California Environmental Protection Agency
DEPARTMENT OF TOXIC SUBSTANCES CONTROL

SUMMARY OF DATA AND FINDINGS FROM TESTING OF A LIMITED NUMBER OF NAIL PRODUCTS

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Department of Toxic Substances Control

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

The mission of DTSC is to protect California's people and environment from harmful effects of toxic substances through the restoration of contaminated resources, enforcement, regulation and pollution prevention.

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ABSTRACT

When nail care products claim to be free of unsafe chemicals, despite how the label reads, just the opposite is often true. In May of 2011, staff from the Department of Toxic Substance Control (DTSC) conducted a limited-scale sampling of nail products offered for sale in the San Francisco Bay Area.

Nail products are known to contain toxic chemicals, such as dibutyl phthalate (DBP), toluene, and formaldehyde, that are health and safety concerns for about 121,000 nail salon workers in California. DBP and toluene are known to the State of California as developmental toxins. Formaldehyde is a known carcinogen.

These three chemicals are commonly called the "toxic-trio". They have been at the center of ongoing public attention over nail product safety, and potential health risks for nail salon workers. A small number of nail product manufacturers claim to have removed some or all toxic-trio chemicals from their goods.

DTSC's objective in sampling the products was to (a) verify if toxic-trio related claims were valid, (b) determine baseline levels of some chemicals of current public interests, and (c) explore trends of ingredient substitutions.

Twenty-five products, representing six product categories, were randomly collected from six distributors who supply products to nail salons. Of the 25 products collected, 12 claimed to be free of at least one toxic-trio chemical. Seven products claimed to be free of all three toxic-trio chemicals.

There were 13 products that did not make any toxic-trio related claims. In this report, products that made no such claims are referred to as "traditional". Toluene was found more frequently, and in higher concentrations in products with toxic-trio related claims than in traditional products. Ten of the twelve products with "toluene-free" claims did, in fact, contain toluene.

Products that claim to be free of all three toxic-trio are called "three-free". The study found that five of the seven "three-free" product claims could not substantiated. Chemicals were also detected whose purpose, property, human toxicity, and environmental fate, are unknown to DTSC.

Based on the report's findings, DTSC recommends manufacturer disclosure of nail product formulations. Additionally, DTSC urges increased collaboration and coordination among interested stakeholders, along with expanded outreach, and education and training of nail salon owners and workers.

INTRODUCTION

Statistics from the California State Board of Barbering and Cosmetology (BBC), for June 2011, indicate there are approximately 121,000 full-time licensed nail technicians and 284,000 cosmetologists offering nail services on a part-time basis in more than 48,000 salons in the State of California (1, 17). A 2008 scientific study suggested that 59% to 80% of these technicians are female immigrants of Vietnamese descent (2). Often, English is not their primary language (2, 3, 4), which can limit their ability to comprehend warnings of health risks, exposure routes, and preventive measures in the product literature. A product's ingredient panel and material safety data sheet (MSDS) may be difficult for some to interpret. Those who continue to work while pregnant expose themselves and their fetuses to a variety of known and potentially toxic chemicals that may lead to a wide range of acute and chronic adverse health conditions for both mother and child (2, 4).

Among many potentially toxic chemicals, dibutyl phthalate (DBP), toluene and formaldehyde, collectively referred to as the toxic-trio, are at the center of ongoing public attention. Particular scrutiny has come from the California Healthy Nail Salon Collaborative, other non-government organizations (NGOs), environmental and worker rights groups, and government regulatory agencies in California and throughout the United States. The State of California has recognized that exposure to these chemicals is associated with cancer, birth defects, asthma, and other chronic health conditions.

In October of 2010, the City and County of San Francisco passed an ordinance directing the San Francisco Department of Environment (SFE) to create a voluntary recognition program for nail salons that choose safer nail products. To qualify for the recognition program, nail salons must use safer nail products, such as those free of the toxic-trio, and additional chemicals designated by SFE (5, 6).

DTSC staff collaborated with SFE to identify candidate chemicals during the first half of 2011. The candidates were used to establish criteria for defining safer nail products to be included in the recognition program regulations, and for planning post recognition program research and evaluation. The final list at the time when the regulations were finalized had 26 chemicals, which included the toxic-trio and 23 other chemicals (6, 7). These chemicals are known or suspected carcinogens, reproductive toxins, asthmagens, acute skin and respiratory irritants, or toxicants that may cause other adverse health conditions.

DTSC staff conducted a limited scale sampling project in May of 2011. This project was designed to investigate the accuracy of "three-free" claims, provide information on hazardous chemicals used in these products, and offer further support to SFE's nail salon recognition program. DTSC staff believes that a successful SFE nail salon recognition program may serve as a model for other municipalities and communities throughout the State. Consumer demand for safer nail products may ultimately stimulate the industry to innovate and reformulate using safer chemical ingredients.

