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November 23, 2022

VIA EMAIL (maryjane.coombs@arb.ca.gov) AND U.S. MAIL

Mary Jane Coombs, Branch Chief, Industrial Strategies Division
California Air Resources Board
1001 I Street, P.O. Box 2828
Sacramento, CA 95814

Follow-Up Letter re Petition to Regulate Sulfuryl Fluoride

Dear Ms. Coombs:

On November 16, 2022, I submitted a letter on behalf of Douglas Products asking the California Air Resources Board (CARB) to deny the Petition to Regulate Sulfuryl Fluoride (Petition) filed by the Center for Biological Diversity and Californians for Pesticide Reform on October 27, 2022. Enclosed for your review is additional information supporting Douglas Products' request, including:[1]

1. A Case Summary describing the 16 deaths from sulfuryl fluoride exposure reported to the California Department of Pest Regulation from 1992 to 2017, inclusive, and identified in the California Pesticide Illness Query (CalPIQ) database, discussed on pages 4–6 of the letter. While all 16 incidents involved illegal or unauthorized entry, I now note that one incident also involved the failure of a structural pesticide control operator or "SPCO" to use chloropicrin—an odorant used as a warning agent in buildings undergoing sulfuryl fluoride fumigation. According to the CalPIQ database, the SPCO was cited for not using chloropicrin.
2. The November 4, 2022 PowerPoint Presentation by David Zilberman et al., "*The economic benefits model supports the use of sulfuryl fluoride for dry wood termites in California*," regarding the monetary benefit from sulfuryl fluoride use in California's housing and real estate market and the cost of eliminating sulfuryl fluoride, cited in footnote 38 of the letter.

Thank you again for your time and attention to our request. If you have any questions or concerns, or need additional information, please feel free to contact me at janet.rowley@douglasproducts.com.

[1] Douglas Products may separately submit additional information to support its request to CARB to deny the Petition. Douglas Products also reserves its right to submit additional comments and information should CARB grant, in whole or in part, the Petition.

Sincerely,

Janet Rowley, International Business Leader
Pest Management Division

DOUGLAS PRODUCTS

Enclosures

cc: Dr. Steven Cliff, Executive Officer, CARB (Steve.Cliff@arb.ca.gov)
Rajinder Sahota, Deputy Executive Officer, Climate Change & Research, CARB (Rajinder.Sahota@arb.ca.gov)
Julie Henderson, Director, CDPR (Julie.Henderson@cdpr.ca.gov)
Karen Morrison, Chief Deputy Director, CDPR (Karen.Morrison@cdpr.ca.gov)

California Pesticide Illness Query (CalPIQ) Database Case Summary
Sulfuryl Fluoride Exposure Deaths Reported From 1992–2017

Douglas Products searched the California Pesticide Illness Query (CalPIQ) database for the years 1992 to 2017, inclusive, for reports of deaths resulting from sulfuryl fluoride exposure to determine the reported cause(es) of death. The table below summarizes the CalPIQ database information for the 16 deaths reported to the California Department of Pesticide Regulation and identified in the CalPIQ database from 1992 to 2017, inclusive.

Year	Case Number	Case Classification	Symptoms	Case Summary
1994	1906	Definite	Vomiting, diarrhea, death.	A tenant entered his apartment through an open front window while the building was under fumigation. The structural pesticide control operator (SPCO) found his body while untarping the building. Analysis of his blood found a blood fluoride level of 3,800 mg/dl (normal is 30 mg/dl).
1995	24	Definite	Severe pulmonary congestion and edema, diarrhea, death.	A transient entered through an open motel room window while the motel was under fumigation. He had apparently sought shelter from the rain. His blood fluoride level was 3,200 mcg/dl. The SPCO found his body while untarping the building.
1998	167	Definite	Vomiting, fecal incontinence, cyanotic skin, death.	An SPCO found the dead body of a male adult between the house and tarps while removing the tarps from a fumigated house. The coroner's report lists the cause of death as sulfuryl fluoride intoxication.
1999	342	Definite	Vomiting, pulmonary congestion, death.	A transient told another transient that he felt sick after crawling under some fumigation tarps. Witnesses saw him in an alley behind a restaurant the next morning and assumed he was asleep. Later that day, the police found him dead in the alley.
2002	509	Definite	Death. The medical examiner noted blood coming from the mouth, nose and anal regions. The coroner noted pulmonary edema, pulmonary congestion, and alveolar hemorrhage.	A man gained entrance into his fumigated house through his open bedroom window. The SPCO found him dead the next day. The fumigation crew had seen him walking around the home as they tarped it. They believed he was intoxicated.
2005	89	Definite	Burning and watering eyes, flushed skin, difficulty breathing, abdominal pain, vomiting, retching, hypocalcemia, hypotension, agitation, confusion,	A woman escaped a fumigated condominium complex after 3 hours exposure but died at a hospital 3 hours later. During set-up, workers noted changes in her room. Afterwards, an unsecured door was found open

