

SCREENING-LEVEL HAZARD CHARACTERIZATION

Alkyl Sulfides Category

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, 1-(*tert*-dodecylthio) CASRN 67124-09-8

Subcategory II: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized CASRN 68511-50-2

Pentene, 2,4,4-trimethyl-, sulfurized CASRN 68515-88-8

Alkenes, C₁₅-C₁₈ *alpha*-, sulfurized CASRN 67762-55-4

The High Production Volume (HPV) Challenge Program¹ was conceived as a voluntary initiative aimed at developing and making publicly available screening-level health and environmental effects information on chemicals manufactured in or imported into the United States in quantities greater than one million pounds per year. In the Challenge Program, producers and importers of HPV chemicals voluntarily sponsored chemicals; sponsorship entailed the identification and initial assessment of the adequacy of existing toxicity data/information, conducting new testing if adequate data did not exist, and making both new and existing data and information available to the public. Each complete data submission contains data on 18 internationally agreed to “SIDS” (Screening Information Data Set^{1,2}) endpoints that are screening-level indicators of potential hazards (toxicity) for humans or the environment.

The Environmental Protection Agency’s Office of Pollution Prevention and Toxics (OPPT) is evaluating the data submitted in the HPV Challenge Program on approximately 1400 sponsored chemicals by developing hazard characterizations (HCs). These HCs consist of an evaluation of the quality and completeness of the data set provided in the Challenge Program submissions. They are not intended to be definitive statements regarding the possibility of unreasonable risk of injury to health or the environment.

The evaluation is performed according to established EPA guidance^{2,3} and is based primarily on

¹ U.S. EPA. High Production Volume (HPV) Challenge Program; <http://www.epa.gov/chemrtk/index.htm>.

² U.S. EPA. HPV Challenge Program – Information Sources; <http://www.epa.gov/chemrtk/pubs/general/guidocs.htm>.

³ U.S. EPA. Risk Assessment Guidelines; <http://cfpub.epa.gov/ncea/raf/rafguid.cfm>.

hazard data provided by sponsors; however, in preparing the hazard characterization, EPA considered its own comments and public comments on the original submission as well as the sponsor's responses to comments and revisions made to the submission. In order to determine whether any new hazard information was developed since the time of the HPV submission, a search of the following databases was made from one year prior to the date of the HPV Challenge submission to the present: (ChemID to locate available data sources including Medline/PubMed, Toxline, HSDB, IRIS, NTP, ATSDR, IARC, EXTOXNET, EPA SRS, etc.), STN/CAS online databases (Registry file for locators, ChemAbs for toxicology data, RTECS, Merck, etc.) and Science Direct. OPPT's focus on these specific sources is based on their being of high quality, highly relevant to hazard characterization, and publicly available.

OPPT does not develop HCs for those HPV chemicals which have already been assessed internationally through the HPV program of the Organization for Economic Cooperation and Development (OECD) and for which Screening Initial Data Set (SIDS) Initial Assessment Reports (SIAR) and SIDS Initial Assessment Profiles (SIAP) are available. These documents are presented in an international forum that involves review and endorsement by governmental authorities around the world. OPPT is an active participant in these meetings and accepts these documents as reliable screening-level hazard assessments.

These hazard characterizations are technical documents intended to inform subsequent decisions and actions by OPPT. Accordingly, the documents are not written with the goal of informing the general public. However, they do provide a vehicle for public access to a concise assessment of the raw technical data on HPV chemicals and provide information previously not readily available to the public.

Chemical Abstract Service Registry Number (CASRN)	67124-09-8 68511-50-2 68515-88-8 67762-55-4
Chemical Abstract Index Name	2-Propanol, 1-(<i>tert</i>-dodecylthio) 1-Propene, 2-methyl-, sulfurized Pentene, 2,4,4-trimethyl-, sulfurized Alkenes, C₁₅₋₁₈ <i>alpha</i>-, sulfurized
Structural Formula	See Section 1
Summary	
<p>These category members are viscous liquids with estimated negligible to moderate water solubility and negligible to low vapor pressure. They are expected to have low to moderate mobility in soil. Volatilization of these category members is considered to be low to moderate based upon their estimated Henry's Law constants. The rate of hydrolysis is considered negligible. The rate of atmospheric photooxidation is considered moderate. These category members are expected to have moderate persistence (P2) and low to moderate bioaccumulation potential (B1-B2).</p>	
<p><i>Subcategory I (CASRN 67124-09-8)</i></p>	
<p>The acute oral and dermal toxicity for CASRN 67124-09-8 in rats and rabbits are low and the acute inhalation toxicity in rats is moderate. An oral repeated-dose toxicity study in rats showed liver effects at 100 mg/kg/day. The NOAEL was not established. A one-generation reproductive toxicity study in rats showed decreased body weight and an increase in mean liver and kidney weights in adult males and hematology changes in dams at 167 mg/kg-bw/day via the oral route; the NOAEL was 50 mg/kg-bw/day. A developmental toxicity showed a decrease in mean pup weight at 67 mg/kg-bw/day; the NOAEL was 50 mg/kg/day. No reproductive toxicity effects were seen at 500 mg/kg-bw/day (highest dose tested). This chemical did not induce gene mutation or chromosomal aberration <i>in vitro</i>.</p>	
<p>The evaluation of available toxicity data for aquatic organisms for CASRN 67124-09-8 indicates that the 96-h LC 50 for fish is 0.42 mg/L, the 48-h EC 50 for aquatic invertebrates is 1.3 mg/L and the 96-hour EC50 for aquatic plants is “no effects at saturation.” The estimated 21-d chronic toxicity value for aquatic invertebrates using ECOSAR is 0.036 mg/L.</p>	
<p>The chronic aquatic invertebrate toxicity endpoint for CASRN 67124-09-8 remains a data gap under the HPV Challenge Program.</p>	

Subcategory II (CASRN 68511-50-2, 68515-88-8, and 67762-55-4)

The acute oral toxicity of CASRN 68511-50-2 and 68515-88-2 in rats is low. The acute inhalation toxicity of CASRN 68515-88-8 in mice, guinea pigs and rats is moderate. The acute dermal toxicity of CASRN 68515-88-8 and 67762-55-4 is low.

In a dermal repeated-dose toxicity study in rats, CASRN 68511-50-2 showed a decrease in body weight gain in male rats and hematological effects in both sexes at 250 mg/kg/day; the NOAEL was 100 mg/kg/day. Female rats exposed to CASRN 68515-88-8 via aerosol inhalation, showed increased hemoglobin levels and relative liver-to-body weight ratios at 150 mg/kg/day; the NOAEL was 50 mg/kg-bw/day. In the same study, liver effects were seen in male rats at 150 mg/kg-bw/day. The NOAEL for male rats was not established. CASRN 68511-50-2 and 68515-88-8 were irritating to rat and rabbit skin in dermal repeated-dose studies.

CASRN 68511-50-2 and 68515-88-8 did not induce gene mutations *in vitro* or chromosomal aberrations *in vivo*. CASRN 67762-55-4 did not induce gene mutations *in vivo*.

The evaluation of available toxicity data to aquatic organisms for all subcategory II members indicates that for the acute hazard to fish, aquatic invertebrates and aquatic plants, there are “no effects at saturation”.