STUDY OBJECTIVES

The specific objectives were to:

a. verify the legitimacy of toxic-trio related product claims,
b. determine baseline levels of chemicals with ongoing public attention, and
c. explore trends of possible ingredient substitutions.

MATERIALS AND METHODS

Sample Collection

Twenty five nail product samples were collected from six distributors in the San Francisco Bay Area. A summary of quantity, source, and product categories of the 25 samples is presented in Table 1. Samples collected included both products with toxic-trio related claims, and traditional products. Table 2 presents a detailed description of manufacturer's name, product type, and marketing claims for the 25 samples collected.

TABLE 1. OVERVIEW OF SAMPLE QUANTITY, SOURCE, AND PRODUCT TYPE

	Quantity	Percent of Total Sample Number (%)
Number of Distributors	6	N/A
Number of Manufacturers	15	N/A
Total number of products	25	N/A
Claim to be three-free products	7	28
Claim to be two-free products	4	16
Claim to be one-free products	1	4
Products without claims	13	52
Product Type		
Topcoat	6	24
Basecoat	3	12
Nail Lacquer/Color *	12	48
Thinner	2	8
Nail Art	1	4
Top- and basecoat combination	1	4

* In this report, nail lacquers and colors are considered one product type.

TABLE 2. BRIEF DESCRIPTION OF PRODUCTS (continued on next page)

Sample No.	Manufacturer	Product Description/Type *	"Toxic-trio" Related Claims**
NPR-0517-A	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	Sation 99 basecoat	Three-free
NPR-0517-B	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	Sation 98 topcoat (shinny)	Three-free
NPR-0517-C	LeChat Nail Care Products, Hercules, CA 94547	Dare To Wear nail lacquer	Three-free
NPR-0517-D	OPI Products, Inc. N. Hollywood, CA 91605	Nail lacquer, Birthday Babe NL A35	No
NPR-0517-E	Sunshine Nail Products Co	Sunshine nail lacquer	No
NPR-0517-F	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	Chelseu 650 Baby's Breath nail lacquer (fast dry formula)	"Toluene & formaldehyde free"
NPR-0517-G	Poshe Almell Products, Ltd., Dallas, TX 75238	Poshe fast drying basecoat	Three-free
NPR-0517-H	Cali Beauty Supply, 9081 Bolsa Ave, Westminster, CA 92683	Nail polish thinner	No
NPR-0517-I	LeChat R&D, Richmond, Ca 94804	CM (Color Madnic) Luscious nail lacquer	Three-free
NPR-0517-J	Cacie Nail Creations, Inc., Gardena, CA 92843	Cacie Lightfree Gel basecoat (Step I)	No
NPR-0517-K	Cacie Nail Creations, Inc., Gardena, CA 92843	Cacie Sun Protection topcoat	No
NPR-0517-L	American International Industries, Los Angeles, CA 90040	China Glaze nail laquer (with hardeners)	No
NPR-0517-M	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	Golden Girl topcoat	No
NPR-0517-N	Omega Labs USA, P.O.Box 840, Sun City, CA 92586	Nail Art Top-N-Seal, topcoat	No
NPR-0517-O	Orly International Inc, Los Angeles, CA 91406	Orly nail lacquer, 40215 Flagstone Rush	Three-free
NPR-0518-A	Unknown	Thinner	No
NPR-0518-B	Art of Beauty Systems, Inc., P.O.Box 22349, Cleveland, OH 44122	Zoya professional nail lacquer	Three-free
NPR-0518-C	Essie Cosmetics Ltd. Astoria, NY 11105	Essie 596 Starter Wife nail lacquer	No
NPR-0518-D	International Nail Manufacturers, 1221 N. Lakeview Avenue, Anaheim, CA 92807	Out the Door topcoat	No
NPR-0518-E	New Look	High Gloss Topcoat	No

* For the purposes of this report, nail lacquers and colors are considered one product type.
** Toxic trio related claim for each product was based on what was stated on the product package at the time of sampling.

Sample No.	Manufacturer	Product Description/Type *	"Toxic-trio" Related Claims**
NPR-0518-F	Prima Technologies, Inc. 110 Lake Avenue South Suite 42, Nesconset, NY 11767	Nail Tek Base Intensive Therapy and topcoat (Quicken) (base- and topcoat twin pack)	No
NPR-0518-G	Omega Labs USA Manufacturing, Inc. P.O.Box 52808, Riverside, CA 92517	Nail Art Stripper Brush #117 Magenta Glitter	Toluene & Formaldehyde free
NPR-0518-H	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	New York Summer nail color	Toluene & Formaldehyde free
NPR-0518-I	Mirage Corp, CA 90012	Paris Spicy 298 nail lacquer	Toluene free
NPR-0518-J	Miss Prof. Nail Prod., Inc. Gardena, CA 90249	Sation 53 Red Pink nail color	Toluene & Formaldehyde free

* For the purposes of this report, nail lacquers and colors are considered one product type.
** Toxic trio related claim for each product was based on what was stated on the product package at the time of sampling.

