



# Department of Pesticide Regulation



Mary-Ann Warmerdam  
Director

## MEMORANDUM

Arnold Schwarzenegger  
Governor

TO: Linda O'Connell  
Senior Environmental Scientist  
Worker Health and Safety Branch

**HSM-09006**

FROM: Lillian J. Kelly *(original signed by L. Kelly)*  
Environmental Scientist  
Worker Health and Safety Branch  
(916) 323-2837

DATE: December 2, 2009

SUBJECT: PARA-DICHLOROBENZENE INITIAL SCOPING DOCUMENT

Attached is the Initial Scoping Document for registered pesticide products containing para-dichlorobenzene as an active ingredient. All actively registered labels (currently 39) were reviewed, as well as pesticide use and sales data, pesticide illness data, and the United States Environmental Protection Agency's revised Reregistration Eligibility Decision for Para-dichlorobenzene, December 2008.

Attachment



---

*California Environmental Protection Agency*  
Department of Pesticide Regulation  
Worker Health and Safety Branch

HSM-09006

PARA-DICHLOROBENZENE  
INITIAL SCOPING DOCUMENT  
December 2009

Lillian J. Kelly, Environmental Scientist  
Human Health Mitigation Program  
1001 I Street P.O. Box 4015, Sacramento, CA 95812-4015  
(916) 323-2837; Fax (916)445-4280 [www.cdpr.ca.gov](http://www.cdpr.ca.gov)

---

## TABLE of CONTENTS

I.	SUMMARY.....	3
II.	PURPOSE .....	3
III.	REGULATORY HISTORY / STATUS.....	3
IV.	PESTICIDE USE and SALES.....	6
V.	FORMULATIONS and USES.....	6
VI.	LABEL REQUIREMENTS.....	7
VII.	POTENTIAL EXPOSURE SCENARIOS.....	8
VIII.	PESTICIDE ILLNESS REPORTS.....	10
IX.	REFERENCES.....	12
X.	APPENDIX.....	14

## **I. SUMMARY**

Para-dichlorobenzene, also referred to as 1,4-dichlorobenzene, is among the pesticide active ingredients being reviewed by the California Environmental Protection Agency (Cal/EPA) Department of Pesticide Regulation (DPR). Para-dichlorobenzene is a non-agricultural, non-food use pesticide that is primarily used to control clothes moths, carpet beetles, and mildew, and to deodorize restrooms and waste containers. It is the vapor that acts as the insect killer or the deodorizer. As of December 2009, DPR has registered 37 products for use in air-tight containers to control clothes moths and carpet beetles, and two products for use in bird cages. In California, para-dichlorobenzene is listed as a toxic air contaminant. It is a chemical known to the State to cause cancer but has a No Significant Risk Level. During the 5-year period 2003-2007, the DPR Pesticide Illness Surveillance Program (PISP) received one report of an illness incident associated with a non-registered use of para-dichlorobenzene. All three exposed workers experienced headache and gastrointestinal symptoms.

In 2007, the United States Environmental Protection Agency (U.S. EPA) released a Reregistration Eligibility Decision (RED) document for para-dichlorobenzene (U.S. Environmental Protection Agency, 2007a) (U.S. Environmental Protection Agency, 2007b). In response to public comment, U.S. EPA revised the RED in 2009 and removed the mothball ingestion assessment since an appropriate endpoint could not be attributed to an acute (single) oral dose. The U.S. EPA did not find any risk estimates of concern associated with potential exposure scenarios. Label amendments, personal protective equipment (PPE) for the one occupational use, and a chamber study using para-dichlorobenzene mothballs are required (U.S. Environmental Protection Agency, 2009) (U.S. Environmental Protection Agency, 2008a).

## **II. PURPOSE**

The Birth Defect Prevention Act of 1984 (Food and Agricultural Code Division 7, Chapter 2, Article 14, Section 13121) requires DPR to review the toxicology of all active ingredients currently registered in California. Para-dichlorobenzene is one of the high priority pesticides on DPR's list of active ingredients for risk characterization (California Department of Pesticide Regulation, 2009). This Initial Scoping Document lays the groundwork for assessing the adequacy of existing protective measures listed on pesticide product labels. It is prepared in support of the Worker Health and Safety Branch, Human Health Assessment Program's Exposure Assessment Document which is an integral part of DPR's risk characterization process.

## **III. REGULATORY HISTORY / STATUS**

### **Brief description**

At room temperature para-dichlorobenzene is a white crystalline solid with a pungent, camphor odor. Para-dichlorobenzene has a vapor pressure of 0.40 millimeters of mercury (mmHg) at 20° Celsius (C) and when exposed to air, it sublimates to produce vapors. The U.S. EPA classifies para-dichlorobenzene as a fumigant insecticide. Residential and commercial uses are for confined spaces to control clothes moths and carpet beetles; in bird cages to kill lice and mites, and in

toilets as deodorizer blocks. There is one occupational use which repels wax moths in empty bee supers (a component of the hive) which are stored indoors. The product for bee supers is not among the list of products ever registered with DPR. A varpal rope to repel snakes, rats, mice, squirrels and bats in attics is also available but not registered in California.