Reproductive and developmental toxicity were identified as data gaps for all subcategory members under the HPV Challenge program.

The sponsor, The American Chemistry Council, Petroleum Additives Panel, Health, Environmental and Regulatory Task Group (HERTG), submitted a Test Plan and Robust Summaries to EPA for the alkyl sulfides category on March 28, 2000. EPA posted the submission on the ChemRTK HPV Challenge website on June 13, 2000 <http://www.epa.gov/chemrtk/pubs/summaries/alkylsul/c12549tc.htm>. EPA comments on the original submission were posted to the website on October 6, 2000. Public comments were also received and posted to the website. The sponsor submitted updated/revised documents on May 18, 2005, which were posted to the ChemRTK website on June 7, 2005.

Category Justification

The sponsor proposes a category of four alkyl sulfide substances that are used as petroleum lubricant additives. One of the sponsored mixtures, 2-propanol, (*tert*-dodecylthio)- (CASRN 67124-09-8), is a hydroxyalkyl monosulfide. Two of the sponsored mixtures, 1-propene, 2-methyl-, sulfurized (CASRN 68511-50-2) and pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8), are highly branched alkyl sulfide chains that contain varying numbers of repeated units. The fourth sponsored mixture, alkenes C15 – 18 alpha-, sulfurized (CASRN 67762-55-4), contains both cyclic and non-cyclic alkyl sulfide structures with long chain alkyl groups that can be either linear or branched. Structures of these three alkyl sulfides indicate that their components may contain mono- through penta- sulfide units.

The sponsor's proposed grouping of these alkyl sulfides into a single category was based on the structural similarity, limited reactivity, low biological activity, very low water solubility and low vapor pressure. EPA, for this phase of review, considers these chemicals as two subcategories: (1) Hydroxyalkyl Monosulfide consisting of 2-propanol, (*tert*-dodecylthio)- (CASRN 67124-09-8) and (2) Alkyl Polysulfides consisting of 1-propene, 2-methyl-, sulfurized (CASRN 68511-50-2), pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8) and alkenes C15 – 18 alpha-, sulfurized (CASRN 67762-55-4). This is primarily based on the fact that 2-propanol, (*tert*-dodecylthio)- is the only sponsored chemical that contains a hydroxyl group which may cause it to be metabolized and excreted differently from the remaining sponsored chemicals. It is the only sponsored chemical that is exclusively a monosulfide, and its molecular weight appears to be much lower than the components that make up the other three sponsored mixtures.

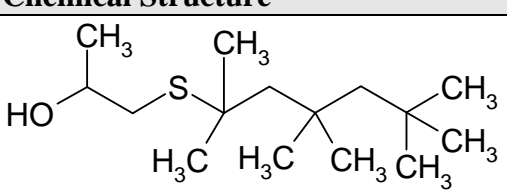
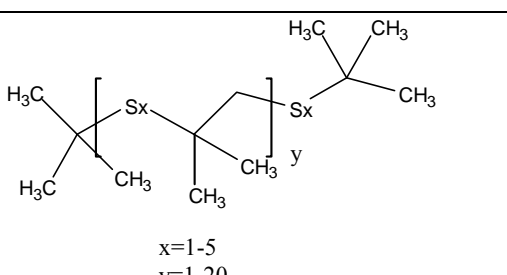
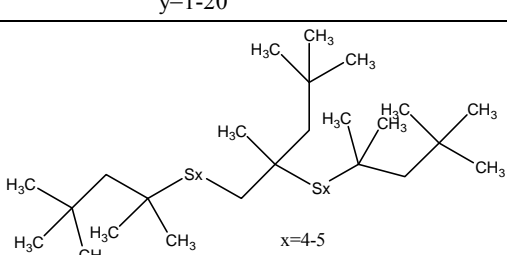
In addition, based on the sponsor's descriptions, pentene, 2,4,4-trimethyl, sulfurized and alkenes C15 – 18 alpha-, sulfurized, are not expected to contain lower molecular weight components and, therefore, would have aquatic toxicity similar to that of 1-propene, 2-methyl-, sulfurized. Thus, grouping of the sponsored mixtures 1-propene, 2-methyl-, sulfurized, pentene, 2,4,4-trimethyl, sulfurized and alkenes C15 – 18 alpha-, sulfurized appears to be supported for evaluation of physicochemical and aquatic toxicity endpoints. In contrast, 2-propanol, (*tert*-dodecylthio)- has a low molecular weight (260.5) and is expected to have different physicochemical properties (lower log K_{ow} and higher water solubility) than the higher molecular weight mixtures. Furthermore, aquatic toxicity data provided for 2-propanol, (*tert*-dodecylthio)- showed evidence of toxicity that is consistent with its lower molecular weight. Thus, these physicochemical and aquatic toxicity data support evaluation of 2-propanol, (*tert*-dodecylthio)- separately from the other sponsored mixtures.

Overall, structural considerations and the physicochemical, aquatic toxicity and health data that allow comparisons among the sponsored chemicals support evaluation of 2-propanol, (*tert*-dodecylthio)- in one subcategory and the three sponsored mixtures in a separate subcategory. Therefore, in this hazard characterization assessment, 2-propanol, (*tert*-dodecylthio)- will be considered alone in Subcategory I (hydroxyalkyl monosulfide), whereas 1-propene, 2-methyl-, sulfurized, pentene, 2,4,4-trimethyl, sulfurized and alkenes C15 – 18 alpha-, sulfurized will be considered together in Subcategory II (alkyl polysulfides).

1. Chemical Identity

1.1 Identification and Purity

All four substances are derived from similar starting materials (i.e., alkenes and sulfur), and all contain similar chain length olefinic hydrocarbons linked by sulfur to form linear, branched, or cyclic structures. Commercial alkyl sulfides are manufactured by reacting olefins (linear or branched) with sulfur in a controlled exothermic reaction and then sparged with nitrogen to remove hydrogen sulfide. The 1-propene, 2-methyl- and Pentene, 2,4,4-trimethyl derivatives require a pre-step where an adduct of the olefin and sulfur is first produced and then further reacted with additional sulfur to create the final product. Three substances include saturated long-chain hydrocarbons. Two of the substances contain mixtures of linear and cyclic alkyl sulfides. These substances can also contain cyclic structures made up of sulfur and carbon, and the alkyl groups can be linear or branched.

Table 1. Sponsored Chemicals		
Chemical Name	CASRN	Chemical Structure
2-Propanol, 1-(<i>tert</i> -dodecylthio)-	67124-09-8	
1-Propene, 2-methyl-, sulfurized	68511-50-2	 x=1-5 y=1-20
Pentene, 2,4,4-trimethyl-, sulfurized	68515-88-8	 x=4-5

Alkenes, C ₁₅₋₁₈ .alpha.-, sulfurized	67762-55-4	
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1.2 Physical-Chemical Properties

The physical-chemical properties of the alkyl sulfides are summarized in Table 2. The alkyl sulfides are viscous liquids with estimated negligible to moderate water solubility and negligible to low vapor pressure.