DTSC staff visited distributor storefronts where products were purchased. The distributors were selected from a list created by the SFE Nail Salon Recognition Regulations development team (8 and 9). Prior to sampling, each distributor was asked if it carried products claiming to be free of any toxic-trio chemical. While on the premises, samples were selected from open access shelves and evaluated for package integrity and leakage. All samples were individually sealed in plastic zipper bags and labeled. No cooling or additional handling occurred prior to laboratory analysis.

Two to five intact retail units (sealed whole bottles), with the same product code, were collected for each product. Some products lacked product codes. Retail units were submitted to DTSC's Environmental Chemistry Laboratory in amounts sufficient for testing. Excess retail units were appropriately stored at the laboratory in the event retesting of samples was necessary.

Nail Polish Thinner

Nail salons typically use 0.5 fluid ounce bottle of products for multiple applications. Repeated openings of the bottles allow volatile chemicals such as solvents to evaporate resulting in undesirable product consistency. A common practice among nail technicians is to add thinners to maintain the consistency of the polishes to aid application and to ensure a satisfactory finish. During sampling, staff observed toluene on the ingredient panel of a nail polish thinner (Fig. 1). Therefore, two thinners were collected for analysis. A sampled container of thinner is shown in Fig. 1 (NPR-0517-H); the other thinner (NPR-0518-A) did not have an ingredient panel.

Figure 1.
Toluene was listed on the ingredient panel of a thinner

Sample Analysis

Test America Laboratories, Inc. at 880 Riverside Parkway, West Sacramento, CA 95605, performed all analyses under contract with DTSC. The samples were analyzed using the following three-method scheme:

1. EPA Method 8260B, a GC-MS method for identification and quantitation of volatile organic compounds (VOCs), was used to test for toluene, formaldehyde (as a non-target compound), and any other VOCs. The samples were initially diluted with methanol, and introduced using the purge and trap methodology following EPA Method 5035.
2. Method 8270C, also a GC-MS method, was used to detect and quantify DBP and other semi-volatile organic compounds (SVOCs).
3. EPA Method 8315, an HPLC based method with derivatization, would be used to confirm and quantify formaldehyde if formaldehyde were to be detected as a tentatively identified compound (TIC) by Method 8260B. However, Method 8315 was not used since none of the 25 samples in this study exhibited sufficient formaldehyde levels to be deemed as a TIC in Method 8260B. More information, such as standard operating procedures and modifications, are presented in Appendix B. The laboratory analyzed the samples in two separate batches consisting of 10 and 15 samples, respectively.

Limitations

This exploratory study was not designed to exhaustively detect all toxic chemicals present in nail products. Instead, it was intended to screen a limited number of chemicals, in a limited number of products, using two EPA methods that were originally developed for hazardous waste characterization. Chemicals beyond the capability of the two methods that might otherwise be present cannot be identified or quantitated.

Matrix interference and extremely high concentrations of some chemicals caused fouling of instrument columns and detectors. For the tests to proceed, large dilutions were necessary for all samples. While dilutions improved chromatographic separations, and detection of some target chemicals, other target chemicals of lower concentrations were diluted below their method reporting limits (MRLs) and could not be measured. Because of this approach, formaldehyde was not detected above its MRL.

This is not necessarily evidence that all products in this study were formaldehyde-free. Thirteen of the 25 products did not declare formaldehyde-free in their ingredient panels. The findings on formaldehyde may only be interpreted that methodologies used in this study were not sufficiently sensitive to determine a presence of formaldehyde in product solutions that had been greatly diluted.

RESULTS AND DISCUSSION

Of the 25 products tested, 12 claimed to be free of at least one of the toxic-trio chemicals (Tables 2 and 3, and Appendix A). Test results suggest that most of the claims cannot be substantiated.

Three-free Claims

Among the seven products claiming to be three-free, only two, sample No. NPR-0517-I and NPR-0518-B indeed tested three-free. Five of the seven three-free products tested contained high levels of DBP, toluene, or a combination of both (Table 3).