Year	Case Number	Case Classification	Symptoms	Case Summary
			incontinence, seizure, cardiac arrest, death. Tox: positive for fluoride, chloropicrin, amphetamine.	
2008	1166	Probable	Vomiting, abdominal pain, collapse, death.	When an SPCO untarped a house, he found a seam and back door open and a woman inside. Police took custody of the woman. The Emergency Department released her, but she collapsed in custody and was pronounced dead soon after arrival at a hospital.
2010	1093	Definite	Death. Autopsy report showed: severe atherosclerotic heart disease, atrophic brain-Alzheimer's disease, COPD, s/p abdominal surgery, chronic hypertension with atheriolonephrosclerosis, [r] below the knee amputee, distended urinary bladder.	An SPCO checked a tampered section of a sealed tarp and found a man dead on a carport sofa, one day after fumigation. The deceased man (with Alzheimer's) was last seen near the treatment site. Despite warnings to leave, he entered the tarped area.
2011	288	Definite	The man was deceased when emergency personnel arrived. He was released to the coroner's office. A blood sample confirmed a fatal dose of fluoride.	When an SPCO crew returned to aerate a house that had been fumigated two days previously, they discovered that someone had removed tarp clips and entered through a window. Emergency responders found a man deceased in the home.
2012	72	Definite	Collapse, not breathing, no heart action. He gave a false name and false history when taken to a hospital after collapsing at a gas station. He had no signs of life when he arrived at a second hospital. Toxicology results positive for fluoride and meth.	A 32-year-old man invited a neighbor to join him in burglarizing a business under fumigation and said he had a respirator. Neighbor declined. Later that day, the man collapsed and died. Investigation provided a coherent account of the break-in.
2014	59	Definite	The cause of death was determined to be acute fluoride inhalation. Alcohol was present in his system.	When a fumigator arrived to aerate a home, he noticed two sand snakes out of place but assumed it was from wind. The next day, while checking sulfuryl fluoride levels for reentry, a man's body was found in a bathroom. The man had illegally entered the structure.
2014	597	Definite	Autopsy revealed no indication that he had died of natural disease or traumatic injury. Cause of death: airway and vascular restriction due to	When an SPCO arrived to begin aeration on a fumigated home, he found a deceased man on the patio under the fumigation tarp. The man was not a resident of the home.

Year	Case Number	Case Classification	Symptoms	Case Summary
			ligature compression of neck associated with methamphetamine intoxication and exposure to fumigating chemicals.	According to police, the man may have been attempting to burglarize the home.
2015	140	Definite	The man was found deceased by emergency responders. Elevated levels of fluoride in urine and blood. Elevated levels of methamphetamine and amphetamine were detected. Sheriff's report indicated that he had a history of psychosis.	A neighbor saw a light coming from a tented structure that had begun the aeration process 9 hours earlier. An hour later, emergency responders removed a deceased 34-year-old man from the property.
2016	758	Definite	Death. The coroner's report has not been provided to the investigators.	An armed homicide suspect entered an apartment complex under fumigation. The swat team found no one inside. 5 days after aeration, a complex owner noted a decaying odor. She told her husband who found a dead body in the storage area.
2016	653	Definite	Skin rash, difficulty breathing, drooling and spitting, slurred speech, vomiting, difficulty moving.	A 26-year-old man broke into an apartment complex under fumigation. He told a police officer he was inside for about 3 hours. Neighbors heard someone yelling for help and called the police. He told a police officer that he smoked methamphetamines prior to breaking into the apartment building. Several hours later, he coded and expired.
2016	1212	Definite	Difficulty breathing, excessive sweating.	An SPCO fumigated an apartment building without chloropicrin because a 24/7 security guard was present. A man broke into an apartment about 18 hours into the fumigation. When he came out, he asked the security guard to take him for care. Police arrested him for burglary but released him to EMTS. He died in transit to the hospital. A tenant reported seeing video of the man inside her apartment. The SPCO was cited for not using chloropicrin.