2. General Information on Exposure

2.1 Production Volume and Use Pattern

The alkyl sulfides category chemicals had an aggregated production and/or import volume in the United States of 52 to 120.5 million pounds during calendar year 2005. The volumes for the category members are as follows:

CASRN 67124-09-8	1 to 10 million pounds
CASRN 68511-50-2	50 to 100 million pounds
CASRN 68515-88-8	1 to 10 million pounds
CASRN 67762-55-4	<500,000 pounds

Non-confidential information in the IUR indicates that the industrial processing and uses of these chemicals include lubricants and functional fluids. Non-confidential information in the IUR indicates that the commercial and consumer products containing these chemicals include lubricants, greases, and fuel additives.

The HPV submission for this category states that these chemicals are used as high temperature and anti-wear inhibitors in the formulation of engine oils, industrial and metal working lubricating oils and greases. Alkyl sulfides are generally sold to finished oil blenders contained in additive packages; these additive packages are then blended into finished oils.

2.2 Environmental Exposure and Fate

No quantitative information is available on releases of this chemical category to the environment.

The environmental fate properties are provided in Table 3. The alkyl sulfides are expected to have low to moderate mobility in soil. Two category members, 2-propanol, 1-(*tert*-dodecylthio)- and 1-propene, 2-methyl-, sulfurized were not readily biodegradable using the manometric

respirometry (OECD 301F) and modified Sturm (OECD 301B) tests; however, alkyl sulfides are typically not recalcitrant in the environment. The rate of volatilization of the alkyl sulfides from water and moist soil is considered low to moderate based on their estimated Henry's Law constants. The rate of hydrolysis is considered negligible under environmental conditions. The alkyl sulfides are expected to have moderate persistence (P2) and low to moderate bioaccumulation potential (B1-B2).

Table 2. Physical-Chemical Properties of Alkyl Sulfides Category¹

Property	2-Propanol, 1-(<i>tert</i> -dodecylthio)-	1-Propene, 2-methyl-, sulfurized	Pentene, 2,4,4-tri-methyl-, sulfurized	Alkenes, C ₁₅₋₁₈ <i>alpha</i> -, sulfurized
CASRN	67124-09-8	68511-50-2	68515-88-8	67762-55-4
Molecular Weight	260	160–1,600 (mean molecular weight of 480)	594–658	520 (mean molecular weight)
Physical State	Viscous liquid	Viscous liquid	Viscous liquid	Viscous liquid
Melting Point	No data ²	No data ²	No data ²	No data ²
Boiling Point	Decomposes at >200°C without boiling	Decomposes at >200°C without boiling	Decomposes at >200°C without boiling	Decomposes at >200°C without boiling
Vapor Pressure	1.1×10 ⁻⁴ mm Hg ³	0.02 to <7.5×10 ⁻⁸ mm Hg ³	<7.5×10 ⁻⁸ mm Hg ³	<7.5×10 ⁻⁸ mm Hg ³
Dissociation Constant (pK _a)	Not applicable	Not applicable	Not applicable	Not applicable
Henry's Law Constant	1.1×10 ⁻⁶ atm-m ³ /mol ³	<1×10 ⁻¹⁰ atm-m ³ /mol ³	<1×10 ⁻¹⁰ atm-m ³ /mol ³	<1×10 ⁻¹⁰ atm-m ³ /mol ³
Water Solubility	4.84 mg/L (m) ¹	2.7 to 6.32×10 ⁻⁶ mg/L	2.35×10 ⁻⁶ mg/L	1.59×10 ⁻¹⁰ mg/L
Log K _{ow}	5.43 ³	5.1 to >6	>6	>6

¹American Chemistry Council. May 19, 2005. Revised Robust Summary and Test Plan for Alkyl Sulfides Category. <http://www.epa.gov/chemrtk/pubs/summaries/alkylsul/c12549tc.htm>.

²Estimated melting points were provided in the Test Plan that conflicted with the physical state of the substance.

³U.S. EPA. 2008. Estimation Programs Interface Suite™ for Microsoft® Windows, v 3.20. United States Environmental Protection Agency, Washington, DC, USA. <http://www.epa.gov/opptintr/exposure/pubs/episuite.htm>.

m=measured data; e=estimated

Property	2-Propanol, 1-(tert-dodecylthio)-	1-Propene, 2-methyl-, sulfurized	Pentene, 2,4,4-tri-methyl-, sulfurized	Alkenes, C₁₅₋₁₈ .alpha.-, sulfurized
CASRN	67124-09-8	68511-50-2	68515-88-8	67762-55-4
Photodegradation Half-life	5.51 hours	1.42–3.60 hours	2.75–6.78 hours	1.66–22.63 hours
Hydrolysis Half-life	Stable	Stable	Stable	Stable
Biodegradation	5.9% after 28 days (not readily biodegradable)	0.3% after 28 days (not readily biodegradable)	Not readily biodegradable based on comparisons with other category members	Not readily biodegradable based on comparisons with other category members
Bioconcentration	BCF= 3,020	BCF=3.16–2,818	BCF=3.16	BCF=3.16
Log K _{oc}	3.0	6.12–11.98	6.49–12.74	9.50–9.77
Fugacity (Level I Model)	Air = 0.265% Water = 0.407% Soil = 97.1% Sediment = 2.158%	Air = <0.1% Water = <0.1% Soil = 97.7% Sediment = 2.172%	Air = <0.1% Water = <0.1% Soil = 97.7% Sediment = 2.172%	Air = <0.1% Water = <0.1% Soil = 97.8% Sediment = 2.172%
Persistence ²	P2 (moderate)	P2 (moderate)	P2 (moderate)	P2 (moderate)
Bioaccumulation ²	B2 (moderate)	B1-B2 (low-moderate)	B1 (low)	B1 (low)

¹American Chemistry Council. May 19, 2005. Revised Robust Summary and Test Plan for Alkyl Sulfides Category. <http://www.epa.gov/chemrtk/pubs/summaries/alkylsul/c12549tc.htm>.

²Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

m=measured data; e=estimated

3. Human Health Hazard

A summary of health effects data submitted for SIDS endpoints is provided in Table 4. The table also indicates where data for tested category members are read-across (RA) to untested members of the category.

Acute Oral Toxicity

Subcategory 1: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Fasted male Sprague-Dawley rats (5/sex/dose) were administered 2-propanol, (*tert*-dodecylthio)- in mineral oil via oral gavage at 5000 mg/kg-bw and observed for 14 days following dosing. Mortality was observed in one rat within 48 hours. No treatment related histopathological changes or microscopic lesions were observed.

LD₅₀ > 5000 mg/kg-bw

Subcategory 2: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

Fasted male Sherman/Wistar rats (5/sex/dose) were administered 1-propene, 2-methyl-, sulfurized via oral gavage at 2.0, 4.0, 8.0, 16.0 or 32.0 mL/kg (~ 2000, 4000, 8000, 16,000 or 32,000 mg/kg-bw) and observed for 14 days following dosing. Four/five deaths were observed day 1 and one/five on day two at 8000 mg/kg-bw. Five/five deaths occurred on day 1 at 16,000 and 32,000 mg/kg-bw. No histopathology or microscopic evaluations were performed.

LD₅₀ = ~ 5700 mg/kg-bw

Pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8)

Albino Sprague-Dawley rats (5/sex/dose) were administered pentene, 2,4,4-trimethyl, sulfurized in a mineral oil based material via oral gavage at 5000 mg/kg-bw and observed for 15 days following dosing. Clinical signs included decreased activity, salivation and urinary incontinence in females and diarrhea and salivation in males. No mortality was observed. No treatment related histopathological changes or microscopic lesions were observed.