TABLE 3. TEST FINDINGS FOR THREE-FREE, TWO-FREE, AND ONE-FREE PRODUCTS

Sample No.	Toxic-trio declaration	Dibytyl Phthalate (ppm)	Toluene (ppm)	
			ppm	%
NPR-0517-A	Three-free	82,000	177,000	17.70
NPR-0517-B	Three-free	ND	73,000	7.30
NPR-0517-C	Three-free	ND	1,800	0.18
NPR-0517-F	Two-free (toluene & formaldehyde)	70,000	69,000	6.90
NPR-0517-G	Three-free	ND	680	
NPR-0517-I	Three-free	ND	ND	
NPR-0517-O	Three-free	ND	42	
NPR-0518-B	Three-free	ND	ND	
NPR-0518-G	Two-free (toluene & formaldehyde)	ND	76	
NPR-0518-H	Two-free (toluene & formaldehyde)	88,000	130,000	13.00
NPR-0518-I	One-free (toluene)	ND	10,000	1.00
NPR-0518-J	Two-free (toluene & formaldehyde)	62,000	360	

* Toluene was detremined by 8260 (B) as a target compound. Dibutyl phthalate was determined by EPA Method 8270 (C).

Toluene-free Claims

All twelve products in Table 3 claim to be toluene-free. This study found that 10 of the products contained toluene with a range from 42 ppm[1] to 177,000 ppm.(Tables 3 and 5). Five of the 12 toluene-free products contained more than 1% toluene; four toluene-free products were found to contain more than 6.9% toluene; the two highest toluene concentrations were 13.0% and 17.7% (Tables 3 and 5). Median and average toluene concentrations were 0.59% and 4.62%, respectively (Table 5).

PRODUCTS WITH TOXIC-TRIO RELATED CLAIMS

Dibutyl Phthalate

In products making a toxic-trio related claim, DBP was found in greater concentrations than in products making no claim at all. For example, in one product claiming to be three-free, DBP levels presented at 8.2%. Similarly, in products claiming to be free of at least one toxic-trio chemical, DBP levels ranged from 6.2% to as high as 8.8%. But, in traditional products, those that made no toxic-trio claims, concentrations of DBP ranged from 1.4% to 4.2% (Tables 4 and 5).

The percentage of samples testing positive for DBP is similar for both products with toxic-trio related claims (33%) and traditional products (38%). However, median DBP concentration in products making toxic-trio claims was higher than median DBP concentration in traditional products (Table 5).

1 Mixed units are used occasionally for presentation clarity and in observance of significant digit rule. Parts per million (ppm) may be converted to percentage (%) using the formula: (ppm/10,000) = percentage (%).

Toluene

Toluene was detected in eight of the 13 traditional products with a range from 110 ppm to 12.0%; two of the 13 products contained more than 1% toluene (Tables 4 and 5). Median and average toluene concentrations in traditional products were 0.34% and 1.76%, respectively (Table 5). These findings suggest, for the 25 products studied, toluene was detected more frequently and at higher concentrations in products with toluene-free claims than in products without toluene-free claims (Table 5).

TABLE 4. TEST RESULTS FOR PRODUCTS WITHOUT "TOXIC-TRIO" DECLARATION*

Sample No.	Toxic-trio declaration	Formaldehyde (ppm)	Dibutyl Phthalate (ppm)	Toluene (ppm)	
				ppm	%
NPR-0517-D	No	ND	ND	ND	
NPR-0517-E	No	ND	14,000	140	
NPR-0517-H	No	ND	ND	ND	
NPR-0517-J	No	ND	24,000	9,100	0.9
NPR-0517-K	No	ND	23,000	24,300	2.4
NPR-0517-L	No	ND	ND	110	
NPR-0517-M **	No	ND	42,000	120,000	12.0
NPR-0517-N	No	ND	42,000	6,600	0.7
NPR-0518-A	No	ND	ND	ND	
NPR-0518-C	No	ND	ND	ND	
NPR-0518-D	No	ND	ND	ND	
NPR-0518-E	No	ND	ND	160	
NPR-0518-F	No	ND	ND	200	

* Dibutyl phthalate was determined by EPA Method 8270 (c). Toluene was detremined by 8260 (B). Formaldehyde was estimated by EPA Method 8260 (B) as a tentatively identified compound.

** Toluene was originally estimated at 100,000 ppm and was out of the calibration range. Sample was re-tested.

TABLE 5. DIBUTYL PHTHALATE AND TOLUENE: PRODUCTS WITH TOXIC-TRIO RELATED CLAIMS VS. PRODUCTS WITHOUT ANY CLAIMS

Products	No. of Products	Dibutyl Phthalate				Toluene				
		% positive	Median	Average	Range	% positive	% with >10,000 ppm	Median	Average	Range
			ppm					ppm		
With Toxic-trio related claims	12	33	76,000	75,500	62,000-88,000	83	42	5,900	46,196	42-177,000
Without Toxic-trio related claims"	13	38	24,000	29,000	14,000-42,000	62	15	3,400	17,576	110-120,000

Thinners

One of the two thinners included in this study listed toluene as an ingredient. However, neither thinner was found to contain toluene above its MRL (Table 4). It was not determined why toluene appeared on the ingredient panel. The possibility of toluene in thinners warrants further investigation. If thinners with toluene are mixed into toluene-free nail products, any benefit of the products being toluene-free is lost.