The economic benefits model supports the use of sulfuryl fluoride for dry wood termites in California

David Zilberman, Distinguished Professor of Agriculture and Resource Economics and Extension Specialist UC Berkeley
Vernard Lewis, Emeritus Cooperative Extension Specialist UC Berkeley

Background

- Sulfuryl fluoride (SF) is a fumigant used to eliminate pests, including drywood termites, wood boring beetles, and bed bugs that infest residential structures and other buildings.
- SF is the sole fumigant remaining for these structural use patterns in the United States, replacing methyl bromide (MB) because of the Montreal Protocol.
- Fumigation with SF has been documented to be the most effective and efficient treatment for eliminating dry wood termites — cryptic pests concealed in potentially large volumes of wood throughout a building.
- Some call to ban the use of fumigation with SF because of its GHG emission.
- We will use Benefit-Cost analysis to document the high social cost of such a ban.
- We recommend to continue to use SF until a sound alternative solution is found.

About Benefit-cost analysis for pest control

- Benefit-cost analysis is a practical approach to assessing the economic value of a pest control agent to society.
- The analysis needs to recognize that optimal choices are different from the perspective of the individual (i.e., private) and society (i.e., public).
- Individuals will choose strategies to maximize their broadly defined economic net benefits (which we define as benefits minus costs.
- Social calculus will also consider environmental impacts and their cost, and the resulting social choice– may be different from the private choice.
- When the lowest private cost solution to a pest control problem has higher environmental costs than the cleanest (with the lowest environmental cost) solution, the cleanest solution is socially optimal if its extra private costs are lower than the environmental costs it saves.

Our analysis

- In our analysis of solutions to dry wood termites problems in California, we will compare:
  - no treatment for termites,
  - local treatment, and
  - fumigation combined with local treatment.
- The objective is to find a solution to minimize the social costs of drywood termites while accounting for both private and environmental costs.

Our analysis

- The private costs include:
  - the cost of housing loss,
  - housing replacement,
  - treatment in terms of labor materials and health, and
  - the cost of adjustment to the changes caused by the damage and treatment of termites.
- The environmental costs include:
  - the net emission of GHG times and
  - the social costs of GHG per unit (a ton of CO2 emissions).
- Our framework evaluates and compares the net present value of each termite management strategy.
- In our empirical analysis, we will compare the annual cost of the strategies, which will result in the same outcome qualitatively.

Cost of no treatment

- The value of the housing market in the US in January 2020 is $40 trillion
- Even if only 40% of the US house are constructed with wood, their value is $16 trillion.
  - If the termite damage is 0.5% yearly, the estimated **yearly damage to US homes could exceed $80 billion.** So obviously, the different types of treatment make a huge difference.
- The housing value in California is $9 trillion.
  - If only 40% of the houses in California are constructed with wood, without drywood termite treatment, the **annual damage from drywood termites in California is $18 billion.**
- The cost of repairing drywood termite damage is between 7-15% of the value of buildings. These costs may occur once between 15 and 30 years, so the estimated annual cost is 0.5% of the value of wood buildings.

Cost if SF is allowed+ Localized treatment

If the 100,000 structures are fumigated.

- The average cost of fumigation for a 2,000 sq ft. house in Los Angeles is between $2000 - $5000. Thus, the private cost of the 100,000 fumigations in California is between $300 million and $750 million annually.
- Localized treatment on 80% of home. The average price of termite treatment in California is between $228 and $957 per home * 400,000 cases of localized treatment.
- Cost of termite damage with SF in California is $625 million annually.
- Adding these costs, the total cost of termites to consumers is between $916.2 and $1507.8 million.
- The environmental cost of SF and GHG emissions, each kg of sulfuryl fluoride has a global warming effect equivalent 5 tons of CO2/kg of SF).
- Each fumigation in California requires 6 kg of SF on average.
- Cost of CO2 equivalents with 6 kg application average assuming 100,000 structures fumigated
  - 30 tons CO2 equivalents/treatment *100,000 treated homes = 3,000,000 CO2 equivalents annually.
  - Cost of 1 ton of CO2 = $30-$150
    GHG Cost range for SF Treatment $30 * 3,000,000 = **$90 Million** and at $150 * 3,000,000 = **$450 Million**
- Altogether, the annual social cost of dry wood termites and their control treatment in California under current conditions is between $1006.6 to $1957.8 million annually. Compare this with the cost of no treatment ($18 billion) in California, and you realize the large social gain from treating drywood termites.