### Applicable regulations

The U.S. Department of Agriculture, predecessor for U.S. EPA pesticide registrations, first registered a product containing para-dichlorobenzene in 1947. The U.S. EPA never issued a Registration Standard for the product. In the late 1990s, U.S. EPA initiated a Label Improvement Program to update the precautionary text, use directions, storage and disposal instructions to reduce exposure to para-dichlorobenzene, especially when used in the home. Current Federal and State laws and regulations applicable to para-dichlorobenzene are given in Tables 1.A. and 1.B.

Table 1.A. Federal Laws and Regulations Applicable to Para-dichlorobenzene					
Laws	FIFRA Registration Type :  <b>Section 3, Regular</b>	FIFRA Reregistration Eligibility Decision (RED) : <b>RED, 9/28/07; Revised RED, 12/ 2008</b>	FFDCA Tolerance Reassessment Eligibility Decision (TRED) :  <b>Not Applicable. No food, water, or outdoor uses.</b>	FQPA Susceptibility of Children :  <b>Not Applicable</b>	FQPA Cumulative Risk :  <b>Not Applicable</b>
Title 40 CFR	Part 170 Worker Protection Standard : <b>Established in the RED</b>		Part 180 Tolerance Levels : <b>Not Applicable</b>		
FIFRA : Federal Insecticide, Fungicide, and Rodenticide Act, 1947 [Section 3(c)(5)(D) and Section 2(bb)]; Amended 1988 to require Reregistration of pesticides registered before 11/1/1984 [Section 4(g)(2)(A)]. FFDCA : Federal Food, Drug, and Cosmetic Act, 1938; Amended 1996 to require a safety determination of no harm from aggregate (inhalation, oral, and dermal) exposures [Section 408(b)(2)(A)(ii)]. FQPA : Food Quality Protection Act, 1996 [Section 408(b)(2)(C)(i) and (ii)]. CFR : Code of Federal Regulations					

Table 1.B. California Laws and Regulations Applicable to Para-dichlorobenzene				
	Restricted Material	Toxic Air Contaminant	Groundwater Protection	Proposition 65 List
Yes / No	No	<b>YES</b>	No	<b>YES</b>
Law	FAC Division 7 Chapter 3, Article 1.5 Section 14001	FAC Division 7 Chapter 3, Article 1.5 Section 14021(b)	FAC Division 7 Chapter 2, Article 15 Section 13141	HSC Section 25249.5 <b>Listed 01/01/89</b>
Title 3, Title 27	3 CCR Section 6400	3 CCR Section 6860	3 CCR Section 6800	27 CCR 25705(b)(1) <b>No Significant Risk Level = 20 micrograms/day (µg/d)</b>
FAC : California Food and Agricultural Code HSC : California Health and Safety Code CCR : California Code of Regulations				

### California regulatory status

As a Toxic Air Contaminant, the Cal/EPA Office of Environmental Health Hazard Assessment developed a chronic inhalation reference exposure level (chREL) of 800 µg/d for non-cancer health effects of para-dichlorobenzene (Office of Environmental Health Hazard Assessment, 2008). The DPR exposure assessment and risk characterization documents are pending.

### Federal regulatory status

The U.S. EPA identified para-dichlorobenzene as a low-risk (List C) pesticide. The last product for outdoor use, which was never registered in California, was cancelled in 2007 (U.S. Environmental Protection Agency, 2007c). Only indoor uses of para-dichlorobenzene remain for

reregistration (U.S. Environmental Protection Agency, 2007d). The Health Effects Division (HED) addressed comments received during the public participation process for the RED (U.S. Environmental Protection Agency, 2008b). In addition to the review of toxicity data submitted for reregistration and discussion of the methodology used to estimate potential exposures and associated risks, the revised RED includes four changes: 1) the acute oral endpoint and the risk estimate for episodic ingestion of mothballs were removed since an appropriate endpoint could not be attributed to a single oral dose; 2) the acute dermal toxicity category was corrected from III to IV as this was a typographical error; 3) the requirement for special packaging to mitigate risk from episodic ingestion of mothballs was removed; and 4) the “keep out of reach of children” language was modified to be consistent with similar chemical warning statements.

Findings regarding exposure scenarios, aggregate and cumulative risks, and the risk management and regulatory decision are as follow.