Observations on Dibytul Phthalate and Other Plasticizers

Two of the 25 samples tested were thinners and therefore not expected to contain any plasticizers. This left 23 products in which DBP and other plasticizers were expected. Of those, 14 did not contain DBP and the methodology used in this study detected no plasticizers in five of the products in the group of 14. The remaining nine of the 14 products containing DBP contained one or more plasticizers (Table 6).

In the nine products where DBP was detected, two contained no additional plasticizers. However, seven of the nine contained camphor as an additional plasticizer detectable by the method used in this study (Table 6).

Triphenyl phosphate was the most commonly used plasticizer when DBP was not present. It was found in five of the 14 products that had no detectable levels of DBP; concentrations ranged from 1.3% to 2.5%. Camphor was the next highest with detectable levels in four products lacking DBP. N-ethyl-o-toluene-sulfonamide, was the third most common, appearing in three of the 14 products; levels from 0.6% to 1.5% (Table 6).

Overall, camphor was the most common of the plasticizers detected (Table 6). It was found in 11 of the 23 products where plasticizers were expected. Its concentrations ranged from 720ppm to1% (Table 6). However, in addition to being a plasticizer, camphor can take on other roles in products, including functioning as a fragrance (10).

Triphenyl phosphate is being considered by SFE for additional evaluation (6). It is also on the California Environmental Contaminant Biomonitoring Program's watch list as an emerging chemical of potential concern (7).

It is worthwhile to note that tosylamide, often observed in products containing DBP, was never found in DBP-free products (Table 6). Dioctyl adipate, a suspected but unverified endocrine disruptor, was found in one product (Table 6).

Worker Exposure Concerns

Studies suggested that volatile and semi-volatile organic compounds cause irritations to the eye, nose, throat, skin, and mucus membranes, as well as adverse central nervous system (CNS) effects, and other potential adverse health effects (2, 4, and 11).

Of the 25 products analyzed, 24 products contained more than 10% volatile and semi-volatile organic compounds with a median concentration of 21% (Fig. 2). The highest solvent

concentration was 66%. Of the 16 volatile and semi-volatile compounds detected in the 25 products studied, the seven compounds shown in Table 7 appeared with the most frequency.

Butyl acetate was found in all 25 products; ethyl acetate was present in all but one (Table 7). These two compounds had the highest concentrations (Table 7). Toluene was found in high concentrations, even where products declared themselves toluene-free. Acetone also exhibited frequent presence in significant concentrations.

TABLE 6. PLASTICIZERS FOUND IN PRODUCTS

Sample No.	Toxic-trio Declaration	Plasticizers * (ppm)								
		Dibutyl phthalate	Camphor	Dioctyl adipate	Tributyl phosphate	Butyl citrate	Triphenyl phosphate	N-ethyl-o toluene-ulfonamide	N-ethyl-p-toluene-ulfonamide	"P-toluene-sulfonamide (tosylamide)
NPR-0517-A	Three-free	82,000	9,200							4,000
NPR-0517-B	Three-free	ND				21,000				
NPR-0517-C	Three-free	ND	720							
NPR-0517-D	No	ND	8,100		19,000			6,700		
NPR-0517-E	No	14,000	10,000							
NPR-0517-F	Two-free**	70,000	10,000							4,300
NPR-0517-G	Three-free	ND		49,000						
NPR-0517-I	Three-free	ND								
NPR-0517-J	No	24,000	6,000							
NPR-0517-K	No	23,000	5,400							
NPR-0517-L	No	ND	5,000				17,000	15,000	5,300	
NPR-0517-M	No	42,000								
NPR-0517-N	No	42,000								
NPR-0517-O	Three-free	ND					18,000			
NPR-0518-B	Three-free	ND								
NPR-0518-C	No	ND	8,100				18,000	6,400		
NPR-0518-D	No	ND					13,000			
NPR-0518-E	No	ND								
NPR-0518-F	No	ND								
NPR-0518-G	Two-free**	ND					25,000			
NPR-0518-H	Two-free**	88,000	8,100							6,200
NPR-0518-I	One-free (toluene)	ND								
NPR-0518-J	Two-free**	62,000	7,700							

* These chemicals were estimated either as target compounds or as tentatively identified compounds from EPA Method 8270 (C).
** Two-free refers to toluene and formaldehyde