Cost of local treatment

- When SF is not available, 500,000 houses use the local treatment and the price is between $228 and $957, the direct cost of local treatment is $114- $478.5 million.
- Without SF, drywood termite damage will reduce real estate value by 7% – 10%.
- The median price of housing in California is about $800,000 in 2022.
- With 7% termite damage, the gain from treatment is $56,000 if treatment prevents immediate loss of value.
- Assuming it takes about 15 years for the damage to be realized and 4% interest, the net present value of $56,000 of damage 15 years from now is $30,000.
- With 10% damage, the discounted cost of termites 15 years from now is $44,421.
- For 100,000 structures, the cost of termite damage is $3.1 - $4.44 billion.
- Adding the cost of localized treatment, the total costs of localized treatment is $3.223 -$4.92 billion.
- These numbers may be underestimated -we do not include the cost of GHG emissions from repairing the 150 thousand units that will not be treated with SF.

Table 1: The Cost of Alternative Treatments of Drywood Termites

Costs	Scenarios (in millions of dollars)					
	No Treatment		SF + Local Treatments		Local Treatments Only	
	Low	High	Low	High	Low	High
Annual Cost of Drywood Termite Structural Damage	18000.00	18000.00	625.00	625.00	3109.48	4442.12
Cost of Local Treatment	0.00	0.00	91.20	382.80	114.00	478.50
Cost of Fumigation	0.00	0.00	200.00	500.00	0.00	0.00
Total Annual Cost to Consumer	18000.00	18000.00	916.20	1507.80	3223.48	4920.62
Total Annual GHG Cost	0.00	0.00	90.00	450.00	0.00	0.00
Total Cost of Scenario	18000.00	18000.00	1006.20	1957.80	3223.48	4920.62
Cost compared to SF + local treatment	16042.20	16993.80			1265.68	3914.42
price of GHG per ton					588.560405	1371.472

The Bottom line

- The gain from using SF when the alternative is a localized treatment, is between $1.27 and $3.91 billion. The average gain from SF compared to localized treatment is $2.6 billion.
- The price of one ton of greenhouse gasses that will equalize the cost of fumigation to the cost of its alternative a local between
  - $588.56/ton of carbon ($3223.48 million - $1457.80 million / $3 million)
  - And $1371.47/ton of CO2 ($4442.12 million - $816.20 million / $3 million).
- These implied prices of GHG emissions is much higher than the price per ton of carbon of GHG in most other applications and obviously is above the frequently discussed implied price per ton of CO2 which is between $30 and $150.

The various formulas appearing in the paper

Variable	Formula
	Total value in CA homes*% wooden homes CA*termite damage coefficient
Annual cost of drywood treatment with SF + Local treatment	US. residents spend an estimated $5 billion annually to control termites. California has 25% of real estate, if 50) of this damage is drywood damage, the annual cost is $625 million.
Annual cost of termite structural with only local treatment both low (high)	Low (high) fraction loss of value due to termite*average home value California*number of fumigated houses*discounting factor (assuming 15 years delay)
Cost of local treatment when used with SF both low (high)	Cost for local treatment (Low/High)* # homes in SoCal with drywood termites/yr* share locally treated when SF is used
Cost of local treatment when used without SF both low (high)	Cost for local treatment (Low/High)* # homes in SoCal with drywood termites/yr
Cost of fumigation both low (high)	# Fumigated houses SoCal* cost of fumigation (low/high)
Total annual cost for consumer	Sum of annual cost of termite damage + cost of local treatment + cost of fumigation
Total annual cost of GHG both low (high)	Number of fumigated houses low (high)* Low/Hi GHG$/ton SF* GHG emissions/ton/kg SF* #Local treatments/yr SoCal
Total cost of scenario	Sum of annual cost for consumer house cost both low (high)
Cost of low treatment compared to SF + local treatment both low (high)	Total cost of low treatment - Total cost of SF and local treatment both low (high)
Implied price of GHG/ton both low (high)	(Total cost of Local treatment -total annual cost for consumer for SF+Local treatment)/total GHG emissions