#### U.S. EPA Exposure Scenarios

Para-dichlorobenzene is considered moderately toxic on an acute basis by the oral route (Category III); of low toxicity by the inhalation and dermal routes (Category IV); and moderately toxic for primary eye irritation (Category II) and dermal irritation (Category III). Para-dichlorobenzene is not a dermal sensitizer. The volatility of para-dichlorobenzene makes the inhalation route the most likely route of exposure given the current use profile as a moth repellent. The U.S. EPA determined that exposure to para-dichlorobenzene is significantly higher from use of mothballs than in other products. Applications of mothballs to closets and dresser drawers were considered the scenarios with the greatest potential for exposure and represented a worst-case scenario. The U.S. EPA did not find any risk estimates of concern associated with the exposure estimates.

#### Aggregate and Cumulative Risks

The U.S. EPA determined that an aggregated dietary assessment was not indicated since para-dichlorobenzene is a non-food use pesticide and there is no potential for drinking water contamination. For the purpose of the risk assessment, U.S. EPA did not assume that para-dichlorobenzene shares a common mode of toxicity with other substances, and determined that a cumulative risk assessment is not indicated at this time.

#### U.S. EPA Risk Management, Reregistration, and Tolerance Reassessment Decision

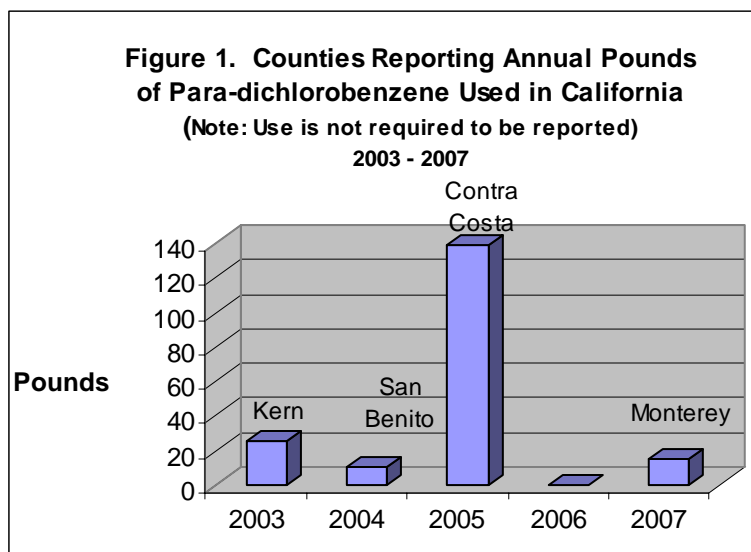
The U.S. EPA determined that products containing para-dichlorobenzene are eligible for reregistration provided that the required label amendments are made. Label amendments are specified for manufacturing-use products, end-use products, and the one occupational-use product. Conditions for the distribution and sale of products bearing old labels/labeling will be established when U.S. EPA approves label changes. Specific existing stocks time frames will be established case-by-case, depending on the number of products involved, number of label changes, and other factors. Since the vapor pressure of para-dichlorobenzene is higher than that of naphthalene, U.S. EPA requires a confirmatory chamber study using para-dichlorobenzene mothballs. The U.S. EPA intends to issue Data Call-In Notices requiring product-specific data.

#### IV. PESTICIDE USE and SALES

The U.S. EPA estimated that approximately five million pounds of para-dichlorobenzene are marketed on average per year, with the majority of use in moth repellent products. Available sales data for California indicate that for the 5-year period 2003-2007, on average less than 750,000 pounds of para-dichlorobenzene were sold annually and accounted for 0.1 percent of the total annual pesticide sales. In California, use is not required to be reported since para-dichlorobenzene is a non-agricultural pesticide. Table 2 shows available California use and sales data for the 5-year period and Figure 1 shows the counties that reported the single entry annual use.

Year	Pounds AI Used	Pounds AI Sold	Total Pounds Pesticide Sales
2003	25	765,693	661,488,765
2004	10	880,715	667,103,789
2005	139	717,811	611,368,382
2006	None reported	667,749	742,761,450
2007	15	620,580	677,920,963
<b>TOTAL</b>	<b>189</b>	<b>3,652,548</b>	<b>3,360,643,349</b>

Note: Use is not required to be reported. AI = active ingredient, para-dichlorobenzene  
Pesticide Use Report data accessed September 22, 2009 at [www.cdpr.ca.gov/docs/pur/purmain.htm](http://www.cdpr.ca.gov/docs/pur/purmain.htm)  
Pesticide Sales data accessed September 22, 2009 from Mill Assessment at [www.cdpr.ca.gov/docs/mill/nopdsold.htm](http://www.cdpr.ca.gov/docs/mill/nopdsold.htm)



Pesticide Use Report data accessed September 22, 2009 at [www.cdpr.ca.gov/docs/pur/purmain.htm](http://www.cdpr.ca.gov/docs/pur/purmain.htm)

#### V. FORMULATIONS and USES

As of December 2009, DPR has 39 active para-dichlorobenzene registrations and one Master Label. A Master Label is a pesticide product label bearing all U.S. EPA accepted uses; however,

the company does not intend to market that label for sale and use in California (California Department of Pesticide Regulation, 2006). The U.S. EPA cancelled ENOZ No Clinging Odor Moth Cake (Registration 1475-40) in August 2008 for non-payment of 2008 fees (U.S. Environmental Protection Agency, 2008c). Registration with DPR will continue through 2010 while the product moves through the channels of trade. Table 3 summarizes the formulation information for the 39 products. A table containing information for each product is available in the Appendix of this document.