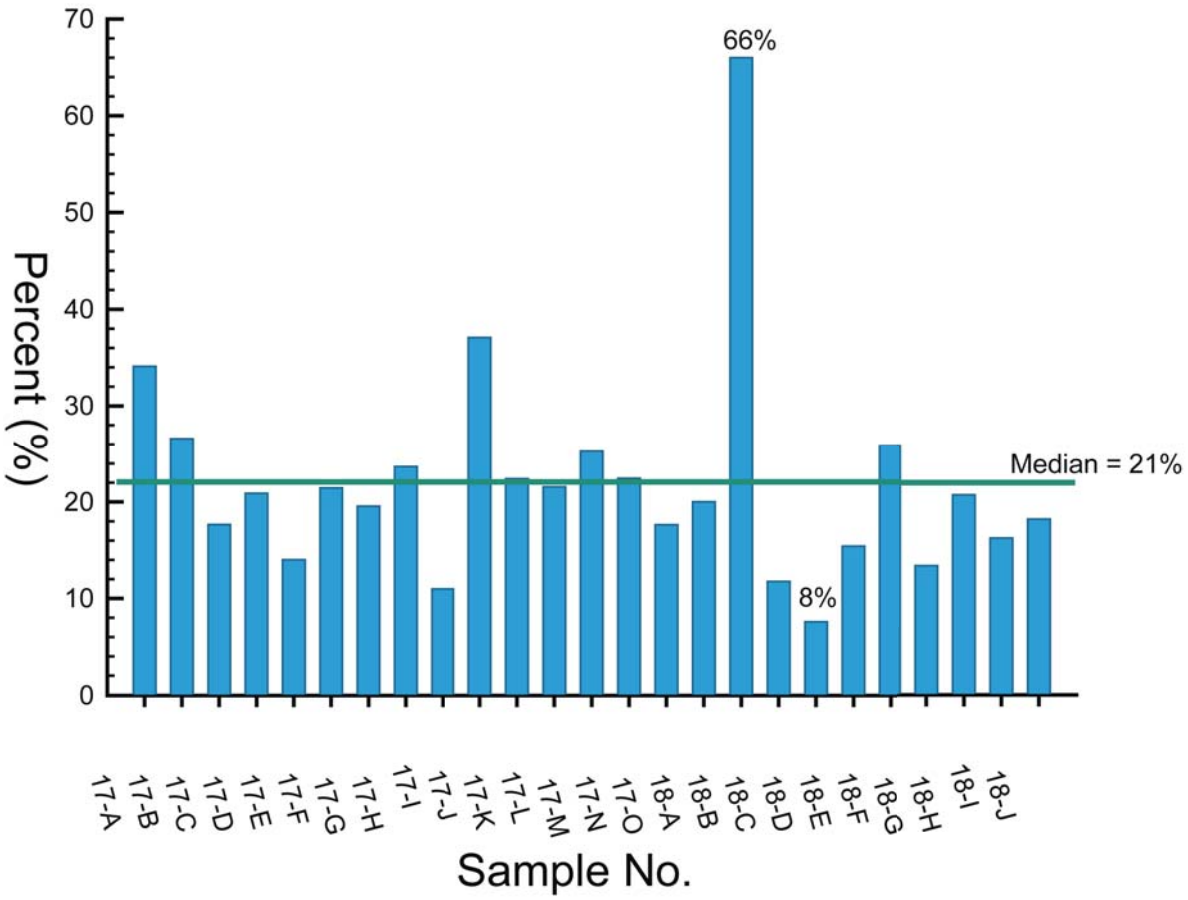

Figure 2. Combined volatile and semi-volatile solvents in products studied

TABLE 7. MAJOR VOLATILE COMPOUNDS IN NAIL PRODUCTS

Sample No.	Compounds* (ppm)						
	Acetone	Butyl Acetate	Ethyl Acetate	Isopropyl Acetate	Isopropyl Alcohol	N-Propyl Acetate	Toluene
NPR-0517-A	3,300	130,000	34,000				177,000
NPR-0517-B		83,000	110,000				73,000
NPR-0517-C	2,700	69,000	100,000	990	4,100		1,800
NPR-0517-D	560	100,000	74,000			35,000	
NPR-0517-E	12,000	65,000	55,000	10,000			140
NPR-0517-F	20,000	86,000	30,000	8,500			69,000
NPR-0517-G		110,000	84,000		790		680
NPR-0517-H		83,000	150,000		3,800		
NPR-0517-I		6,300	99,000		3,200		
NPR-0517-J	3,400	170,000	180,000	10,000			9,100
NPR-0517-K	670	96,000	100,000		3,900		24,300
NPR-0517-L	10,000	100,000	74,000	4,800		29,000	110
NPR-0517-M	850	78,000	65,000	8,400			100,000
NPR-0517-N	8,800	200,000		13,000	3,200		6,600
NPR-0517-O	480	89,000	76,000		870	10,000	42
NPR-0518-A	27,000	200,000	110				
NPR-0518-B	7,000	130,000	530,000				
NPR-0518-C	2,800	100,000	6,900			6,900	
NPR-0518-D		67,000	8,500				
NPR-0518-E		69,000	85,000				160
NPR-0518-F		120,000	130,000				200
NPR-0518-G	1,200	64,000	68,000	2,700			76
NPR-0518-H		78,000	110				130,000
NPR-0518-I	580	110,000	41,000	2,300			10,000
NPR-0518-J	1,600	87,000	76,000	19,000			360

* These chemicals were estimated by EPA Method 8260 (B), either as target compounds or tentatively identified compounds.

