SIDS INITIAL ASSESSMENT PROFILE

Chemical Category	**C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category**
Chemical Names and CAS Registry Numbers	**Substance Name** — **CAS Number** Stoddard solvent — 8052-41-3 Kerosine, petroleum, hydrodesulfurized — 64742-81-0 Naphtha, petroleum, hydrodesulfurized heavy — 64742-82-1 Solvent naphtha, petroleum, medium aliphatic — 64742-88-7 Note: Substances in this category are also commonly known as mineral spirits, white spirits, or Stoddard solvent.
Structural Formula and CAS Registry Numbers	**CAS Number** — **Chemical Description** 8052-41-3† — Includes C_8 to C_{14} branched, linear, and cyclic paraffins and aromatics (6 to 18%), <50ppmV benzene 64742-81-0† — Includes C_9 to C_{14} branched, linear, and cyclic paraffins and aromatics (10 to 25%), <100 ppmV benzene 64742-82-1† — Includes C_8 to C_{13} branched, linear, and cyclic paraffins and aromatics (15 to 25%), <100 ppmV benzene 64742-88-7† — Includes C_8 to C_{13} branched, linear, and cyclic paraffins and aromatics (14 to 20%), <50 ppmV benzene Individual category member substances are comprised of aliphatic hydrocarbon molecules whose carbon numbers range between C_9 and C_{14}; approximately 80% of the aliphatic constituents for a given substance fall within the C_9-C_{14} carbon range and <100 ppmV benzene. In some instances, the carbon range of a test substance is more precisely defined in the test protocol. In these instances, the specific carbon range (e.g. C8-C10, C9-C10, etc.) will be specified in the SIAP. * It should be noted that other substances defined by the same CAS RNs may have boiling ranges outside the range of 143-254° C and that these substances are not covered by the category. †Denotes a UVCB substance. UVCBs are defined as chemical substances of unknown or variable composition, complex reaction products or biological materials.

The category has been defined for members with specific constituents/component profiles or composition as outlined in the full SIDS Initial Assessment Report and the SIDS Dossiers.

The substances in the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category contain >99% hydrocarbons. Category members are described as UVCBs (Unknown or Variable Composition, Complex Reaction Products and Biological Materials) because they are composed of a defined, progressive carbon number range that includes various types of hydrocarbons: aliphatic molecules (linear, branched, and cyclic) and aromatic molecules (generally one-ring alkylbenzenes), predominantly in the C_9 to C_{14} range. Benzene and sulfur content of category members is extremely low, typically <10 ppm with some substances identified as having <100 ppm, because these compounds are intentionally removed.

As complex hydrocarbon substances, some of the category members share CAS RNs with some petroleum process streams.

This assessment only applies to CAS RNs with the constituent profiles and compositions described within this assessment. Consequently, the conclusions of this assessment do not specifically apply to all petroleum process streams with the same CAS number as those belonging to the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category or to substances with constituents (i.e. benzene) outside the category ranges. Production of hydrocarbon solvents is differentiated from other refinery substances such as gasoline and diesel fuel by additional processing steps leading to finished substances with a narrow distillation range, a defined aromatic content, removal of benzene, polyaromatic hydrocarbons (PAHs), sulfur- and nitrogen-containing compounds, and low color.

Table 1 - Typical compositional data for representative commercial C_{9-14} aliphatic [2-25% aromatic] hydrocarbon solvents

CAS No.	Carbon* Number	Aliphatics* (%)			Aromatics*	Ethyl-benzene*	Naphthalene*	Benz
	(range)	% total	% n-, iso-	% cyclo	% total	%	%	ppm
8052-41-3	8-14	82-94	38-84	8-50	8-17	<0.2	< 0.5	< 50
64742-82-1	8-13	77-85	40-65	15-40	15-25	<0.3	< 0.1	<100
64742-81-0	9-13	73-88	40-55	25-35	10-22	<0.1	<0.3	< 10
	9-16**	77.3	~42.0	>28.0	22.2	na	~0.6	na
64742-88-7	8-13	80-86	35-50	10-46	14-20	~0.3	<0.1	<50

* The values in this table are approximate values reported from manufacture analyses and are not specifications.
** Analogue substance, with same CAS RN (64742-81-0) as contained by the category; see above.
< Less than detection limit (detection limit reported)
nd not detected
na not available

Table 2 - Typical Carbon Number Range for the Aliphatic Molecules in the C_{9-14} aliphatic [2-25% aromatic] hydrocarbon solvents category

Identification of chemicals defined by processing procedures	Typical Carbon Number Range for the Aliphatic Molecules (%)									
	< C8	C8	C9	C10	C11	C12	C13	C14	C15 to C16	Total Arom
Stoddard solvent 8052-41-3	~0.5	~2	~11	~25	~30	~13	~3	~0.5		~15

Naphtha, petroleum, hydrodesulfurized heavy 64742-82-1	~0.5	~1	~9	~27	~35	~7	~0.5			~20	
Kerosine, petroleum, hydrodesulfurized 64742-81-0			~0.5	~3	~8	~24	~30	~10	~3.5	~21	
Kerosine, petroleum, hydrodesulfurized 64742-81-0*			~1	~5	~8	~10	~20	~12	~20	~22	
Solvent naphtha, petroleum, medium aliphatic 64742-88-7		~2	~10	~17	~40	~13	~1			~17	

* Analogue substance, with same CAS RN (64742-81-0) as contained by the category.

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Category Definition/Justification

The C_9-C_{14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category is comprised of four CAS numbers that are associated with complex aliphatic hydrocarbon solvent commercial products that can contain up to 25% aromatic content. These hydrocarbon solvent products are generally defined by boiling range and/or flash point and the predominant carbon number range of these products is primarily within the range from C_9 to C_{14} (approximately 80%). The chemical constituents in these complex UVCB substances may include straight chain (n-), branched (iso-) and cyclic aliphatic hydrocarbons and aromatic hydrocarbons (generally one-ring aromatics). These products may be sold under a variety of brand, commercial and trade names, such as mineral spirits, Stoddard solvent and white spirits, and they may be associated with one or more of the four Chemical Abstract Services (CAS) Registry Numbers (RN) for this category.

Assignment of CAS RNs for complex hydrocarbon products is generally based on a hierarchy of considerations including hydrocarbon type(s), carbon number range, distillation range, and last processing step. One documented source of criteria for assignment of CAS RNs for complex hydrocarbons is provided by the U.S. EPA on proceedings for development of the TSCA inventory for U.S. chemicals. These criteria, however, may allow the same CAS RN to be applied to various hydrocarbons and petroleum-derived substances with somewhat different composition and applications (e.g., solvents, fuels, lubricants, etc.). Similarly, different CAS RN can be applied to substances of similar composition and application. In the case of this C_9-C_{14} Aliphatic [2-25% Aromatics] Hydrocarbon Solvents Category, the four CAS RNs described here are all applied to compositionally similar and generally commercial interchangeable hydrocarbon solvents. This similarity of composition and commercial applications is the primary justification for evaluating these substances in a category. Further, the existing toxicology data shows that substances in this category have a similar order of toxicity and support the grouping of these substances as a category.