<b>Table 3. Formulation Types For Products Containing Para-dichlorobenzene, California Department of Pesticide Regulation, December 2009</b>				
Application Method	Formulation Type *	Percent Active Ingredient	Number of Products	Use : Household
Evaporating Solid	Technical Grade Granular/Flake	99.9	3	Formulation into End-Use Products
	Pellet, Tablet, Cake or Briquette	50	2	In Bird Cages against Lice and Mites; Deodorizer
	Granular, Flake	99.90 - 99.94	3	To control Clothes
	Pellet, Tablet, Cake or Briquette	99.35 – 99.9	31	Moths and Carpet Beetles

\* Formulation type as specified in the Department of Pesticide Regulation Registration Branch, Product Label Database; latest access December 2, 2009. [www.cdpr.ca.gov/docs/label/labelque.htm](http://www.cdpr.ca.gov/docs/label/labelque.htm)

## VI. LABEL REQUIREMENTS

- a. Thirty-four para-dichlorobenzene labels are registered for non-agricultural, household use on human clothing and domestic dwelling contents (e.g., carpets, rugs, drapes, blankets). All of these labels direct use in air-tight containers (chests, trunks, garment bags, and storage closets) or tightly enclosed/contained space. The Reefer-Galler Moth Sachettes Old Fashioned Lavender Scented label includes “drawers” in the list of air-tight containers. Two other product labels are for use in bird cages. The PPG Industries, Inc. manufacturing-use label is for formulation into registered end-use products for domestic, indoor use to control clothes moths and carpet beetles. Both Willert Home Products, Inc. technical grade labels are for formulation into registered end-use products for moth control. None of the 39 labels state use in toilets.
- b. The signal word “WARNING” is on all labels except the 8 in 1 Bird Protector which has the signal word “CAUTION.”
- c. Among the 36 end-use products, 9 labels state “Wear safety glasses”, one label states “while holding cake by the wrapper”, and 15 labels contain both statements.
- d. There is no maximum application rate specified for para-dichlorobenzene. The percent active ingredient (% AI) is  $\geq 99.5$  in all but three labels: the two bird cage labels contain 50 % and Reefer-Galler Cedar-ize Moth Cake contains 99.35 % para-dichlorobenzene. Label application rates range from 0.01–0.025 lb AI/ft<sup>3</sup> in closets, trunks, and storage containers; 0.125–0.375 lb AI/garment bag; and 0.015–0.02 lb AI/ bird cage.



- e. There is no maximum number of applications per year. The two labels for bird cage use state “Replace when slight odor of para-dichlorobenzene cannot be detected.” Twenty of the 34 other product labels contain a retreatment schedule of twice per year.
- f. Reentry Interval (REI): Not applicable.
- g. Pre-harvest Interval (PHI): Not applicable.
- h. Use Restrictions: Four labels specify use on wool or wool-blend cloths only: Austin Moth Control, The Fuller Brush Scented Moth Block, and the two Paragon Household Products, Inc. Other label restrictions include not to use para-dichlorobenzene in plastic containers or bags that allow vapors to escape into occupied rooms, and not to use para-dichlorobenzene with any other moth control chemical. Twenty-one of the 22 Willert Home Products, Inc. labels specify use only in polyethylene or polypropylene containers. The one exception is the Reefer-Galler Cedar-ize Moth Cake which states not to use in a plastic storage box or place in contact with plastic items since para-dichlorobenzene damages some plastics.

The revised RED requires the following amendments to labels: 1) for manufacturing-use products, “Only for formulation into an ***insecticide/repellent*** for the following use(s);” and 2) for end-use products, “Do not place in areas accessible to children.” Maximum application rates per application, indicated in the Appendix of the revised RED, include: 0.02 lbs AI/ft<sup>3</sup> when applied as moth balls, flakes, crystals, cakes and sachets; 0.025 lbs AI/ft<sup>3</sup> when applied as a block; and 0.0313 lbs AI/cage when applied to bird cages.