LD₅₀ > 5000 mg/kg-bw

Acute Inhalation Toxicity

Subcategory 2: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

Sprague-Dawley rats (10/sex/concentration) were exposed whole-body to 1-propene, 2-methyl-, sulfurized vapor at 0.07 or 0.39 mg/L for 4 hours and observed for 14 days. Five males and five females from each group were sacrificed 24 hours following exposure and the remaining animals were observed for 14 days. Clinical signs included oral and ocular discharge, shallow respiration (high dose) decreased response to stimuli. No mortality, treatment related histopathological changes or microscopic lesions were observed.

4-h LC₅₀ > 0.39 mg/L

Pentene, 2,4,4-trimethyl, sulfurized (CASRN. 68515-88-8)

(1) CD-1 mice and Hartley guinea pigs (5/sex/species/concentration) were exposed whole-body to pentene, 2,4,4-trimethyl, sulfurized aerosol at 0 or 4.3 mg/L for 4 hours, observed every 15 minutes during/after dosing and for 14 days following. Ano-genital staining was observed in guinea pigs during week two. One death occurred that was not attributed to treatment. No treatment related histopathological changes or microscopic lesions were observed.

4-h LC₅₀ (mice and guinea pigs) > 4.3 mg/L

(2) Sprague-Dawley rats, CD-1 mice and Hartley guinea pigs (5/sex/species/concentration) were exposed whole-body to pentene, 2,4,4-trimethyl, sulfurized aerosol at concentrations of 0 or 4.3 mg/L for 4 hours, observed every 15 minutes during/after dosing and for 14 days following. One female rat died within 2 hours, and three female rats died within one day of dosing. An additional two rats (sex not stated) were found dead the morning after dosing. A single male mouse and a single male guinea pig also died on test days 7 and 9, respectively. A significant decrease in body weight was seen in all three species.

4-h LC₅₀ (mice and guinea pigs) > 4.3 mg/L

4-h LC₅₀ (rat) < 4.3 mg/L

(3) Sprague-Dawley rats, (5/sex/concentration) were exposed whole-body to pentene, 2,4,4-trimethyl, sulfurized as an aerosol at concentrations of 1.5, 2.5 or 5.6 mg/L for 4 hours and observed for 14 days following dosing. Three/five females exposed to 1.5 mg/L died on day 2, 4/5 females exposed to 2.5 mg/L died on day 2, 3/5 females exposed to 5.6 mg/L died on day 2 with an additional death on day six. Male rats showed a decrease in body weight at 2.5 and 5.6 mg/L (significance not specified). No mortality, treatment related histopathological changes or microscopic lesions were observed in males.

4-h LC₅₀ (males) > 5.6 mg/L

4-h LC₅₀ (females) = 2.2 mg/L

Acute Dermal Toxicity

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)-(CASRN 67124-09-8)

New Zealand White rabbits (5/sex) were administered 2-propanol, (tert-dodecylthio)- in a mineral oil-based material dermally on unabrased shaved skin at 2000 mg/kg-bw under occluded conditions for 24 hours and observed for 14 days following dosing. Blistering and blanching at the site of application was observed. No mortalities were observed. Gross pathological examination revealed no abnormal findings.

LD₅₀ > 2000 mg/kg-bw

Subcategory II: Alkyl Polysulfides

Pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8)

New Zealand White rabbits (5/sex) were administered pentene, 2,4,4-trimethyl, sulfurized in a mineral oil-based material dermally on unabrased shaved skin at 2000 mg/kg-bw under occluded conditions for 24 hours and observed for 14 days following dosing. One male rabbit died on day 14. Mild skin erythema and mild-to-moderate edema was observed in both sexes within 24 hours. By day 7, slight to mild skin irritation was noted and was completely resolved by day 14.
LD₅₀ > 2000 mg/kg-bw

Alkenes C15 – 18 alpha-, sulfurized (CASRN 67762-55-4)

New Zealand White rabbits (5/sex) were administered alkenes C15 – 18 alpha-, sulfurized dermally on clipped dorsa skin at 2000 mg/kg-bw under unspecified occlusion for 24 hours and observed for 14 days following dosing. Erythema and edema was seen at the application site on day one. Gross pathological examination revealed no abnormal findings. No mortality was observed.

LD₅₀ > 2000 mg/kg-bw

Repeated-Dose Toxicity

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Sprague-Dawley rats (5/sex/dose) were administered 2-propanol, (tert-dodecylthio)- in corn oil via gavage at 0, 100, 300 or 1000 mg/kg-bw/day 7 days/week for 28 days, and observed 14 days post exposure. Additional high-dose and control animals (5/sex/group) were observed for a 14-day recovery period. No mortalities were observed. Body weight gain was decreased in high-dose males during the first week of the study. A decrease in hemoglobin and hematocrit values was observed in high-dose females following exposure; however, values returned to normal during the recovery period. Gross pathological examination of the liver revealed an accentuated lobular pattern in the mid- and high-dose females following treatment, which resolved during the recovery period. Increased kidney weights and kidney/body weight ratios were noted in high-dose males following treatment and throughout recovery. Dose-related increases in mean liver weights and/or liver/body weight ratios were seen at study termination in males at all dose levels and in females at the mid- and high-dose levels. Recovery was apparent during the 2-week recovery period for the high-dose group. Histopathological effects included hepatocellular hypertrophy of the liver at all dose levels following the treatment period and throughout the recovery period as well as increased incidences of globular casts and hyaline droplets in all treated males. Hyaline droplets in the proximal tubules were seen only at dosing termination. The nephropathy in males is consistent with the alpha 2 μ -globulin-mediated mechanism that is male rat-specific. EPA's Risk Assessment Forum has outlined the key events and the data that are necessary to demonstrate this mode of action (Alpha 2 μ -Globulin: Association with Chemically Induced Renal Toxicity and Neoplasia in the Rat, EPA/625/3-91/019F).

LOAEL = 100 mg/kg-bw/day (based on liver effects)