Category Member Conventional Naming

The naming convention used to identify category members is based on their general compositions (predominant carbon number range and hydrocarbon type, specifically aromatics) and is intended to identify hydrocarbon solvent substances manufactured by various companies that are sufficiently similar with regard to composition such that their physical and biological properties would exhibit similar if not identical values. The naming convention as applied to hydrocarbon solvents was seen as a means to provide an immediate understanding of the type of solvent and its composition to allow for an accurate grouping of hydrocarbon substances within categories. As UVCBs, some of the hydrocarbon solvent category members share CAS RNs with some petroleum process streams, which have broader boiling ranges and consequently are compositionally more complex.

Category members (CAS RN 8052-41-3, 64742-81-0, 64742-82-1, and 64742-88-7) meet the criteria for UVCB substances because they contain a relatively large number of discrete chemical constituents and the exact composition of some of the constituent chemicals may be unknown. The general naming convention guidance was developed and used for category members as follows:

"Hydrocarbons", the first part of the name, recognizes the specific chemical class.

The carbon number range typically identifies at least 80% of the chemical constituents in the substance.

The structures are identified by the types of hydrocarbons present: n-paraffins (n-alkanes), iso-paraffins (isoalkanes), cyclic-paraffins or naphthenic (cyclics), and aromatics. The first three are mentioned when present in the substance at a level between 10 and 80%. Aromatics will be indicated when present at levels greater than 2% or less than or equal to 25%.

Components with specific toxicology or classification will be mentioned, using the classification cut-off as an indication level (according to EU DSD [Dangerous Substances Directive] and GHS [Global Harmonized System of Classification and Labeling of Chemicals] guidance).

Read-Across Substance Identification

In addition to the available physical and biological data for substances in this category, data for the following analogues are also presented, as necessary, to support the characterization of selected endpoints:

CAS RN 64771-72-8; Hydrocarbons, C_{12}-C_{14}, n-alkanes, <2% aromatics
CAS RN 90622-57-4; Hydrocarbons, C_{10}-C_{12}, isoalkanes, <2% aromatics
CAS RN 90622-58-5; Hydrocarbons, C_{11}-C_{13}, isoalkanes, <2% aromatics
CAS RN 8008-20-6 ; JP-8 (having a carbon range of 8-16 and ~25% aromatics)
CAS RN 64742-81-0 ; Kerosine, petroleum, hydrodesulfurized (C_9-C_{16}, wide cut UVCB)
CAS RN 64742-48-9 ; dearomatised white spirit, consisting of carbon molecules primarily in the C8-C11 range and containing approximately 30% n-alkanes, 20% isoalkanes, 50% cycloalkanes, and less than 0.5%) aromatics.
CAS RN 108-67-8 ; 1,3,5-trimethylbenzene

The two read-across substances, Hydrocarbons, C_{12}-C_{14}, n-alkanes, <2% aromatics and Hydrocarbons, C10-C12, isoalkanes, <2% aromatics form a physical-chemical continuum with the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category and contain a range of carbons and physical-chemical properties that are either immediately above or below the range specified for the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category.

Jet fuel (JP-8), a U.S. military fuel, is a wide cut hydrocarbon stream and is less refined than the hydrocarbon solvents. JP-8 is a complex hydrocarbon substance (UVCB) that has a carbon number range of C_8-C_{16}, a boiling range of approximately 150 – 290^{o}C, and an aromatic content of approximately 25% and approximates the physical/chemical properties of the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents. Since JP-8 is not as severely refined as the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents, test results from JP-8 could be considered a "worst-case" scenario when used as read-across to the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents.

Another analogue substance has a CAS RN contained by this category 64742-81-0 (hydrodesulfurized kerosene) and is defined as *C_9-$_{16}$ mixed aliphatics/aromatics with 22% aromatic content*. Although the carbon number range extends beyond the category definition, the similarity in constituent content over the carbon range shared by the analogue and category members is sufficiently similar to justify the use of the analogue data (see Table 1 for composition).

Table 4 – Data for the following analogues are also presented to support the characterization of selected endpoints.

Analogue (CAS RN)	**Composition**	**Endpoint(s) Characterized**
64771-72-8	Hydrocarbons, C_{12}-C_{14}, n-alkanes, <2% aromatics	Biodegradation
90622-57-4	Hydrocarbons, C_{10}-C_{12}, isoalkanes, <2% aromatics	Biodegradation Chronic Aquatic Toxicity
90622-58-5	Hydrocarbons, C_{11}-C_{13}, isoalkanes, <2% aromatics	Chronic Aquatic Toxicity
64742-81-0	Kerosine, petroleum, hydrodesulfurized (C_9-C_{16}, wide cut UVCB)	Acute Toxicity Irritation

		Sensitization In vitro genotoxicity
8008-20-6	JP-8	Reproductive Toxicity Chronic Fish Toxicity
64742-48-9	Dearomatised white spirit, consisting of carbon molecules primarily in the C8-C11 range and containing approximately 30% n-alkanes, 20% isoalkanes, 50% cycloalkanes, and less than 0.5%) aromatics	toxicokinetics
108-67-8	1,3,5-trimethylbenzene	toxicokinetics

Substances in the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category are composed of a range of paraffinic and aromatic hydrocarbons that fall within a carbon number (C) range of 9 to 14. As a result, many of the category member physicochemical properties are characterized by a range of values as a function of composition because a single value is not possible. For example, a complex hydrocarbon will not exhibit a single P_{ow} value, but rather a range based on constituent composition. This would be the case regardless of whether the data were measured using a standard testing procedure or calculated based on the individual constituent chemicals.

For several of the physical-chemical properties, the value range is based on a series of representative hydrocarbons that were selected by industry, based on hydrocarbon process (distillation) knowledge, to accurately characterize category members. The hydrocarbons selected include paraffins and aromatics from C_9 to C_{14}:

Chemical Name	**CAS RN**
n-nonane	111-84-2
2-methyloctane	n/a
1,2,4-trimethylcyclohexane	2234-75-5
1,2,4-trimethylbenzene	95-63-6
1,2,3,4-tetrahydronaphthalene	119-64-2
1,3-dimethyl-2-ethylbenzene	2870-04-4
2,4-dimethyl-nonane	n/a
n-tridecane	629-50-5
2,5-dimethyl-undecane	n/a
2,3,6-trimethyldecalin	n/a
n-tetradecane	629-59-4
2,5,6,9-tetramethyldecane	n/a
2,3,6,7-tetramethyldecalin	n/a

n/a = not available

Physicochemical Properties

The members of the C_9-C_{14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category are liquids at room temperature. The measured melting point values for constituents range from -83.5 to 18.1°C. The initial boiling points range from approximately 143 to 160°C and the final boiling points from 205 to 254°C. The measured Vapour pressure for constituents range from 0.02 to 8.3 hPa at 20° to 25°C. The calculated Water solubility values range from 0.01 to 94.3 mg/L (at 25°C) for constituents, with a relative density range of 0.77 to 0.81 g/cm^3 (at 20°/4° C). The measured log Pow values for category member constituents range from 3.5 – 7.2 (at 25°C). Viscosity values range from 0.98 mm^2/sec to 1.6 mm^2/sec at 20^{o}C.