Sources of information

Variable	Definition	Assumptions	Sources
Loss of property from termite with SF	Residential home l	US. residents spend an estimated $5 billion annually to control termites. California has 25% of real estate, If 50) of this damage is drywood damage, the annual cost is $625 million.	https://www.orkin.com/pests/termites/termite-statistics Briar et al. 1988
Total value CA homes	Residential homes	$ value only SoCal	Manhertz etal 2022
Average home value CA	Residential homes	Average$ SoCal	Manhertz etal 2022
% wooden homes CA	Residential homes	% wooden homes CA	Manhertz etal 2022
Cost for local treatment - Low	Low cost, $228	Finding spot, per spot, and 1st treatment only	PCOC (Pest Control Operators of California, Inc)
Cost for local treatment - High	High cost, $957	Higher degree of difficulty to find and treat or inaccessible	PCOC
# homes in SoCal with drywood termites/yr	500,000 with drywood termites/yr SoCal	Only includes drywood termites	PCOC; Brier etal 1988
Discount Factor		Assuming it takes 15 years for the damage to occur 4% interest, The net present value of $1 damage in 15 years with 4% interest is 0.5552645	Conservative estimate based onhttps://www.petrispestcontrol.com/pest-center/frequently-asked-questions/how-long-does-it-take-for-drywood-termites-to-cause-damage-/
Termite Damage Coefficient	Average damage loss to homes if SoCal if not treated for drywood termites	0.005-Half a percent dam/yr	Ripa 2022, personal comm. Chile Lewis&Forschler 2014, Lewis etal 2011, Rust&Su 2012, Scheffrahn etal 1997
#Local treatments/yr SoCal	6 kg/yr	#Additional local treatments	Lewis etal 2011, Rust&Su 2012, Scheffrahn etal 1997
Low GHG$/ton SF	$30		https://www.bloomberg.com/news/articles/2022-09-15/too-low-carbon-prices-won-t-stop-companies-from-emitting the prices of CO2
Hi GHG$/ton SF	$150		https://www.goldstandard.org/blog-item/carbon-pricing-what-carbon-credit-worth
LoDamCost/yr	0.07	Low damage value loss per yr SoCal	Ripa 2022, personal comm. Chile Atkinson 1994
LoDamCost/yr	0.1	High damage value loss per yr SoCal	Ripa 2022, personal comm. Chile Atkinson 1994
# fumigated houses SoCal	100,000	State estimate of fumes/yr for SoCal	PCOC
Scaling factor	Normalize data to million$	Basic math	.
Cost of fumigation - Low	$2,000	2-3 bedroom residential home, SoCal	PCOC
Cost of fumigation - High	$5,000	4 bedroom residential home, SoCal	PCOC
GHG emissions/ton/kg SF	5 ton/kg		Douglass fumigation survey 2022

Other implications

1. Equity effects: Individuals with low incomes living in under-resourced regions are less likely to afford pest treatment and suffer from increased levels of termite damage.
2. Value of information: Having a good database that would allow you to know where different types of treatments have been utilized and how they worked.
3. Need for research and extension: There hasn't been as much investment in academic research on drywood termites as compared to agricultural pests and mosquitoes. Improved input use efficiency requires both technological development as well as better training, suggesting the need for research leading to improvement of:
    i. Field application practices,
    ii. Sealing methods to reduce leaking of SF during the active fumigation phase
    iii. Devices/methods to re-capture SF during the aeration phase before re-occupancy
    a. Developing effective, non-damaging building and contents, non-greenhouse alternatives acceptable to the state's mandate on being "certified free of pests."
    b. Development of a supply chain to produce these products –
    c. Improved applicator, field representative, and operator training.
    d. Land grant colleges and other research institutions need to allocate more resources to address drywood termites, bed bugs, and similar pests to identify economically, environmentally, and socially effective solutions to problems that tend to affect the disadvantaged.

Conclusions

- Fumigation by SF has become an essential treatment of termites in dry wood in California and elsewhere. It is also a GHG that contributes to climate change.
- When considering restricting its use, one must consider the increased social cost of termites and the most likely alternative, local treatment.
- We calculated that in California, not using SF will cost between $1.2 billion to $4 billion annually. Furthermore, the implied price of CO2 is between $588.56 and $1371.47 per ton of carbon dioxide.
- These costs are much higher than the implied price of CO2 removal from most other applications.
- Banning Sf has significant equity effects as its restriction will most likely impact low-income individuals living in a rented property. Replacing housing damaged by termites will also result in GHG emissions. Therefore, we recommend that we continue to use SF until a sound alternative solution is found.
- Even with the continuous use of SF, it is essential to pursue research to find ways to increase the efficiency of SF and contain its emissions so that it can provide the same protection against termites with lower GHG emissions.