It should be noted that the Methods 8260B and 8270C identify and quantitate only combined volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Organic compounds with higher molecular weights and low volatility cannot be determined by these methods. Less volatile organic chemical compounds, however, are not the focus of this study.

Exposure to elevated levels of VOCs and SVOCs released from nail products may put nail salon workers at risk. Although studies on long-term health outcomes are rare, short-term and acute toxicities have been documented (2,4,11). A survey of nail salon technicians in Boston, MA, specifically associated working in nail salons with headaches, skin, and respiratory problems (11).

A California study involving 201 workers in Alameda County reported similar findings (2). In the California study, 62% of the workers surveyed complained about work-related health problems; 47% specifically reported acute symptoms such as skin irritation, breathing difficulty, numbness, and eye and throat irritation; 42% also reported chronic pain (2). A more recent study (4) documented that average toluene levels from nail salon personal air monitoring was higher than State recommended ambient air levels of 0.08 ppm (12). This same study also found that concentrations of total VOCs in air samples from 3 to 25 mg/m3. These VOC levels may cause worker discomforts such as headaches and irritations of the eyes, nose, and throat (13).

Adoption of preventative measures for removing solvent vapors from breathing zones could reduce VOC exposures and minimize possible long-term adverse health outcomes. One measure would be to install ventilation devices, such as commercially available down-draft tables, ventilated hoods, and similar suction devices currently not present in most salons (2).

Less Frequently Used Compounds and Chemicals of Unknown Functions

Table 8 lists additional volatile and semi-volatile chemicals found in the products; they cause similar health concerns as other more popular compounds. For example, n-butanol is extremely irritating to the eyes and repeated dermal contact can cause skin irritations (14). A rare solvent, mesityl oxide, was detected in one sample (NPR-0517-F). Available literature lists a number of solvent uses for mesityl oxide, e.g., for nitrocellulose, lacquers and lacquer thinners, and carburetor cleaners, but its solvent uses have been largely phased out (15). It is not listed in the International Cosmetic Ingredient Dictionary and Handbook (10). The primary use of mesityl oxide is as an intermediate in the manufacture of 4-methyl-2-pentanone (MIBK). Based on mesityl oxide's high concentration and the absence of MIBK (Table 7), mesityl oxide appeared to be an intentional ingredient in the sample tested. The purpose for using this solvent is unclear. According to OSHA, this solvent may cause eye, skin, nose, throat and mucous membrane irritation, as well as narcosis, coma and CNS effects (16).

Three isomers of xylene were found in two products at low concentrations (Table 8). It is undetermined by this study if they were intentionally introduced as part of the product formulations. Neither of these products listed xylene isomers on their ingredient panels (Appendix A). A known toxicant and irritant, 4-toluenesulfonylmethylisocyanide, was found at 5,000 ppm (0.5%) in one sample (NPR-0517-L). It is not a common ingredient of nail products and its purpose remains undetermined by this study. Likewise, the use and purpose of formaldehyde diisopropyl acetal in a sample, NPR-0517-J, remains unknown.

TABLE 8. OTHER VOLATILE, SEMI-VOLATILE COMPOUNDS AND CHEMICALS FOUND IN NAIL PRODUCTS*

Sample No.	1-Butanol	t-Butanol	Formaldehyde diisopropyl acetal	Heptane	Methyl acetate	3-Methyl-hexane	Mesityl Oxide**	4-Methyl-2-pentanone (MIBK)	4-Toluenesulfonyl-methylisocyanide (Tosylbenzyl isocyanide) **	P-Toluene-sulfonyl-acetonitril **	m-Xylene & p-Xylene	o-Xylene
	ppm											
NPR-0517-C						680						
NPR-0517-E		7,000						2,900				
NPR-0517-F		13,000					3,900			4,100		
NPR-0517-I				620		620						
NPR-0517-J			1,100					420				
NPR-0517-L		7,700							5,000			
NPR-0517-M					1,300							
NPR-0517-N	1,700											
NPR-0517-O	310											
NPR-0518-C		3,800										
NPR-0518-D												150
NPR-0518-F		8,500										
NPR-0518-J								560			43	

* Unless otherwise indicated, chemicals concentrations were estimated by EPA Method 8260 (B), either as target compounds or tentatively identified compounds.