## VII. POTENTIAL EXPOSURE SCENARIOS

Potential exposure scenarios associated with registered use of a pesticide are classified as occupational and non-occupational. Both classifications include handler and non-handler potential exposure scenarios. The handler applies the pesticide, among other activities. Non-handlers are individuals not involved in the application but whose work brings them in proximity with the application or storage area. Examples of occupational non-handlers are fieldworkers and office personnel. Residential use is non-occupational and potential exposure may occur as a handler or non-handler activity. Bystander exposure occurs when an individual incidentally comes in contact with a pesticide that moves offsite during or following application.

### **Occupational, Handler**

At this time, there are no potential occupational handler exposure scenarios for para-dichlorobenzene.

### **Occupational, Non-Handler**

There are no potential occupational non-handler exposure scenarios for para-dichlorobenzene.

### **Non-Occupational, Handler - Residential**

A potential exposure scenario associated with labeled household uses of para-dichlorobenzene exists during application: the resident may experience dermal irritation while handling a para-dichlorobenzene product and/or inhale vapors when the package is initially opened. Table 4 contains the label directions for applying household products.

<b>Table 4. Label Directions For Application of Para-dichlorobenzene Household Products, California Department of Pesticide Regulation, December 2009</b>	
Products	Directions
Hangers/Block	Remove paper seal from the container and hang with perforations facing the bird cage. Punch through clear poly seal where holes appear on flower design; hang the container on the outside with the opening facing the bird cage. Remove cellophane and hang above stored articles in tightly sealed closet garment bag or storage container. Open container; unwrap both cakes and while holding each cake by the cellophane wrapper, transfer both cakes back into the container; place the filled container at the top of the storage container or closet.
Balls	Distribute moth balls evenly around and between the folds of stored articles. Apply in air-tight containers and bags.
Block/Bar/Can	Apply in air-tight container, bags, or closet. Remove the plastic container from package; open plastic container and remove the cake; remove plastic wrapper from the cake; while holding cake by the plastic wrap, place back into the container and close; hang on rod in air-tight garment bag. Apply product (can) for garment bag, large trunk, or small closet.
Cake	Place the cake in the plastic holder and hang in the garment bag or on a coat hanger. Unwrap the cake, punch holes out of sides and bottom of the box and while holding the cake by the cellophane wrapper, transfer the cake back into the box; place the filled box at the top of the storage container. Remove all cellophane from the cake and hang above stored articles in tightly sealed closet, garment bag, or storage container. <i>To freshen closet</i> , hang after removing all cellophane (only on Reefer-Galler Cedar-ize Moth Cake label).
Can/Crystals/Flakes/Nuggets	Sprinkle crystals freely on the bottom of the storage space, between folds and layers of articles, and an extra amount on the top before closing container. Remove lid and tear off inner seal; sprinkle nuggets freely on the bottom of the storage container or garment bag, between folds and layers of articles to be treated, and an extra amount on the top before closing container. <i>Rugs and Carpets</i> : freely sprinkle nuggets/crystals on the surface of the rug; roll the rug/carpet and wrap in a polyethylene/polypropylene sheet; tape the seams of the sheet (only on Reefer-Galler Snowwhite Nuggets and ENOZ Moth Ice Crystals labels).
Sachet/Packet	Apply in air-tight containers and bags. Do not remove the mothballs from the packets; scatter packets throughout the storage area; storage containers should be tightly closed at all times. Leave crystals in bags and place on articles in chests, drawers, trunks, garment bags and other closed storage receptacles.

#### **Non-Occupational, Non-Handler – Residential and Bystander**

After application, residents in a home where clothes or dwelling contents are treated and stored may be exposed to para-dichlorobenzene vapors. Additionally, a child may ingest a flake or crystal or chew a mothball, bar or cake.

There are no registered outdoor uses of para-dichlorobenzene. At this time, there are no potential bystander exposure scenarios associated with para-dichlorobenzene.

## VIII. PESTICIDE ILLNESS REPORTS

### PISP illness reports

For the 5-year period 2003-2007, PISP received only a report of one illness incident associated with para-dichlorobenzene. In 2004, three employees experienced nausea, headache, stomach ache and watery stool and sought medical care after drinking water from a container that had been contaminated with mothballs. A worker was suspected of putting the mothballs into the water cooler when a wrapper was found on his forklift. The incident was not a labeled use of para-dichlorobenzene.

### Illnesses from other States

The U.S. EPA evaluated incident reports for the revised RED from the following four databases:

- The National Poison Control Centers (PCC), the primary data source
- The U.S. EPA's Office of Pesticide Program's Incident Data System (ISD)
- The DPR PISP data
- The National Institute for Occupational Safety and Health's (NIOSH) Sentinel Event Notification System for Occupational Risk (SENSOR) program.