Human Health

Toxicokinetics, Metabolism, and Distribution

The study of the toxicokinetics of the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category is complex as this category comprises a mixture of hydrocarbons. However, these hydrocarbons display similar chemical properties. The relative percentage of the single compounds and their different physical and chemical properties greatly affects the toxicokinetics of this class of hydrocarbons. The inhalation absorption of materials in this category depends on several factors including concentration in the inspired air, blood partition coefficient, pulmonary ventilation, and pulmonary flow. However, studies have generally shown that materials in this

category are readily absorbed through the lungs.

It is estimated that 61% - 81% of a C_9-C_{14} hydrocarbon solvent would be absorbed when ingested. C_9-C_{14} aliphatic, 2-25% aromatic hydrocarbon fluids are typically metabolized by side chain oxidation to alcohol and carboxylic acid derivatives. These metabolites can be glucuronidated and excreted in the urine or further metabolized before being excreted. The majority of the metabolites are expected to be excreted in the urine and to a lower extent, in the feces. Excretion is expected to be rapid with the majority of the elimination occurring within the first 24 hours of exposure.

Absorption

When inhaled, white spirit constituents were readily absorbed. After a 30-minute exposure at rest to approximately 1040 mg/m^3 of the aliphatic components, the concentration in alveolar air was 255 mg/m^3 (25 % of the concentration in the inspiratory air). The corresponding arterial blood concentration was 1.7 mg/kg. When alveolar ventilation tripled (50 W exercise), the alveolar concentration increased to 515 mg/m^3 (50 % of the concentration in inspiratory air), whereas the arterial concentration rose to 3.5 mg/kg. When alveolar ventilation was raised to 60 L/min (150 W exercise), the alveolar concentration rose to about 60 % of the concentration in inspiratory air. Thirty minutes following exposure, alveolar concentration was ~180 mg/m^3 and arterial concentration was near 0 mg/kg.

After a 30-minute exposure at rest to approximately 210 mg/m^3 of the aromatic components, the concentration in alveolar air after 30 minutes was about 30 mg/m^3 (15% of the concentration in the inspiratory air). The corresponding arterial blood concentration was approximately 0.2 mg/kg. When alveolar ventilation tripled (50 W exercise), the alveolar concentration increased to about 20% of the concentration in inspiratory air. However, the arterial blood concentration increased from 0.2 to 0.7 mg/kg. When alveolar ventilation was raised to 60 L/min (150 W excercise), the alveolar concentration rose to about 150 mg/m^3 and the arterial blood concentration was 0.9 mg/kg. Thirty minutes following exposure, alveolar concentration was ~20 mg/m^3 and arterial concentration was near 0 mg/kg. Pulmonary ventilation appeared to be more important to uptake in arterial blood than to circulation. The results are believed to be due to the differing solubilities of aliphatic and aromatic components in blood, (i.e., aromatic components are generally more soluble in blood than aliphatic and alicyclic hydrocarbon components).

Distribution

Studies have shown that following absorption, members of the $C_{9\text{-}14}$ Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category are widely distributed throughout the body of both humans and animals and preferentially accumulate in the adipose tissues due to the lipophilic nature of the solvents.

A toxicokinetic study on the distributions of C_9 to C_{10} alkanes, aromatics and cycloalkanes in blood, brain, liver, kidney and perirenal fat demonstrated that aromatics generally showed higher blood concentrations than alkanes and cycloalkanes. C_9 cycloalkanes showed higher brain concentrations than the corresponding aromatics and alkanes, while brain concentrations of C_{10} alkanes were slightly greater than C_{10} cycloalkane concentrations, which in turn were greater than C_{10} aromatic concentrations. Fat contained the highest concentrations of each of the hydrocarbons examined; concentrations of aromatics and cycloalkanes in fat were higher than concentrations of alkanes. The concentrations of aromatics in fat decreased on each successive day of exposure, which could be an indication of a higher rate of metabolic elimination. Brain/blood ratios of 11.4, 2.0 and 11.4, and fat/blood ratios of 113, 63 and 135 were found for n-nonane, trimethylbenzene and trimethylcyclohexane, respectively. A marked decrease in biological concentrations of trimethylbenzene and trimethylcyclohexane during the initial phase of exposure indicates that these hydrocarbons are capable of inducing their own metabolic conversion resulting in lower steady state levels.

Metabolism

Very little is known about the metabolic fate of the $C_{9\text{-}14}$ Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category since metabolic studies have most frequently been conducted with single hydrocarbons and not with hydrocarbon mixtures. Consequently, it is difficult to predict the extent of the metabolic conversion of single components in a mixture because several factors may influence the metabolism, e.g., substrate saturation of the metabolizing enzymes, competition phenomena and enhancement or inhibition of enzyme systems.

Aliphatic hydrocarbons are known to undergo oxidative conversion, catalyzed by monooxygenases, to alcohols. The cytochrome P-450 dependent monooxygenases, located mainly in the endoplasmic reticulum of liver cells, are responsible for this first metabolic transition. Polycyclic aromatic hydrocarbons are oxidized by P450 enzymes is an initial step in the activation process. The resultant epoxide intermediates are usually more reactive than the parent compounds and have been shown to require further metabolism to evoke their critical carcinogenic potentials. These epoxide metabolites have been shown to be readily hydrolyzed to dihydrodiol metabolites by microsomal epoxide hydrolases and finally oxidized again by P450 enzymes to form highly reactive diol-epoxides that can interact with DNA to initiate cell transformation.

Excretion

Most of the information concerning the elimination and excretion of aliphatic and aromatic hydrocarbons has been derived from studies involving exposure to single substances. Few studies have systematically evaluated the elimination and excretion of complex hydrocarbons mixtures such as those found in the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category. Generally speaking, it is expected that components or metabolites of materials such as Stoddard solvent/white spirit that are volatile but have low solubility in the blood, would be rapidly exhaled from the lungs. Like for absorption, this process is governed by blood/gas solubility ratios. Components with low blood/gas ratios would be most rapidly excreted from the lungs because of their low blood solubility, while those with high blood/gas solubility ratios would be eliminated less efficiently by the lungs due to their high blood solubility; this situation is exactly the reverse of that for inhalation absorption. The aromatic hydrocarbons are expected to be excreted primarily in the urine.

One study conducted reported that ten minutes after exposure had ceased, the expiratory concentration levels of aliphatics and aromatics were found to be about 12% of the initial exposure level for both fractions. Sixteen hours later, the levels in expiratory air had fallen to 2% (aliphatics) and 4% (aromatics) of the initial exposure level. The overall half-life of white spirit in adipose tissue was determined to be 46-48 hours in one study. These results indicate that steady state in adipose tissue will be reached after approximately 3 weeks following continuous exposure.