NOAEL = not established

Subcategory II: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

(1) Sprague-Dawley rats (10/sex/dose) were administered 1-propene, 2-methyl-, sulfurized dermally onto clipped intact skin at 0, 500 or 2000 mg/kg-bw/day undiluted and at 0, 10, 50, 100, 250 or 500 mg/kg-bw/day diluted in mineral oil, respectively, under non-occluded conditions 5 days/week for 13 weeks. Rats were fitted with Elizabethan collars to minimize ingestion of test material. Male rats treated with diluted doses at ≥ 250 mg/kg-bw/day exhibited a 15% decrease in body weight gain. At doses ≥ 250 mg/kg-bw/day, both sexes had decreased levels of red blood cells and increased levels of neutrophils in circulation, increased spleen size and increased pigment and red pulp in the spleen. There was increased production of white blood cells in the spleen and bone marrow at ≥ 100 mg/kg-bw/day. Mean liver to body weight ratios were increased in male rats at ≥ 250 mg/kg-bw/day and in females at ≥ 500 mg/kg-bw/day. Male rats treated with undiluted doses at 500 or 2000 mg/kg-bw/day had increased kidney weights correlating with dose-related increases in hyaline droplet formation indicative of hyaline droplet nephropathy. Administration of 1-propene, 2-methyl-, sulfurized undiluted at doses of 500 and 2000 mg/kg-bw/day and diluted in mineral oil at doses of 250 and 500 mg/kg-bw/day induced moderate to severe reactions in the skin, characterized by erythema, edema and increased thickness and stiffness; these effects were more severe at 500 mg/kg-bw/day. Microscopic examination revealed hyperkeratosis, hyperplasia of sebaceous gland, increased mitosis in the epidermis and dermal abscesses. Virtually no irritation was observed in the vehicle control group or in dose groups of 10, 50 or 100 mg/kg-bw/day. No effects on sperm motility or morphology were observed in rats treated at 2000 mg/kg-bw/day. The relative weight increases in livers of higher dose animals of both sexes had no microscopic correlation and is considered by the authors as an adaptive response to treatment. The increase in kidney weight and hyaline droplet formation in male rats is indicative of hyaline droplet nephropathy. Although many changes in hematology parameters can be associated with infections that can occur with severe skin irritation, increased dose related neutrophil production was observed in animals with minimal skin irritation and can be considered a direct effect of the test material.

LOAEL = 250 mg/kg-bw/day (based on decreased bodyweight gain in males, and hematological effects)

NOAEL = 100 mg/kg-bw/day

(2) Albino rabbits (6/sex/dose) were administered 1-propene, 2-methyl-, sulfurized dermally, onto intact or abraded skin (3/sex/group) at 0, 200 or 2000 mg/kg-bw/day under occluded conditions, 6 hours/day, 5 days/week for 4 weeks (20 applications). One high-dose male died. Decreased body weight was noted in high-dose males during the latter half of the study, and weight gain in five/six females at the high-dose. Severe skin irritation was observed at both dose levels and abrasion of the skin increased the degree of irritation at the low-dose level (sex not stated). Hematological and clinical chemistry effects included increased monocytes at the high dose, increased chloride and decreased albumin at the low dose and increased chloride and globulin and decreased alkaline phosphatase activity at the high dose. Gross and histopathological examination revealed no treatment-related findings.

LOAEL = 2000 mg/kg-bw/day (based on hematological effects)

NOAEL = 200 mg/kg-bw/day

(3) New Zealand White rabbits (10/dose) were administered 1-propene, 2-methyl-, sulfurized dermally undiluted at 0 mg/kg-bw/day (5/sex), 140 mg/kg-bw/day (seven males, three females), 560 mg/kg-bw/day (eight males, two females) or 2240 mg/kg-bw/day (six males, four females) under non-occluded conditions, 5 days/week for 3 weeks (15 applications). Rabbits were fitted

with Elizabethan collars to minimize ingestion of test material. No mortalities or effects on body weight were observed. All animals exhibited lethargy, ptosis, gastrointestinal disturbances, nasal and ocular discharges and respiratory distress, all more often in the second and third weeks with no discernible pattern of response. Skin reactions included mild to moderate erythema and mild edema during week 1 for all treated groups. During week 2, reactions in all treated groups included moderate to severe erythema with additional signs of cracked skin, bleeding and discoloration. Edema was mild at the low-dose and mild to moderate at higher doses. During week 3, all treated animals exhibited severe erythema with cracked and bleeding skin, eschar and discoloration and slight to moderate edema. Hematology, clinical chemistry and urinalysis revealed no treatment-related effects. At necropsy, sporadic occurrences of dark lungs and liver, red and bloated intestines, pale kidney coloration and small or gray coloration of the spleen were observed, but were not considered to be treatment-related. Epithelial hyperplasia of the treated skin was observed in all rabbits with the treated groups exhibiting slightly more severe grades of hyperplasia than the control group. With no discernible pattern of response in both test and control groups, observed clinical signs are considered to be related to handling. The occurrence of hyperplasia in all groups suggests a relationship to clipping rather to test material administration. Six errors in sex determination was discovered which resulted in uneven sex distribution within groups.

NOAEL = 2240 mg/kg-bw/day (based on no systemic toxicity at the highest dose tested))

Pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8)

(1) Sprague-Dawley rats (10/sex/concentration) were exposed (whole-body) to pentene, 2,4,4-trimethyl, sulfurized aerosol at 0, 15, 50 or 150 mg/mL for 6 hours/day, 5 days/week for 4 weeks (20 applications). Additional control and high-dose animals (5 males and 10 females/group) were observed over a 3-week recovery period. Convulsive behavior was observed in one high-dose female on day 3 followed by death on day 4, due to undetermined causes. A trend toward lower body weight gains was noted in males at all dose levels and in females at the two highest dose levels; however, statistical significance was not achieved. Hematological effects included a significant increase in hemoglobin concentration in high-dose females. Gross pathological examination revealed a significant increase in kidney weights in mid- and high-dose males and increased spleen, adrenal and liver weights/relative liver-to-body weight ratios in high-dose animals of both sexes. Post-recovery increases in testes, heart, lung and spleen weights were noted at unspecified dose levels. Histopathological examination revealed treatment-related effects in the kidneys of males at all dose levels and included globular casts at the corticomedullary junction, cortex and medulla as well as hyaline droplets in the proximal convoluted tubule. These effects were also noted in high-dose males following the 3-week recovery period. The nephropathy in males is consistent with the alpha 2 μ -globulin-mediated mechanism that is male rat-specific. EPA's Risk Assessment Forum has outlined the key events and the data that are necessary to demonstrate this mode of action (Alpha 2 μ -Globulin: Association with Chemically Induced Renal Toxicity and Neoplasia in the Rat, EPA/625/3-91/019F).

LOAEL (male) = 150 mg/kg-bw/day (based on liver effects)

NOAEL (male) = Not established

LOAEL (female) = 150 mg/kg-bw/day (based on increased hemoglobin levels and relative liver-to body weight ratios)

NOAEL (female) = 50 mg/kg-bw/day

(2) Sprague-Dawley rats (5 males/dose) were administered pentene, 2,4,4-trimethyl, sulfurized dermally at 0 or 1000 mg/kg-bw/day under semi-occluded conditions, 6 hours/day, 5 days/week for 4 weeks (20 applications). No mortality was observed and no changes in body weight were noted. Treatment-related effects included weak to moderate irritation characterized by erythema, eschar and flaking of the skin at the application site and persisting throughout the duration of treatment.