Findings in the revised RED for the period 1993 to 2005 were summarized as follows:

- The proportion of symptomatic cases among those exposed in all population groups evaluated (occupational, non-occupational, children) were not significantly different from the overall national composite average.
- Among children under the age of six, there were 3,165 exposure cases while the entire population had 4,480 cases; children represent the largest portion of total exposed (70.6%).
- There was an average of approximately 344 exposures per year, 33 symptomatic cases per year, and 38 cases seen in a health care facility per year across all population groups.
- An irregular decreasing trend is evident in the 12-year span, with the number of total exposed cases reduced by half in the period.

### Review of published literature

Unusual exposures to para-dichlorobenzene mothballs have been reported:

- A 1978 article reported a case of aplastic anemia in a woman employed in a clothing resale shop in Maryland (Harden and Baetjer, 1978). She placed clothing in storage bags and boxes for mothproofing. The storage area was located on the second of three floors and all windows in the storage area were sealed. During her work period in June 1977, she handled 5.5 kilograms (kg) of para-dichlorobenzene nuggets and 7 kg of naphthalene flakes, both of which were labeled 100% pure. Outdoor temperatures averaged 27 – 31°C. The maximum vapor concentration at 30°C of para-dichlorobenzene is 1400 parts per million (ppm) and of naphthalene, 184 ppm. The timing and concentration of the mothproofing to the onset of disease suggested para-dichlorobenzene may have played a role in the production of the woman's aplastic anemia.
- A 1988 article reported reversible ataxia in a woman in Japan exposed for six years to para-dichlorobenzene mothballs (Miyal *et al.*, 1988). She ground the mothballs into powder and scattered the powder everywhere in her room. She placed mothballs in her bedclothes and pillow as well as her wardrobe. She developed clumsiness of both hands, could not use chopsticks, and had difficulty in gait and speech. Symptoms improved after cessation of exposure.

- A 2006 article reported a woman in Maryland who had been eating para-dichlorobenzene mothballs and toilet-bowl fresheners for at least two years and experienced withdrawal toxicity (Cheong *et al.*, 2006). Five previously reported cases of para-dichlorobenzene addiction also noted withdrawal symptoms. The woman was diagnosed with mothball withdrawal encephalopathy based on clinical evidence and biological plausibility.

---

## IX. REFERENCES

- California Department of Pesticide Regulation 2006. Registration of Master Labels. California Notice 2006-10 to Pesticide Registrants and Applicants from Barry Cortez, Chief, Pesticide Registration Branch, Department of Pesticide Regulation, California Environmental Protection Agency. July 28, 2006. Sacramento, CA.  
[www.cdpr.ca.gov/docs/registration/canot/camenu.htm](http://www.cdpr.ca.gov/docs/registration/canot/camenu.htm).
- California Department of Pesticide Regulation 2009. Prioritization and Status of Active Ingredients for Risk Characterization: Report 51. Gary Patterson, Ph.D., Chief, Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency. July 16, 2009. Sacramento, CA.  
[www.cdpr.ca.gov/docs/risk/priot.pdf](http://www.cdpr.ca.gov/docs/risk/priot.pdf).
- Cheong, R., Wilson, R. K., Cortese, I. C., and Newman-Toker, D. E. 2006. Mothball withdrawal encephalopathy: case report and review of paradichlorobenzene neurotoxicity. *Subst Abus* 27:63-67.
- Harden, R. A., and Baetjer, A. M. 1978. Aplastic anemia following exposure to paradichlorobenzene and naphthalene. *J Occup Med* 20:820-822.
- Miyal, I., Hirono, H., Fujita, M., and Kameyama, M. 1988. Reversible ataxia following chronic exposure to paradichlorobenzene. *Journal of neurology, neurosurgery, and psychiatry*. 51:453-454.
- Office of Environmental Health Hazard Assessment 2008. All OEHHA Acute, 8-Hour and Chronic Reference Exposure Levels (chRELs) as on December 18, 2008. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology, Sacramento, CA. [www.oehha.ca.gov/air/allrels.html](http://www.oehha.ca.gov/air/allrels.html).
- U.S. Environmental Protection Agency. 2007a. Para-dichlorobenzene; Reregistration Eligibility Decision for Low-Risk Pesticide; Notice of Availability. Federal Register 72, no. 238. (December 12, 2007). 70589-70591. Docket ID: EPA-HQ-OPP-2007-0937-0001 found at [www.regulations.gov](http://www.regulations.gov).
- U.S. Environmental Protection Agency. 2007b. Reregistration Eligibility Decision for Para-dichlorobenzene, U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, D.C. 20460. September 28, 2007. Docket ID: EPA-HQ-OPP-2007-0937-0002 found at [www.regulations.gov](http://www.regulations.gov).
- U.S. Environmental Protection Agency. 2007c. Paradichlorobenzene: EFED Memorandum in Support of the Reregistration Eligibility Decision. Memorandum to Molly Clayton, Chemical Review Manager, from Greg Orrick, Environmental Scientist, dated May 8, 2007. U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, D.C. 20460. PC Code 061501 DB Barcode 333996. Docket ID: EPA-HQ-OPP-2007-0937-0003 found at [www.regulations.gov](http://www.regulations.gov).