A 3-week inhalation study conducted in rats exposed for 6 hours/day, 5 days/week at levels of 2290 and 4580 mg/m^3 found white spirit (20% aromatics) concentration in the brain of 3.4 and 10.2 mg/kg wet weight, respectively immediately preceding exposure cessation. In a follow up study that only examined the aliphatic components of white spirits, male rats were exposed by inhalation to 0, 400 (2290 mg/m^3) or 800 ppm (4580 mg/m^3) of dearomatised white spirit (CAS 64742-48-9) for 6 hr/day, 5 day/week for 3 weeks. Five rats from each group were sacrificed immediately after the exposure duration of 1, 2, or 3 weeks and 2, 4, 6, or 24 hr after the end of 3 weeks' exposure. Immediately follow the end of the 3 weeks of exposure, the concentration of total white spirit was 1.5 and 5.6 mg/kg in blood; 7.1 and 17.1 mg/kg in brain; 432 and 1452 mg/kg in fat tissue at the exposure levels of 400 and 800 ppm respectively. Two hours after the end of exposure the white spirit concentration decreased to about 25% in blood and 50% in brain. The authors calculated that the post-exposure half-life in blood could be separated into two phases with half-lives of approximately 1 and 8 hr; in brain tissue two slopes with half-lives of 2 and 15 hr were identified. In adipose tissue, only one slope with half-life of about 30 hr was identified.

A study using 1,3,5-trimethylbenzene (TMB; CAS RN 108-67-8) as a surrogate for the aromatic fraction of white spirit was observed to have a biphasic elimination with half-lives of 13h and 60 h with peak elimination occurring 4-8 hours after the end of the exposure. It is expected that metabolites are rapidly elimated in the urine following the cessation of exposure, although a slower elimination from the adipose tissue is expected.

Acute Toxicity Summary

The available acute toxicity data demonstrate that hydrocarbon solvent substances tested in the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category did not demonstrate acute toxicity at the limit dose by the oral, dermal, and inhalation routes of exposure.

Acute Inhalation Toxicity

Six acute inhalation toxicity test (similar or equivalent to OECD TG 403) were conducted on C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents. Four studies were conducted on male and female rats using substances with the CAS RN 8052-41-3 vapours; the LC_{50} were between >5500 mg/m^3 to >12190 mg/m^3. No deaths were reported in these four studies. One study was conducted in rats using C_{9-13} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RN 64742-88-7); the LC_{50} was > 710 ppm, which was the highest attainable concentration (54% of saturation). Finally, one study using hydrodesulfurized kerosene (CAS RN 64742-81-0) was conducted on rats, no deaths were reported at the highest dose tested (5.2 mg/L).

Acute Dermal Toxicity

Five dermal toxicity studies (similar or equivalent to OECD TG 402) were conducted on commercial C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RNs 8052-41-3, 64742-82-1, 64742-88-7). The dermal LD_{50} in rabbits was greater than 3.0 g/kg in all five studies. One acute dermal study was conducted in rats using C_9-C_{13} Mixed aliphatics and aromatics (CAS RN 64742-82-1); the LD_{50} > 4 mL/kg bw.

Acute Oral Toxicity (gavage administration)

The acute oral toxicity studies (equivalent or similar to OECD TG 401) were conducted in male and female rats on commercial C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RNs 8052-41-3, 64742-82-1, 64742-88-7). The LD_{50} was >5.0 g/ kg bw for test materials with the CAS RN 8052-41-3. One study conducted in rats

with C_9-C_{13} Aliphatics and 2-25% aromatics (CAS RN 64742-82-1) had a LD_{50} > 8.0 mL/kg. The last study was conducted in rats with C9-C13 Aliphatics and 2-25% aromatics (CAS RN 64742-88-7); the LD_{50} was > 25.0 mL/kg. This assessment does not include less refined substances that share the same CAS number or substances with a higher benzene content. The C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents products may be an aspiration hazard based on their viscosities. Chemicals with a viscosity of <20.5 mm2/sec at 40°C should also be considered an aspiration hazard (the accidental inhalation of fluids into the lungs).

Irritation and Sensitisation

Irritation studies (equivalent or similar to OECD TG 404) were conducted in rabbits on commercial C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RN 8052-41-3 and 64742-88-7). In dermal irritation tests, the erythema score (24, 48, 72 hour) results were 1.04 to 2.1. The edema score (24, 48, 72 hour) results were 0.0 to 0.67. One study (CAS RN 8052-41-3) used an occlusive dressing and a 24 hour continuous exposure; under these conditions the test material was irritating. Due to the occlusive nature of the dressing, these conditions are not anticipated to be encountered outside of experimental settings. The results of these studies indicate that C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents are minimal to mild irritants to rabbits.

Several eye irritation studies (equivalent or similar to OECD TG 405) were conducted in rabbits on commercial C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RN 8052-41-3, 64742-82-1, and 64742-88-7). The average conjunctivae score (24, 48, 72 hours) results were 0.0 to 0.22. The average chemosis score (24, 48, 72 hour) results were 0.0 to 0.05; all iritis and cornea opacity scores were 0 for all studies. These results suggest that these solvents produce no to minimal irritation to the eyes of rabbits.

Two respiratory irritation studies were conducted in mice on commercial C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RN 8052-41-3 and 64742-82-1). The RD_{50} = 10 mg/L and no effects observed at 4.4 mg/L (CAS RN 8052-41-3) Exposure to 6, 87, or 172 ppm produced 7, 16, and 15% decreases in breathing rate, respectively (CAS RN 64742-82-1). Sensory irritation was evident in the breathing patterns of the test animals; the test substances produced only slight irritation in the respiratory tract.

Two studies (equivalent or similar to OECD TG 406) were available on the sensitisation potential of C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents (CAS RN 8052-41-3 and 64742-82-1). Tests were conducted using guinea pigs; both test yielded negative results. Based on these data, the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents are not expected to be sensitizers.

Based on the data presented above, the category members are not expected to be eye irritants; the category members are expected to be minimal skin irritants under semi-occlusive conditions. No toxicological studies have demonstrated skin defatting (which may result in cracking of the skin) but it is a well-known property of organic solvents. Category members are not expected to have the potential to cause skin sensitization. This assessment does not include less refined substances that share the same CAS number or substances with a higher benzene content.

Repeated Dose Toxicity (Inhalation)

Three inhalation repeated dose studies were located for the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category.

A repeated dose inhalation study was conducted in C_5-C_{12} (but primarily C_8-C_{12}) Mixed paraffin and aromatics (CAS RN 64742-82-1). Hydrocarbons, C_9 - C_{12}, n-alkanes, isoalkanes, cyclics, 2-25% aromatics (CAS RN 64742-82-1) was administered via inhalation to rats at concentrations of 0.049 (7.8 ppm), 0.10 (16 ppm), or 0.23 mg/L (37 ppm) of 140° flash aliphatic solvent for 6 hours a day, 5 days per week for 14 weeks (similar to OECD TG 413). No adverse effects were observed at the highest dose tested. The only significant finding was slight to moderate tubular regeneration in male rats which is consistent with alpha-2u-globulin induced nephropathy. Alpha-2u-globulin is not relevant to human health. Based on these observations, the repeat inhalation concentration NOAEC is 0.23 mg/L (37 ppm) for C_9 - C_{12}, n-alkanes, isoalkanes, cyclics, 2-25% aromatics.