NOAEL = 1000 mg/kg-bw/day (based on no systemic toxicity at the highest dose tested))

Reproductive/Developmental Toxicity

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Sprague-Dawley rats (28/sex/dose) were administered 2-propanol, (tert-dodecylthio)- in corn oil via gavage at 0, 50, 167 or 500 mg/kg-bw/day once a day, 7 days/week for 14 days during pre-mating, 25 days during gestation and 20 days during lactation. Lower mean body weights (5 – 7% compared to controls) were noted in males at the high-dose level. There were no treatment-related effects on food consumption mating and fertility indices, hematology data, absolute and relative organ weights, sperm evaluation parameters or macro or microscopic pathology. Dams at all dose levels exhibited reddish vaginal discharge, mammary gland swelling and dark material around the eyes and nose. Two low-dose females delivered all stillborn pups. Because this finding was not observed at any other dose level, it was not considered to be a toxicologically significant effect. In the control, low-, mid- and high-dose groups, the number of females with live born pups was 25, 24, 27 and 26, respectively. There were no treatment-related effects on pre-coital intervals, gestation length or mean hematology values. Gross pathological examination of one high-dose female sacrificed on post mating day 25 included dark red/brown fluid in the uterus and vagina as well as one small placenta and two nonviable pups in the vagina. There were no treatment-related effects on total and mean number of pups delivered, number of live pups/litter or sex ratio. A decrease in the number of live pups was noted at the low-dose level; however, this was attributed to both litter losses at the lowest dose and therefore not considered to be an adverse effect. Mean pup weights were decreased at the mid-dose level on lactation day 14 and at the high-dose level on lactation days 14 and 21. Necropsy of stillborn pups, pups found dead, pups culled on day 4 and pups sacrificed on lactation day 21 revealed no treatment-related findings. In addition to the above findings, increased mean liver weights were noted at the highest dose in adult males and females and at the two highest doses in males only. Males also exhibited increased mean kidney weights at the two highest dose levels accompanied by evidence of accumulation of alpha-2- μ globulin in renal hyaline droplets. The nephropathy in males is consistent with the alpha 2 μ -globulin-mediated mechanism that is male rat-specific. EPA's Risk Assessment Forum has outlined the key events and the data that are necessary to demonstrate this mode of action (Alpha 2 μ -Globulin: Association with Chemically Induced Renal Toxicity and Neoplasia in the Rat, EPA/625/3-91/019F). (Summarized from TSCATS submission OTS0574387).

NOAEL (reproductive toxicity) = 500 mg/kg-bw/day (based on no effects at the highest dose tested)

LOAEL (systemic toxicity) = 167 mg/kg-bw/day (based on decreased body weight in males, hematology changes in dams, increased mean liver and kidney weights males)

NOAEL (systemic toxicity) = 50 mg/kg-bw/day

LOAEL (developmental toxicity) = 167 mg/kg-bw/day (based on decreased mean pup weight)

NOAEL (developmental toxicity) = 50 mg/kg-bw/day

Subcategory II: Alkyl Polysulfides

No data

Genetic Toxicity – Gene Mutation

Subcategory I: Hydroxyalkyl Monosulfide

In vitro

2-Propanol, (tert-dodecylthio)-(CASRN 67124-09-8)

Salmonella strains TA98, TA100, TA1535, TA1537 and *Escherichia coli* strain WP-2 were exposed to 2-propanol, (tert-dodecylthio)- in DMSO at 15, 50, 150, 500, 1500 or 5000 µg/plate in the presence and absence of metabolic activation. Positive and negative controls were included and responded appropriately. Cytotoxicity was observed in *Salmonella* strain TA1537 at concentrations of 50, 500, 1500 and 5000 µg/plate both with and without metabolic activation, but the number of revertants was not increased in any strain.

2-Propanol, (tert-dodecylthio)- was not mutagenic in this assay.

Subcategory II: Alkyl Polysulfides

In vitro

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

Salmonella typhimurium strains TA98, TA100, TA1535, TA1537 and TA1538 were exposed to 1-propene, 2-methyl-, sulfurized in DMSO at 0.01, 0.05, 0.1, 0.5 or 1 µL/plate in the presence and absence of metabolic activation. Positive and negative controls were included and responded appropriately. Cytotoxicity was not noted. (This assay was conducted using very low concentrations.)

1-Propene, 2-methyl-, sulfurized was not mutagenic in this assay.

Pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8)

Salmonella typhimurium strains TA98, TA100, TA1535, TA1537 and TA1538 were exposed to pentene, 2,4,4-trimethyl, sulfurized in DMSO at 0.01, 0.03, 0.1, 0.3 or 1 µL/plate in the presence and absence of metabolic activation. Positive and negative controls were included and responded appropriately. Cytotoxicity was not observed. (This assay was conducted using very low concentrations.)

Pentene, 2,4,4-trimethyl, sulfurized was not mutagenic in this assay.

Alkenes C15 – 18 alpha-, sulfurized (CASRN 67762-55-4)

Salmonella strains TA98, TA100, TA1535, TA1537, TA102 and *Escherichia coli* strain WP2 uvrA were exposed to alkenes C15 – 18 alpha-, sulfurized at 50, 167, 500, 1670, 5000 or 10,000 µg/plate in the presence and absence of metabolic activation. Positive and negative controls were included and responded appropriately. Cytotoxicity was not noted. The test substance was

found to be incompletely soluble (droplets were observed) at all does levels under both treatment conditions.

Alkenes C15 – 18 alpha-, sulfurized was not mutagenic in this assay.

Genetic Toxicity – Chromosomal Aberrations

Subcategory I: Hydroxyalkyl Monosulfide

In vitro

2-Propanol, (tert-dodecylthio)-(CASRN 67124-09-8)

Chinese hamster ovary (CHO) cells were exposed to 2-propanol, (tert-dodecylthio)- in DMSO at 0.05, 0.15, 0.5, 1.5, 5, 15, 50, 495, 1490 or 4950 µg/mL and 0.05, 0.15, 0.5, 1.5, 15, 50 or 150 µg/mL in the absence and presence of metabolic activation, respectively, for exposure periods of 10 or 20 hours each. Positive and negative controls were included and responded appropriately. For the 20- and 10-hour exposure periods, cytotoxicity was observed at concentrations of ≥ 15 and 50 µg/mL in the absence of metabolic activation and >50 and 15 µg/mL in the presence of metabolic activation, respectively. A slight increase in the number of aberrant cells was observed in the activated 10-hour exposure assay at 5 µg/mL; however, this increase did not achieve statistical significance.

2-Propanol, (tert-dodecylthio)-did not induce chromosomal aberrations in this assay.

Subcategory II: Alkyl Polysulfides

In vivo

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

(1) B63CF1 mice (5/sex/dose) were administered 1-propene, 2-methyl-, sulfurized in Methocel K4M Premium (hydroxypropyl methyl cellulose; Dow Chemical) via intraperitoneal injection at 3500 mg/kg-bw and sacrificed at 24-, 48- or 72-hour intervals. Positive and negative controls were included and responded appropriately. Positive controls were sacrificed at the 24-hour interval only. Cytotoxicity was not observed.

1-Propene, 2-methyl-, sulfurized did not induce micronuclei in this assay.

(2) In the 13-week dermal repeated-dose toxicity study in rats on 1-propene, 2-methyl-, sulfurized described above, micronuclei were analyzed from femoral bone marrow samples taken 24 hours following the final dermal administration (5/sex/dose). A negative control was included and responded appropriately; however, a positive control was not tested. Cytotoxicity was not observed.

1-Propene, 2-methyl-, sulfurized did not induce micronuclei in this assay.

Pentene, 2,4,4-trimethyl, sulfurized (CASRN 68515-88-8)

B63CF1 mice (5/sex/dose) were administered pentene, 2,4,4-trimethyl, sulfurized via gavage at 5 mg/kg-bw and sacrificed at 18-, 24- or 48-hour intervals. Positive and negative controls were included and responded appropriately. Positive control animals were treated via intraperitoneal injection and sacrificed at the 24-hour interval only. Cytotoxicity was not observed.