- 
- U.S. Environmental Protection Agency. 2007d. Paradichlorobenzene: Addendum to EFED's Memorandum in Support of the Reregistration Eligibility Decision. Memorandum to Molly Clayton, Chemical Review Manager, from Melissa Ranger, Biologist, dated September 28, 2007. U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, D.C. 20460. PC Code 061501 DB Barcode 333996. Docket ID: EPA-HQ-OPP-2007-0937-0004 found at [www.regulations.gov](http://www.regulations.gov).
- U.S. Environmental Protection Agency 2008a. Reregistration Eligibility Decision for Para-dichlorobenzene, Revised December 2008. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, Washington, D.C. 20460, December 29, 2008. Docket ID: EPA-HQ-OPP-2007-0937-0011 found at [www.regulations.gov](http://www.regulations.gov).
- U.S. Environmental Protection Agency 2008b. Ingredient: para-Dichlorobenzene; Title: HED Chapter of the Reregistration Eligibility Decision Document (RED). Revised Version. U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, D.C., 20460. April 1, 2008. PC Code: 061501. DP Barcode: D350920. Docket ID: EPA-HQ-OPP-2007-0937-0010 found at [www.regulations.gov](http://www.regulations.gov).
- U.S. Environmental Protection Agency. 2008c. Cancellation of Pesticides for Non-Payment of Year 2008 Registration Maintenance Fees. Federal Register Notice 73, no. 152. (August 6, 2008). 45758-45766. [www.gpoaccess.gov/fr/Index.html](http://www.gpoaccess.gov/fr/Index.html).
- U.S. Environmental Protection Agency 2009. Para-dichlorobenzene; Issuance of Revised Reregistration Eligibility Decision: Notice. Federal Register 74, no. 46. (March 11, 2009). 10574-10575. Docket ID: EPA-HQ-OPP-2007-0937-0012 found at [www.regulations.gov](http://www.regulations.gov).

## X. APPENDIX

Currently Registered Products Containing Para-dichlorobenzene California Department of Pesticide Regulation, December 2009					
Product	EPA Registration Number	Percent Active Ingredient (AI)	Package Amount (oz = ounces; lb = pounds)	Area Treated (ft <sup>3</sup> = cubic feet)	Maximum Application Rate (lb AI /ft <sup>3</sup> )
<b>Eight in One Pet Products</b>					
8 in 1 Bird Protector, Hanger	1903-6-AA	50	0.75 oz	Large cage	0.02 lb AI /cage
<b>GPS Group</b>					
Scalex Bird Cage Defender, Hanger	43576-2-ZC	50	0.50 oz	Medium-Small cage	0.015 lb AI/cage
<b>Austin Chemical Co.</b>					
Austin's Moth Control (can)	10937-1-AA	99.9	15 oz	50 ft <sup>3</sup>	0.018
<b>The Fuller Brush Company</b>					
Fuller Brush Scented Moth Block	2915-26-ZC	99.7	12 oz/block	30 ft <sup>3</sup>	0.025
<b>Paragon Household Products, Inc</b>					
Para Moth Balls	70305-1-AA	99.5	10 oz package	1 lb/50 ft <sup>3</sup>	0.02
Para Moth Balls Cedar Scented	70305-2-AA	99.9	1lb	50 ft <sup>3</sup>	0.02
<b>IMS Trading, LLC</b>					
IMS Moth Balls	81433-2-AA	99.8	10 oz bag	31.2 ft <sup>3</sup>	0.02
IMS Moth Block	81433-3-AA	99.8	6 oz (2 -3oz cakes)	36 ft <sup>3</sup>	0.01
IMS Moth Cake	81433-4-AA	99.8	6 oz (3-2oz cakes)	12 ft <sup>3</sup>	0.01
IMS Moth Crystals	81433-5-AA	99.94	1lb	50 ft <sup>3</sup>	0.02
<b>Oxford &amp; Hill Home Products</b>					
Moth Avoid Brand Moth Balls	83424-1-AA	99.72	10 oz	6 oz /15 ft <sup>3</sup>	0.025
Moth Avoid Brand Moth Bar	83424-1-ZA	99.72	6 oz	Garment bag	0.375 lb AI / bag
Avoid Moth Brand Moth Chaser	83424-1-ZB	99.72	6 oz (3-2oz)	Garment bag	0.125 lb AI /bag
Moth Avoid Brand Sachets	83424-1-ZC	99.72	6 oz	12 ft <sup>3</sup>	0.03
<b>Willert Home Products, Inc.</b>					
Reefer-Galler Snowwhite Nuggets	1475-1-ZE	99.9	14 oz	1oz /3.1 ft <sup>3</sup>	0.02
Reefer-Galler No Moth Hangerette	1475-7-ZG	99.9	3.5 oz	10.9 ft <sup>3</sup>	0.02
Reefer-Galler Cedar-ize Moth Cake	1475-113-ZE	99.35	6 oz	36 ft <sup>3</sup>	0.01
Reefer-Galler Moth Cake Cedar Scented (Aids in Mildew Control)	1475-113-ZL	99.68	6 oz (2-3oz cakes)	3oz /9.4 ft <sup>3</sup>	0.02
Reefer-Galler No Mildew Cake Cedar Scented (Aids in Mildew Control)	1475-113-ZM	99.68	6 oz (2-3oz cakes)	3oz /9.4 ft <sup>3</sup>	0.02
Reefer-Galler Moth-Tek Snowwhite Paper Covered Mothball Packets	1475-143-ZB	99.68	6 oz	18.75 ft <sup>3</sup>	0.02
Reefer-Galler Moth Sachettes Old Fashioned Lavender Scented	1475-144-AA	99.68	12 oz; (6-2oz sachettes)	3 sachettes/15 ft <sup>3</sup>	0.025
Reefer-Galler No-Moth Closet Hanger	1475-157-AA	99.89	2-7oz cakes	2 /43.75 ft <sup>3</sup>	0.02
Reefer-Galler No-Moth Refill (Cakes)	1475-157-ZA	99.9	2-7oz cakes	2 /43.75 ft <sup>3</sup>	0.02
ENOZ Moth Ice Crystals	1475-1-ZB	99.9	1lb	1oz /3.1 ft <sup>3</sup>	0.02
ENOZ Moth Cake	1475-7-ZE	99.9	2 oz	6.25 ft <sup>3</sup>	0.02