In a second study, C_9-C_{12} Mixed paraffin and aromatics (CAS RN 64742-82-1). Hydrocarbons, C_9 - C_{12}, n-alkanes, isoalkanes, cyclics, 2-25% aromatics (CAS RN 64742-82-1; aromatic content ~19%) was administered via inhalation to rats at concentrations of 0, 100, or 300 ppm for 6 hours a day, 5 days a week for 12 weeks. No mortality occurred during the study. The only adverse effects observed in this study were significant elevations in absolute and relative kidney weights in male rats. These observed effects were consistent with alpha-2u-globulin induced nephropathy in male rats, an effect that is not relevant to human health. The NOAEC for this study was 294 ppm.

In a third repeated-dose inhalation study, rats were exposed to 2000, 4000, or 8000 mg/m^3 (345, 690, or 1293 ppm, respectively) of a C9-13 hydrocarbon solvent containing 19% aromatics (CAS RN 64742-82-1) for 6 hours per day, 5 days week for 13 weeks. No deaths were observed. Clinical signs of toxicity were absent in the 2000 and

4000 mg/m^3 dose groups, with some lethargy noted in the 8000 mg/m^3 dose group. Body weight gain was slightly reduced in the 4000 mg/m^3 males (-4.1%) and in the 8000 mg/m^3 males and females (-6.6% and -4.5%, respectively). These body weight reductions were not biologically significant.

There were several haematological parameters that were statistically, but not biologically, significant in the exposed male rats. Total red blood cell count was reduced in the 2000, 4000, or 8000 mg/m^3 males (-4.1%, -6.2%, -7.0%, respectively). Packed cell volume was slightly reduced in the 2000, 4000, or 8000 mg/m^3 males (-2.9%, -4.2%, -5.0%, respectively). Red blood cell volume was slightly increased at all dose level (< +3%) and mean cell haemoglobin was elevated to +5.5% in all dose groups. There were no changes to haematological parameters in female rats. There were no changes in reticulocytes count or in bilirubin and haemoglobin levels. Given the minimal changes within biologically normal values, these haematological changes were not considered biologically significant.

Splenic weight was slightly statistically increased in the 4000 mg/m^3 males; the absolute splenic weight was +23.6% of control. However, at the low dose and at the high dose, there was no corresponding increase in spleen weight. Given the lack of a dose response and lack of pathological findings, this effect is not considered to be biologically relevant.

Kidney weights were marginally increased in the 4000 and 8000 mg/m^3 female exposure groups (≤5%) but no exposure-related renal lesions were identified in the female rats and these effects were not considered biologically relevant. Male kidney weights were increased at all exposure levels. Hyaline intracytoplasmic inclusions and an increased incidence of tubular degeneration change were recorded in cortical tubules in all exposed male groups. There effects are consistent with α2u- globulin effects in male rats. Exposure of male rats to hydrocarbon solvents results in the formation of α2u-globulin protein complexes in the kidney. These complexes accumulate in rat kidney cells and produce sex and species-specific histopathological changes. Since α2u-globulin protein is not present in humans, the changes in the male rat kidney as a consequence of an α2u-globulin mediated process are not useful or relevant for assessing human risk.

An increase in female liver weights was observed at all dose levels but no lesions were histologically identified in the liver. In the absence of histological hepatic changes, this increase in liver weight was regarded as an hyperfunctional adaptation rather than a toxic effect. The NOAEC for this study was 4000 mg/m^3.

Repeated Dose Toxicity (Oral)

A 28 -day subchronic oral repeated dose toxicity study (OECD TG 407) was conducted on Hydrocarbons, C_{11}-C_{14}, n-alkanes, isoalkanes, cyclics, aromatics (2-25%) (CAS RN 64742-81-0) using male and female Crj: CD (SD) rats. Groups of 5 rats of each sex were given doses of 0.14 (116 mg/kg), 0.42 (347 mg/kg), or 1.28 (1056 mg/kg) mL/kg of test substance in corn oil for 30 days. Animals were examined for clinical signs, mortality, body weight, food consumption, water consumption, and food conversion. After sacrifice clinical chemistry, hematology, clinical chemistry, urinalysis, organ weights, histopathology, and gross pathology were examined. There was no mortality during the experiment. Renal damage was observed in male rats at all dose levels. This type of renal pathology is specific to male rats due to an alpha2u-globulin-mediated process that is not relevant to humans. Female rats exhibited adaptive liver changes at the highest dosage and was not considered an adverse effect. The LOAEL for male rats was 0.14 ml/kg/day based on renal damage, which is not relevant to human health. The female NOAEL was 1.28 (1056 mg/kg) mL/kg.

In repeated-dose toxicity studies, exposure of male rats to hydrocarbon solvents results in the formation of α2u-globulin protein complexes in the kidney. These complexes accumulate in rat kidney cells and produce sex and species-specific histopathological changes. Since α2u-globulin protein is not present in humans, the changes in the male rat kidney as a consequence of an α2u-globulin mediated process are not useful or relevant for assessing human risk. Some studies have reported liver effects and some hematological changes, but these effects have generally not been dose-related or consistent between studies. Based on the data above, the C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category members are expected to present low toxicity after repeated dose exposure.

Repeated Dose Toxicity (Dermal)

A 13 week subchronic dermal repeated dose toxicity study was conducted on the read-across substance hydrodesulfurized kerosene (CAS RN 64742-81-0) using groups of 12 male and 12 female rats. Test material was applied at concentrations of 0, 20, 40 or 60% (v/v) (0 (mineral oil), 165, 330 or 495 mg/kg/day, respectively) five consecutive days each week for 13 weeks under a semi-occlusive dressing. An additional group in the vehicle controls and high dose group were maintained for a 4-week recovery period following dosing for 13 weeks. During the week prior to the first dose, each rat was subjected to a functional observation battery (FOB) and was conducted again 1, 6 and 24 hours after the first dose and at 7 and 14 days. All animals survived until scheduled termination. Treatment related dermal irritation was noted in the animals. There were no test substance-related

effects on survival, clinical observations (apart from skin irritation), neurobehavioral signs or ophthalmological findings. The only clinical observations during the study were related to skin irritation at the application site. There was a generally dose-related increase in the incidence and severity of erythema, edema, epidermal scaling, scab formation, thickening of the skin and ulceration at the treated site. The FOB screen did not demonstrate any substance-related effects. Growth rates were unaffected by treatment. Hematological and serum clinical parameters were unaffected by treatment. There were no treatment-related microscopic changes in the tissues examined with the exception of the findings in the skin. The skin observations were minimal in nature with a severity score less than 1 on a 1 [low] to 4 [severe] scale. The findings included acanthosis, ulceration, parakeratosis, chronic active inflammation and hyperkeratosis. Recovery group animals revealed complete recovery in the females and minimal hyperkeratosis in the high dose group males. No effects were found in the animals subjected to a detailed neuropathological examination. The systemic NOAEL is 495 mg/kg. It should also be noted that the more highly refined hydrocarbon solvents are not dermal irritants.

Mutagenicity

In vitro Studies

Several *in vitro* genotoxicity assays have been conducted on substances in the C_{9-14} Aliphatic [2-25% Aromatics] Hydrocarbon Solvents Category. Stoddard solvent (CAS RN 8052-41-3) was tested in a standard Ames Salmonella typhimurium assay, a mouse lymphoma assay, and a mutation assay in *S. cerevisiae* both in the presence and absence of metabolic activation. There was no evidence of mutagenic activity in any of these *in vitro* studies. In addition, hydrodesulfurized kerosine (CAS RN 64742-81-0), an analogue, containing C_9-C_{16} mixed aliphatics and 18% aromatics, did not induce sister chromatid exchanges in Chinese hamster ovary cells with and without metabolic activation. This substance was also negative in a standard Ames assay and mouse lymphoma assay.