Pentene, 2,4,4-trimethyl, sulfurized did not induce micronuclei in this assay.

Conclusions:

Subcategory I (CASRN 67124-09-8)

The acute oral and dermal toxicity for CASRN 67124-09-8 in rats and rabbits are low and the acute inhalation toxicity in rats is moderate. An oral repeated-dose toxicity study in rats showed liver effects at 100 mg/kg/day. The NOAEL was not established. A one-generation reproductive toxicity study in rats showed decreased body weight and an increase in mean liver and kidney weights in adult males and hematology changes in dams at 167 mg/kg-bw/day via the oral route; the NOAEL was 50 mg/kg-bw/day. A developmental toxicity showed a decrease in mean pup weight at 67 mg/kg-bw/day; the NOAEL was 50 mg/kg/day. No reproductive toxicity effects were seen at 500 mg/kg-bw/day (highest dose tested). This chemical did not induce gene mutation or chromosomal aberration *in vitro*.

The evaluation of available toxicity data for aquatic organisms for CASRN 67124-09-8 indicates that the 96-h LC 50 for fish is 0.42 mg/L, the 48-h EC 50 for aquatic invertebrates is 1.3 mg/L and the 96-hour EC50 for aquatic plants is “no effects at saturation.” The estimated 21-d chronic toxicity value for aquatic invertebrates using ECOSAR is 0.036 mg/L.

The chronic aquatic invertebrate toxicity endpoint for CASRN 67124-09-8 remains a data gap under the HPV Challenge Program.

Subcategory II (CASRNs 68511-50-2, 68515-88-8, and 67762-55-4)

The acute oral toxicity of CASRNs 68511-50-2 and 68515-88-2 in rats is low. The acute inhalation toxicity of CASRN 68515-88-8 in mice, guinea pigs and rats is moderate. The acute dermal toxicity of CASRNs 68515-88-8 and 67762-55-4 is low.

In a dermal repeated-dose toxicity study in rats, CASRN 68511-50-2 showed a decrease in body weight gain in male rats and hematological effects in both sexes at 250 mg/kg/day; the NOAEL was 100 mg/kg/day. Female rats exposed to CASRN 68515-88-8 via aerosol inhalation, showed increased hemoglobin levels and relative liver-to-body weight ratios at 150 mg/kg/day; the NOAEL was 50 mg/kg-bw/day. In the same study, liver effects were seen in male rats at 150 mg/kg-bw/day. The NOAEL for male rats was not established. CASRNs 68511-50-2 and 68515-88-8 were irritating to rat and rabbit skin in dermal repeated-dose studies.

CASRNs 68511-50-2 and 68515-88-8 did not induce gene mutations *in vitro* or chromosomal aberrations *in vivo*. CASRN 67762-55-4 did not induce gene mutations *in vivo*.

The evaluation of available toxicity data to aquatic organisms for all subcategory II members indicates that for the acute hazard to fish, aquatic invertebrates and aquatic plants, there are “no effects at saturation”.

Reproductive and developmental toxicity were identified as data gaps for all subcategory members under the HPV Challenge program.

Table 4. Summary of Human Health Data				
Endpoints	Subcategory I	Subcategory II		
	2-Propanol, (<i>tert</i>-dodecylthio)- (67124-09-8)	1-Propene, 2-methyl, sulfurized (68511-50-2)	Pentene, 2,4,4-trimethyl, sulfurized (68515-88-8)	Alkenes C15 – 18 alpha-, sulfurized (67762-55-4)
Acute Oral Toxicity LD₅₀ (mg/kg-bw)	> 5000	~ 5700	> 5000	No Data > 5000 (RA)
Acute Inhalation Toxicity LC₅₀ (mg/L) Rat Mouse and guinea pig	—	> 0.39 —	> 2.17 > 4.3	No Data > 0.39 (RA)
Acute Dermal Toxicity LD₅₀ (mg/ kg-bw)	> 2000	No Data > 2000 (RA)	> 2000	>2000

Table 4. Summary of Human Health Data				
Endpoints	Subcategory I	Subcategory II		
	2-Propanol, (<i>tert</i>- dodecylthio)- (67124-09-8)	1-Propene, 2-methyl, sulfurized (68511-50-2)	Pentene, 2,4,4-trimethyl, sulfurized (68515-88-8)	Alkenes C15 – 18 alpha- , sulfurized (67762-55-4)
Repeated-Dose Toxicity Oral (mg/kg-bw/day)	LOAEL = 100 NOAEL = Not Est.	No Data	No Data	No Data
Repeated-Dose Toxicity Inhalation (mg/L-bw/day)	—	No Data LOAEL = 150 (RA)	LOAEL = 150 (male) NOAEL = Not Est. LOAEL = 150(female) NOAEL = 50	No Data LOAEL = 150 (RA)
Repeated-Dose Toxicity Dermal (mg/kg-bw/day)	—			No Data
Rat		LOAEL = 250 NOAEL = 100	NOAEL = 1000 (hdt)	LOAEL = 250 NOAEL = 100
Rabbit		LOAEL = 2000 NOAEL = 200		LOAEL = 2000 NOAEL = 200 (RA)
Reproductive/Developmental Toxicity (mg/kg-bw/day)				
Systemic Toxicity	LOAEL = 167 NOAEL = 50	No Data	No Data	No Data
Developmental Toxicity	LOAEL = 167			

Table 4. Summary of Human Health Data				
Endpoints	Subcategory I	Subcategory II		
	2-Propanol, (<i>tert</i>-dodecylthio)- (67124-09-8)	1-Propene, 2-methyl, sulfurized (68511-50-2)	Pentene, 2,4,4-trimethyl, sulfurized (68515-88-8)	Alkenes C15 – 18 alpha-, sulfurized (67762-55-4)
Reproductive Toxicity	NOAEL = 50 LOAEL = 500			
Genetic Toxicity – Gene Mutation <i>In vitro</i>	Negative	Negative	Negative	Negative
Genetic Toxicity – Chromosomal Aberrations <i>In vitro</i>	Negative	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)
Genetic Toxicity – Chromosomal Aberrations <i>In vivo</i>	—	Negative	Negative	No Data Negative (RA)

Measured data in bold text; (RA) = read across; — indicates that endpoint was not addressed for this chemical, (hdt) = highest dose tested.

4. Hazard to the Environment

A summary of aquatic toxicity data submitted for SIDS endpoints is provided in Table 5. The table also indicates where data for tested category members are read-across (RA) to untested members of the category.

Acute Toxicity to Fish

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Rainbow trout (*Oncorhynchus mykiss*) were exposed to 2-propanol, (tert-dodecylthio)- as water accommodated fractions (WAFs) under semi-static conditions for 96 hours. The loading rates were 0, 1, 1.8, 3.2, 5.6 or 10 mg/L. During the initial main study, mortality or sublethal effects were observed at all concentrations; therefore, a second definitive study was conducted at 0, 0.32, 0.56, 1.0, 1.8 or 3.2 mg/L. Analytical monitoring was not conducted, but all of the loading rates were below the reported measured water solubility for 2-propanol, (tert-dodecylthio)- (4.84 mg/L). At 0.56, 1, 1.8 and 3.2 mg/L, 100% mortality was noted at 96, 48, 24 and 24 hours, respectively.