** Concentrations of these chemicals estimated as tentatively identified compounds from EPA Method 8270 (C)

POTENTIAL NEXT STEPS

Based on the findings of this limited study, DTSC has identified the following key areas needing action:

- Availability of Information:
  a. Findings in this report highlight the unreliability of product designations and labeling for nail coatings. Manufacturers of nail coating products should ensure labels accurately reflect product ingredients and that nail salon owners, practitioners and consumers have the ability to identify hazardous constituents in the products they use. Lack of accurate information on the hazardous chemicals contained in nail products presents an unlevel playing field for those manufactures that deserve to make such claims and prevents users from making informed choices to improve health and safety.
  b. Manufacturers should provide information regarding formaldehyde, and compounds releasing formaldehyde, in nail products. Data gaps regarding the presence of formaldehyde in nail products, due to the limits of this study, should be addressed through disclosure of the formulation and function of nail coatings ingredients. Manufacturers and regulatory agencies should work in partnership for the development of better testing protocols to handle the presence of chemicals in consumer products.
  c. Manufacturers should expand the dialogue regarding how to avoid regrettable substitutions. In this limited scale study, DTSC found chemicals in nail products whose functionality, toxicities, environmental behavior, and exposure risks remain unknown. These chemicals may be alternatives to known toxic chemicals under current public scrutiny. Manufacturers should provide information demonstrating that these substitutions are safer to public health and the environment.
- Stakeholder Coordination and Collaboration
  a. To further information sharing and coordination by health and environmental agencies, DTSC will support continuing efforts of the existing interagency workgroup on nail salon product safety. The workgroup will specifically focus on sharing information and data, identifying further research and analytical needs and coordinating outreach and education efforts.
  b. The California Healthy Nail Salon Collaborative should continue bringing together manufacturers, nail salon owners and practitioners, government agencies, academia and advocacy groups to promote filling data, information and safety gaps that hinder implementation of efforts to increase worker and consumer safety in the nail salon sector.
- Outreach, Education and Training
  a. Educational tools, information and training should be expanded to promote the greening of nail products and salon practices. In light of concerns regarding the reliability of product information, promoting best management practices at nail salons is an important first step toward improving the health and safety in nail salons. Examples of best management practices include engineering improvements in building ventilation systems, installation of nail station exhaust hoods, and use of personal protection equipment such as masks and gloves.

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DISCLAIMER

This data report was reviewed by the Department of Toxic Substances Control and approved for release and publication. This is a technical report and approval does not create a new policy of the Department. The mention of trade names or commercial products in the report text, tables and figure, and appendices does not constitute an endorsement or recommendation by the Department for use or otherwise.

ABBREVIATIONS, SYNONYMS, AND TERMS

ARB	Air Resources Board, State of California
BBC	California Board of Barbering and Cosmetology
Cal/OSHA	California Division of Occupational Safety and Health
CDPH	California Department of Public Health
CNS	Central nervous system
DBP	Dibutyl phthalate
DTSC	Department of Toxic Substances Control, State of California
ECL	Environmental Chemistry Laboratory, DTSC
EPA	United States Environmental Protection Agency
GC-MS	Gas chromatography-mass spectroscopy
HPLC	High performance liquid chromatography
MRL	Method Reporting Limit
MSDS	Material safety data sheet
Nail Polish	Nail lacquer and enamel, base and topcoats.
Nail Product	Any product used for and applied to the nails of the hands and feet, of the customer as part of a manicure or pedicure. “Nail product” includes, but is not limited to, lotion, nail polish, polish remover, and artificial nails.
Nail Salon	Any business establishment, including salons, spas, and others, that offers pedicures, manicures, or application of artificial nails, and their component processes.
ND	Not detected at the method reporting limit
NGOs	Non-government organizations
One-free	Nail products free from one of the toxic-trio (dibutyl phthalate, formaldehyde, and toluene).
OPPGT	Office of Pollution Prevention and Green Technology
OSHA	Occupational Safety & Health Administration, U.S. Department of Labor
P2	Pollution Prevention
ppm	Parts per million. 10,000 ppm is equivalent to 1% (on weight basis).
SFE	San Francisco Department of Environment
SOPs	Standard Operating Procedures
SVOCs	Semi-volatile organic compounds

The Collaborative	California Healthy Nail Salon Collaborative
Three-free	Products that do not contain dibutyl phthalate, formaldehyde, and toluene
TIC	Tentatively identified compound
Toxic trio	An NGO coined term referring to three chemical ingredients in nail products, dibutyl phthalate, formaldehyde, and toluene
Two-free	Nail products free from two of the toxic-trio (dibutyl phthalate, formaldehyde, and toluene).
VOCs	Volatile organic compounds