In vivo Studies

The *in vivo* germ cell mutation was assessed in a dominant lethal inhalation study on a C_8-C_{13} mixed aliphatic hydrocarbon solvent containing 21% aromatics (CAS RN 64742-82-1). There were no treatment-related effects under the conditions of this test. Rats were exposed via inhalation to 100 or 300 ppm. Exposure did not produce genotoxicity in the germ cells of treated male rats.

In vivo assays were conducted on members of the C_9-C_{14} Aliphatic [2-25% Aromatics] Category. Stoddard solvent (CAS RN 8052-41-3) showed no evidence of chromosome aberrations in a rat bone marrow cytogenetic assay. In addition, Stoddard Solvent was evaluated in a mouse bone marrow micronucleus assay. There was no evidence of mutagenic activity in this test. Although the substance tested was referred to as a Stoddard Solvent and identified as having physical characteristics consistent with the category, because there was no specific information on the CAS RN for this material or carbon number range, the results are used only as additional supportive evidence.

Members of the C_9-C_{14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category have shown no mutagenic activity in a number of *in vitro* bacterial and mammalian cell mutagenicity tests. In addition, they have been negative in *in vivo* mouse and rat bone marrow mutagenicity assays. This assessment does not include less refined substances that share the same CAS number or substances with a higher benzene content.

Reproductive and Developmental Toxicity

There are no studies for reproductive or developmental effects conducted with C_9-C_{14} Aliphatic [2-25% Aromatics] Hydrocarbon Solvents Category products, however there is data available in the read-across substance hydrodesulfurized kerosine (CAS RN 64742-81-0, analogue) and JP-8 (CAS RN 8008-20-6, analogue), which is a less refined C_9-C_{16} mixed aliphatic hydrocarbon with up to 25% aromatic content.

In the first study, male rats were given 0, 750, 1500 or 3000 mg/kg neat JP-8 (CAS RN: 8008-20-6; an aliphatic carbon range of C_8-C_{16}, aromatics <25%) daily by gavage for 70 days prior to mating with naive females to assess fertility and sperm parameters (similar to OECD TG 415). Males were allowed to mate while continuing to receive treatment. Aside from a decrement in male body weight in the 3000 mg/kg bw/day dose group, no clinical signs were observed. There were no statistical differences noted in any reproductive parameter measured. The reproductive NOAEL = 3000 mg/kg bw/day for male rats.

In the second study, female rats were dosed (0, 325, 750, 1500 mg/kg) with neat JP-8 (CAS RN: 8008-20-6; an aliphatic carbon range of C_8-C_{16}, aromatics <25%) daily by gavage for a total of 21 weeks (90-day plus mating with naive males, gestation and lactation) in an effort to assess general toxicity, fertility and reproductive endpoints (similar to OECD TG 415). The NOAEL was 1500 mg/kg bw/day for female fertility, the highest dose tested. The NOAEL for the pup was 750 mg/kg bw/day based on a decrease in body weight which correlated with a decrease in maternal body weight at 1500 mg/kg bw/day.

A reproductive/developmental toxicity screening study was conducted in rats with an analogue substance, hydrodesulfurized kerosine (C_9-C_{16} mixed aliphatics/aromatics with 18% aromatic content), by the dermal route of exposure. 0, 165, 330, and 494 mg/kg test material was administered daily for approximately seven weeks (pre-mating, mating and through Day 19 of gestation) to groups of 10 female rats via dermal application, at a dose volume of 1 ml/kg. Male rats also received daily administration of the same concentrations and dose volume. In addition, one "sham" treated control group (10 males and 10 females) received no test material. Exposure began two weeks prior to mating for 7 days/week. F0 males continued to be exposed daily throughout mating, female gestation and postpartum period and throughout the female necropsy period. F0 females continued to be exposed throughout the mating period and gestation days 0-19. Slight to moderate skin irritation was produced at 494 mg/kg dose group in both sexes, but no apparent maternal, reproductive or developmental toxicity was observed. No clinical signs of toxicity and no effects on body weights, food consumption, fertility or absolute organ weights were observed. Relative kidney weights were higher in male rats at the high dose. No microscopic changes in testes, epididymides or ovaries of parental animals were observed. However, skin changes associated with irritation were observed in male rats in all groups and in female rats in the high dose group. There were no differences in mean number of corpora lutea, implantation sites and live pups per litter. Pups born from treated dams showed comparable body weights and weight gain. Viability index on postpartum day 4 was >97%. No gross anomalies were observed in the pups. In summary, the NOAEL for reproductive and developmental toxicity in this study was 494 mg/kg.

A developmental inhalation toxicity study was conducted in rats with an analogue substance, hydrodesulfurized kerosine (C_9-C_{16} mixed aliphatics/aromatics with 18% aromatics). In this study, pregnant female rats (20/dose group) were exposed to 0, 100 and 400 ppm kerosine for 6 hours per day on days 6 through 15 of gestation. Actual doses received were 106.4 ppm and 364 ppm kerosine. There were no treatment-related deaths in the study. Lung mottling was observed at necropsy in two females exposed to 100 ppm, but this was not considered to be treatment-related. No other maternal abnormalities were noted. There were no statistically significant differences between the control and treated animals with respect to clinical observations, body weights, food consumption or uterine measurements. No visible differences were observed in the pups treated with 106.4 ppm and 364 ppm kerosine compared to controls. No statistically significant differences were observed in sex ratios, number of litters, litter size, live fetuses, or fetal weights between treated and control groups. Some skeletal changes, mainly related to retarded bone ossification, were noted in both the control and treated fetuses. However, these changes have routinely been observed by this laboratory in this particular strain of rat. Neither the frequency nor character of these changes indicated an adverse effect on fetal growth and development. The NOAEL for both maternal and developmental effects was 364 ppm.

A segment II inhalation teratology study was conducted in rats with a C_8-C_{13} mixed aliphatic/aromatic solvent containing 19% aromatics (CAS RN 8052-41-3). In this study, pregnant female rats (20/dose group) were exposed to 0, 100, and 300 ppm of test material for 6 hours per day on days 6 through 15 of gestation. This study included a chamber-exposed negative control and an acetylsalicyclic acid positive control (400 mg/kg/day by gastric intubation from days 6 to 15). No mortality occurred during the study. No treatment-related physical observations were observed. Treated females gained more weight than chamber-exposed controls during the post-dosing interval. Pregnancy rates were comparable to chamber-exposed controls. The mean number of corpora lutea was significantly decreased in the 300 ppm dose group but was not considered to be a treatment-related effect since ovulation occurred prior to initiation of treatment. An increase in implantation efficiency was observed in treated groups but is not considered indicative of an adverse effect. The number of live fetuses, resorption sites and the incidence of dams with one or more resorption sites were comparable with controls. Few gross lesions were observed at necropsy but no treatment-related effect was indicated. Mean crown-rump distances (both sexes) were considered comparable between the chamber-exposed and treated groups. Although some statistically significant differences were observed in crown-rump distances between these same groups, the differences were slight with no apparent dose-response pattern and were not considered to be treatment-related. Sex ratio was unremarkable. The incidence of fetuses with ossification variations was comparable to chamber-exposed controls. No treatment-related effects were observed for external, soft tissue and skeletal evaluations of fetuses recovered from treated females. The NOAEL for maternal and developmental toxicity was 300 ppm.