96-h LC50 = 0.42 mg/L

Subcategory II: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

(1) Fathead minnows (*Pimephales promelas*) were exposed to 1-propene, 2-methyl-, sulfurized as WAFs under static renewal conditions for 96 hours. The loading rates were 0, 100, 300 or 1000 mg/L, and no analytical measurements were made on the WAFs. At 1000 mg/L, all fish were lethargic and exhibited erratic swimming by the end of the exposure period. The 96-hour LC₅₀ and NOEC values were > 1000 and 300 mg/L, respectively. EPA does not consider the loading rate as the no-effect concentration when the concentration exceeds the water solubility of the substance. Assuming that the exposure concentration in the WAF is the water solubility limit (saturation) for 1-propene, 2-methyl-, sulfurized, the no-effect concentration would be approximately 2.7 mg/L.

No effects at saturation.

(2) Sheepshead minnow (*Cyprinodon variegatus*) were exposed to 1-propene, 2-methyl-, sulfurized as WAFs under static renewal conditions for 96 hours. The loading rates were 0 or 10,000 mg/L, and no analytical measurements were made on the WAFs. No effects were noted at any of the WAF loading rates. The 96-hour LC₅₀ and NOEC values were > 10,000 and 10,000 mg/L, respectively. EPA does not consider the loading rate as the no-effect concentration when the concentration exceeds the water solubility of the substance. Assuming that the exposure concentration in the WAF is the water solubility limit (saturation) for 1-propene, 2-methyl-, sulfurized, the no-effect concentration would be approximately 2.7 mg/L.

No effects at saturation.

Acute Toxicity to Aquatic Invertebrates

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Water fleas (*Daphnia magna*) were exposed to 2-propanol, (tert-dodecylthio)- as WAFs under static conditions for 48 hours. The loading rates were 0, 1, 1.8, 3.2, 5.6, 10, 18, 32, 56 or 100 mg/L, and no analytical measurements were made on the WAFs. Within 24 hours, 100% immobilization was noted at concentrations ≥ 1.8 mg/L. The 48-hour EC₅₀ and NOEC values were 1.3 and 1.0 mg/L, respectively. These concentrations are below the reported measured solubility for 2-propanol, (tert-dodecylthio)- (4.84 mg/L).

48-h EC50 = 1.3 mg/L

Subcategory II: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

Water fleas (*Daphnia magna*) were exposed to 1-propene, 2-methyl-, sulfurized as WAFs under static conditions for 48 hours. The loading rates were 0, 100, 300 or 1000 mg/L, and no analytical measurements were made on the WAFs. No effects were noted at any of the WAF loading rates. The 48-hour EC₅₀ and NOEC values were > 1000 and 1000 mg/L, respectively. EPA does not consider the loading rate as the no-effect concentration when the concentration exceeds the water solubility of the substance. Assuming that the exposure concentration in the WAF is the water solubility limit (saturation) for 1-propene, 2-methyl-, sulfurized the no-effect concentration would be approximately 2.7 mg/L.

No effects at saturation.

Toxicity to Aquatic Plants

Subcategory I: Hydroxyalkyl Monosulfide

2-Propanol, (tert-dodecylthio)- (CASRN 67124-09-8)

Green algae (*Scenedesmus subspicatus*) were exposed to 2-propanol, (tert-dodecylthio)- as WAF under static conditions for 96 hours. The loading rates were 0 or 100 mg/L, and no analytical measurements were made on the WAFs. No effects were noted for growth rate or biomass. The 96-hour EC₅₀ and NOEC values were > 100 and 100 mg/L for biomass and growth rate, respectively. EPA does not consider the loading rate as the no-effect concentration when the concentration exceeds the water solubility of the substance. Assuming that the exposure concentration in the WAF is the water solubility limit (saturation) for 2-propanol, (tert-dodecylthio)-, the no-effect concentration would be approximately 4.84 mg/L.

No effects at saturation.

Subcategory II: Alkyl Polysulfides

1-Propene, 2-methyl-, sulfurized (CASRN 68511-50-2)

Green algae (*Pseudokirchneriella subcapitata*) were exposed to 1-propene, 2-methyl-, sulfurized as WAFs under static conditions for 96 hours. The loading rates were 0, 1, 5, 10, 50 or 100

mg/L and no analytical measurements were made on the WAFs. The NOEC was 5 mg/L and 72-hour EC₅₀ was 26 mg/L (21 – 32 mg/L) for biomass and > 100 mg/L for growth rate. EPA does not consider the loading rate as the no-effect concentration when the concentration exceeds the water solubility of the substance. Assuming that the exposure concentration in the WAF is the water solubility limit (saturation) for 1-propene, 2-methyl-, sulfurized, the no-effect concentration would be approximately 2.7 mg/L.

No effects at saturation.

Chronic Toxicity to Invertebrates

Subcategory I: Hydroxyalkyl Monosulfide

EPA recommended that the sponsor conduct chronic toxicity testing on invertebrates (i.e., the daphnid 21-day reproduction test), but no chronic data has been submitted. The physical-chemical properties of this chemical indicate that it is soluble in water at concentrations that could cause chronic effects. The estimated toxicity based on ECOSAR (v1.00) is 0.036 mg/L.

Conclusions:

Subcategory I: Hydroxyalkyl Monosulfide

The aquatic toxicity data submitted were generated using the Water Accommodated Fraction (WAF) method. The evaluation of available toxicity data for aquatic organisms for CASRN 67124-09-8 indicates that the potential acute hazard for fish is high, for aquatic invertebrates is moderate and for aquatic plants is low. The potential chronic hazard is high based on the estimated toxicity value using ECOSAR.

The chronic aquatic invertebrate toxicity endpoint for CASRN 67124-09-8 remains a data gap under the HPV Challenge Program.

Subcategory II: Alkyl Polysulfides

The aquatic toxicity data submitted were generated using the WAF method. The evaluation of available toxicity data to aquatic organisms for all subcategory II members indicates that the potential acute hazard to fish, aquatic invertebrates and aquatic plants is low.

Table 5. Summary of Environmental Effects – Aquatic Toxicity Data				
Endpoints	Subcategory I	Subcategory II		
	2-Propanol, (tert-dodecylthio)- (67124-09-8)	1-Propene, 2-methyl, sulfurized (68511-50-2)	Pentene, 2,4,4-trimethyl, sulfurized (68515-88-8)	Alkenes C15 – 18 alpha-, sulfurized (67762-55-4)
Fish 96-h LC₅₀ (mg/L)	0.42 (m)	NES (m)	No Data NES (RA)	No Data NES (RA)
Aquatic Invertebrates 48-h EC₅₀ (mg/L)	1.3 (m)	NES (m)	No Data NES (RA)	No Data NES (RA)
Aquatic Plants 72-h EC₅₀ (mg/L)	NES (m)	NES (m)	No Data NES (RA)	No Data NES (RA)
Chronic Toxicity to Invertebrates 21-day EC₅₀ (mg/L)	0.036 (e)*	–	–	–

m= measured; RA= Read Across; -- indicates endpoint was not addressed for this chemical; NES= Measured data with No Effects at Saturation *Testing was recommended for this endpoint.