formulations that contained this CC	Number of products that contained this CC	Concentration range reported for this CC	Functions reported for this CC
Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-	6300-37-4	1	32	1,475	more than 0.5% but less than 1%	colorant
Platinum	7440-06-4	2	3	3	more than zero but less than 0.1%	dispersing agent and filler
Siloxanes and Silicones, di-Me, hydrogen-terminated	70900-21-9	1	2	210	more than zero but less than 0.1%	film former
Silver	7440-22-4	9	57	8,385	more than zero but less than 50%	antifungal/antimicrobial and colorant
Tin	7440-31-5	19	171	10,296	more than zero but less than 50%	abrasive, colorant, contaminant, filler, opacifying agent, residual, bulking agent
Triclosan	3380-34-5	2	2	2	more than zero but less than 1%	antifungal/antimicrobial
Tricresyl phosphate	1330-78-5	1	1	1	more than 1% but less than 5%	plasticizer
Zinc	7440-66-6	1	6	363	more than zero but less than 0.1%	contaminant

**See Table A2.1 in Appendix 2 for concentration ranges defined by DTSC. Stakeholders did not report whether these percentages of concentration ranges were by weight or volume.*

***Some stakeholders reported a CC as a contaminant in their formulations, while some stakeholders reported the same CC as a residual. Stakeholders did not report what they considered to be the distinctions between the residual CC and the contaminant CC.*