A prenatal development toxicity study equivalent or similar to OECD TG 414 was conducted using groups of 26 or 27 female rats. Female rats were exposed by inhalation to white spirit (CAS RN not specified but reported in CAS RN 8052-41-3 dossier) at concentrations of 0, 600, or 2400 mg/m^3 (0, 100, and 400 ppm, respectively) for 6 hours per day on days 6 to 15 of gestation. No maternal toxicity or differences in litter size or average fetal weight were seen between the groups. There were no statistical differences for skeletal variations between the control group and the 100 ppm or the 400 ppm exposed group. Based on this information, the developmental NOAEC = 400 ppm, the highest concentration tested.

The available data on potential reproductive and developmental effects of members of the C_9-C_{14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category are limited to animal studies. These studies suggest that these solvents

are not expected to be reproductive or developmental toxicants. This assessment does not include less refined substances that share the same CAS number or substances with a higher benzene content.

Carcinogenicity

No carcinogenicity studies for C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category members were located in the scientific literature.

Neurotoxicity/Neurobehavioral

Animal Models

A number of acute and subchronic inhalation neurotoxicity studies were conducted in rats exposed to white spirits and examined numerous endpoints including, but not limited to, visual discrimination performance, coordinated movement, spontaneous activity, grip strength, and peripheral nerve conduction time. In some subchronic studies, food and water intake, neuropathology evaluations, and/or reversibility of effects were also evaluated. There is no consistent evidence that chronic, low-level solvent exposure in animal models produce irreversible CNS effects.

In a short-term study with white spirit vapors containing 20 volume % aromatics, male rats were exposed to 0, 200, 400, or 800 ppm white spirit vapors for 8 hrs/day for 3 consecutive days with behavioral tests conducted immediately after exposures. This study confirmed that acute (from the first day) white spirit exposure at 200 to 800 ppm could produce transient behavioral effects. In a subchronic study, male rats were exposed to 0, 200, 400, or 800 ppm white spirit vapors for 8 hrs/day, 5 days/week for 26 weeks with behavioral tests generally conducted weekly at least 10 hours after the last daily exposure. No persistent changes in neurobehavioral functioning were observed. In addition, no exposure-related changes in brain, spinal cord, or sciatic nerve were seen in light microscopy studies.

Another study examined the behavioral effects of exposure to white spirits containing 20 volume % aromatics in adult (3-month) and aged (15-month) rats. In these experiments, rats were exposed to white spirits (0, 400, or 800 ppm) for 6 hrs/day, 5 days/week for 6 months. After an exposure-free period of two months, neurobehavioral, pathological, and neurochemical examinations were performed. There was no neurobehavioral white spirit-induced neurotoxicity. As expected, age-related differences in motor activity were detected, however, no dose-related macroscopic or histopathological changes were found. The concentration of neurotransmitters noradrenaline (NA), dopamine (DA), and 5-hydroxytryptamine (5-HT) in various brain regions and in whole brain was changed in the 400 and 800 ppm groups. The significance of changes in neurotransmitter levels is difficult to evaluate and in the absence of any pathological or functional changes, it is difficult to determine if this is toxicological, phenomenological, compensatory, or merely a random variation.

An evaluation on the effects of white spirits (20 volume % aromatics) on synaptosomal neurochemistry in rats was conducted. Rats were exposed to white spirits by inhalation (0, 400, or 800 ppm) for 6 hrs/day, 5 days/ week for either 3 weeks or 6 months. Synaptosomal neurochemistry was investigated as an index of the in situ conditions in the presynaptic nerve terminal. In both dosing regimens, the relative and absolute yields of synaptosomal protein were significantly reduced in the two exposed groups. An increase in synaptosomal NA, DA, and 5-HT concentrations, high-affinity 5-HT uptake rate and uptake capacity after 3 weeks and 6 months of exposure.

In a more recent study, the effects of high aromatic versus low aromatic white spirit on rat brain 5-hydroxytryptamine (5-HT) receptor functions and synaptic remodeling were examined. In this study, male rats were exposed to 0, 400, or 800 ppm of aromatic (20 vol. % aromatics) or dearomatized white spirit (catalytically hydrogenated white spirit) in the inhaled air for 6 hours/day, 7 days/week for 3 weeks. Both types of white spirit at 800 ppm decreased the binding capacity for the 5-HT2A receptor. The aromatic type decreased the equilibrium dissociation constant of the 5-HT2A and 5-HT4 receptors and the NCAM increased in the hippocampus and the NCAM/SNAP-25 ratio decreased in the entorhinal cortex at 800 ppm. There were no effects reported for the dearomatized white spirit in any brain region. Again, in the absence of any pathological or functional changes, it is difficult to determine the significance of these acute effects.

Levels of glutathione and the activity of glutamine synthetase were assayed in the brain in male rats. Rats were exposed at 5 months of age (young) or 14 months of age (aged) were exposed to 0, 400 (2290 mg/m^3), or 800 ppm (4580 mg/m^3) aromatic white spirit (14-21% aromatics) in air for 6 hours/day, 7 days/week for 3 weeks. Solvent inhalation significantly increased the level of glutamine synthetase within the P2 fraction of hippocampus from both young and aged rats, but cortical levels of glutamine synthetase were unaffected by treatment. The changes found in brain tissue did not reveal evidence of oxidative stress. However, the changes suggested that glial activation was taking place.

Male rats to 575 (100 ppm), 2875 (500 ppm), or 5750 mg/m^3 (1000 ppm) white spirit vapor (11.7% aromatics) for 4 to 17 weeks, 5 days a week for 6 hours/day. The neurochemical effects included a dose-dependent decrease in the cerebellar succinate dehydrogenase activity for 8 weeks while creatine kinase activity increased after 12 weeks. The dose-dependent increase in creatine kinase its activity may therefore indicate an early astroglial

proliferation as the specific activity in the glial cell fraction was below or within the control range. The absence of significant demyelination is indicated by unaltered 2',3'-cyclic nucleotide 3'-phosphohydrolase, a notion also sustained by grossly unaltered acid proteinase activity involved in the degradation of myelin protein. The lowest exposure concentration in this study, 575 mg/m^3 (100 ppm) represents a virtual "no effect" level for rats in the 17-week study.

Neurotoxicity endpoints following dermal exposure to white spirits containing up to 17 volume % aromatics were examined in rats. White spirits (210-260 mg) were applied to the tail 3 hr/day, 5 days/week, for 6 weeks. No change in motor conduction velocity was observed, although some electrophysiological changes occurred. Morphological analysis of the tail nerve revealed axon swelling, widening of the nodes of Ranvier, and/or demyelinated foci in the axons.