Currently Registered Products Containing Para-dichlorobenzene California Department of Pesticide Regulation, December 2009					
Product	EPA Registration Number	Percent Active Ingredient (AI)	Package Amount (oz = ounces; lb = pounds)	Area Treated (ft <sup>3</sup> = cubic feet)	Maximum Application Rate (lb AI /ft <sup>3</sup> )
ENOZ Moth Cake Refills	1475-7-ZF	99.9	2-2oz refills	2oz /6 .25	0.02
ENOZ Moth Blok No Clinging Odor	1475-7-ZK	99.9	6 oz (2-3oz cakes)	3oz /9.4 ft <sup>3</sup>	0.02
ENOZ Para Moth Balls	1475-39-ZA	99.9	10 oz	1oz /3 ft <sup>3</sup>	0.02
ENOZ No Clinging Odor Moth Cake (Aids in Mildew Control)	1475-40-ZA	99.9	4 oz	12.5 ft <sup>3</sup> 6.25 ft <sup>3</sup>	0.02 moths 0.04 mildew
ENOZ Mildew Cake Cedar Scented (Aids in Mildew Control)	1475-113-ZF	99.68	6 oz (2-3oz cakes)	3oz /9.4 ft <sup>3</sup>	0.02
ENOZ Moth Cake Cedar Scented (Aids in Mildew Control)	1475-113-ZI	99.68	4 oz	12.5 ft <sup>3</sup>	0.02
ENOZ Plastic Hang Up Moth Case (Aids in Mildew Control)	1475-113-ZJ	99.68	6 oz (3-2oz cakes)	2oz /6.3 ft <sup>3</sup>	0.02
ENOZ Moth & Deodorant Cakes Refills For Hang-Up (Aids in Mildew Control)	1475-113-ZK	99.68	6 oz (3-2oz cakes)	2oz /6.3 ft <sup>3</sup>	0.02
ENOZ Moth Bar Lavender Scented (Aids in Mildew Control)	1475-113-ZN	99.68	6 oz (2-3oz cakes)	3oz /9.4 ft <sup>3</sup>	0.02
ENOZ Moth-Tek Paper Covered Moth Ball Packets Lavender Scented	1475-143-ZA	99.68	6 oz	18.75 ft <sup>3</sup>	0.02
ENOZ Moth Sachettes Lavender Scented	1475-144-ZA	99.68	12 oz; (6-2oz sachettes)	3 sachettes/15 ft <sup>3</sup>	0.025
Paradichlorobenzene Size B/C	1475-21-ZA	99.9	300 lbs	Technical Grade	End-Use Products
Paradichlorobenzene Size D	1475-21-ZB	99.9	300 lbs	Technical Grade	End-Use Products
<b>PPG Industries, Inc.</b>					
Para-dichlorobenzene	748-68-AA	99.9	100 lbs	Technical Grade	End- Use Products
Maximum Application Rate calculated as (amount of active ingredient in pound) / (area treated) = pound AI per cubic feet, unless otherwise indicated.					