A physiologically-based pharmacokinetic (PBPK) model was developed in rats using white spirit (WS) and two marker compounds, 1,2,4-trimethyl benzene (TMB) and n-decane (NDEC). The rat models were then allometrically scaled to obtain models for inhalatory exposure for humans. The human models were validated with blood and alveolar air kinetics of TMB and NDEC, measured in human volunteers. In general, the curves predicting the blood and brain levels in rats and the blood levels in humans fit well with the measured data. A WS exposure concentration of 344 mg/m^3 was predicted to result in a human brain concentration of TMB equivalent to that in the brains of rats exposed to 600 mg/m^3 WS (the no effect level for acute CNS effects in rats). A similar calculation for NDEC in human brains equated to an external exposure of 721 mg/m^3 WS. From these results the no effect level for acute CNS effects in humans was predicted to be in the range of 344 to 721 mg/m^3. To test this PBPK model, volunteers were exposed to WS for four hours at approximately 570 mg/m^3, and a number of neurobehavioral parameters were monitored. Of these, the only statistically significant finding was a small change in reaction time. Thus, it was determined that 570 mg/m^3 represented either a no effect or a minimal effect level for acute CNS effects in humans. Of note, TMB was found to be the compound with the lower estimated NOEL and LOEL. This indicates that aromatic compounds might be more important than aliphatic compounds, for the acute CNS effect of WS.

Human Experience/Epidemiology - Neurological Effects

Several studies conducted were conducted to evaluate white spirit's acute (<1 hour) effects in humans, including:

- 3 to 5 minutes of exposure to 400 ppm Stoddard solvent "produced no marked effects, and subsequent evaluations it was concluded that the irritating concentration of Stoddard solvent was 370 ppm and that the low and high odor thresholds were 1.00 ppm and 120 ppm
- 15-minute inhalation produced eye irritation in one of six volunteers (ages 22 to 61 years) at 150 ppm and was reported at 470 ppm Stoddard solvent by all six volunteers
- 30 min exposure to white spirits in 15 young adult males exposed at 440-875 ppm solvent produced nausea and vertigo.

30 minute exposures to white spirits at 175 to 440 ppm at rest or during exercise demonstrated a linear relationship between alveolar and arterial concentrations of the individual solvent components; pulmonary absorption of the aliphatics ranged from 46% to 59% and that of the aromatics, 58% to 70%. Total systemic absorption was somewhat greater during exercise, but the proportion of circulating aliphatic to aromatic components decreased with increasing physical activity.

Chronic Exposure to White Spirit

The chronic toxicity of white spirits in humans focuses exclusively on retrospective epidemiology studies whose subjects were primarily workers in the paint industry in the 1960's and 80's . Many of these studies estimate inhalation exposure rather than use measured data. While it is true that white spirit was the predominant organic solvent used during this time period, other aromatic solvents (e.g. xylene and toluene) were also used. Several of the epidemiological studies acknowledge this co-exposure issue. Finally, many of these studies fail to adequately characterize the type of white spirit used. The white spirit (or Stoddard Solvent) used at the time was typically comprised of 80-85% aliphatic molecules with carbon chain lengths in the C8 to C11range and an aromatic content of 15- 20%. While no CAS numbers are given in these reports, the following CAS numbers correspond to the type of white spirit used at the time:

Stoddard solvent - CAS number: 8052-41-3

Naphtha (petroleum), hydrodesulphurized heavy - CAS number: 64742-82-1

Solvent naphtha (petroleum), medium aliphatic - CAS number: 64742-88-7

The following reports have been determined by peer reviewed literature to be the dispositive studies on the potential for white spirits to cause chronic CNS effects in occupational workers (located in the Dossier with the CAS Number: 8052-41-3 as no CAS number was identified in the following studies).

In a cross-sectional study, 219 housepainters and 229 reinforcement workers were assessed using 8 neuropsychological tests to determine intelligence and psychomotor performance. The mean exposure period was 22 years with an estimated average level of white spirit of 40 ppm (232 mg/m³) during working hours; exposure indices made for total lifetime exposure and average exposure levels. Among painters, there were significantly increased prevalence of acute symptoms such as nausea, runny noses and malaise. Short-term visual memory and simple reaction time were affected, however, when pre-exposure intellectual level was taken into account, the painters performed more poorly only in the visual memory test. The authors conclude that the result imply that adverse psychological effects exist.

In a cross-sectional study, 101 construction painters and 31 dry wall tapers. It should be noted that due to language barriers and other factors, the control group was not used in the evaluation. All analyses were reported as internal comparisons between painter groups. The researchers grouped the painters based on their level of exposure and compared these groups to each other, however, the exposure levels used were not reported. The painters had worked as both construction and maintenance painters, jobs which use different solvent systems. The painters were assessed using 8 neuropsychological tests to determine intelligence and psychomotor performance. The subjects were interviewed to assess subjective complaints and then given a neurobehavioral examination a computer evaluated neurobehavioral evaluation system (NES). The mean exposure period was 18 years. The results of the 21 NES tests were compared by regression analysis to 4 measures of exposure, EI lifetime, EI past year, weeks of exposure in past year, and days of exposure in past year. There were only two correlations which were significant at the 0.05 level, symbol digit latency ($p = 0.04$) and digit span forward ($p = 0.03$) and both of these were for weeks of exposure in the previous year rather than for years or lifetime exposure. Among painters, dose-related increase in symptoms such as dizziness, nausea, fatigue, feeling of drunkenness and mood tensions were observed. The authors conclude that the described pattern of the occurrence of symptoms without clear evidence of function deficit is consistent with central nervous system disorder as classified by the World Health Organisation.

In a cross-sectional study, 186 construction painters were compared to each other (there was no reference group) and assessed using 9 neuropsychological tests to determine intelligence and psychomotor performance. Since solvent identity and exposure concentrations were not explicitly identified, painters were grouped based on the paint application method (e.g. spray, roll, brush, or mixed). This information on intensity and duration were combined and to create exposure indices. Stratification to 6 subgroups, according to the index of lifetime exposure intensity (LEI), was done. The mean exposure period was 12 years. Unadjusted as well as adjusted (adjustments were made by regression analysis to account for the factors age, race, education, social status and alcohol habits) was used. Significant effects were associated with lifetime exposure, but not years worked as a painter, for five mood parameters. A significant latency ($p=0.006$) in the symbol-digit test was associated with the lifetime exposure indices, but was not significant when compared to years worked as a painter.

In a cross-sectional study, 85 painters (consisting of house painters, ship painters, industrial painters, and silk screen painters) and 85 bricklayers were assessed using a neuropsychological l test battery (13 tests intellectual functions and psychomotor performance), neurological tests (motor performance, coordination, reflexes, sensitivity), and by neurophysiological examination (CT). White spirit was estimated to account for about 75% of the total solvent exposure. The mean exposure period was 32.5 years with an average daily solvent consumption (estimated as paint consumed) of 1.3 l/d = 41.4 (l/d) years. Solvent exposure was graded according to the cumulative solvent consumption. Low exp.: < 15 (l/d) years (n=22); medium exp.: 15-30 (l/d) years (n=29); high exp.: > 30 (l/d) years (n=33). Twenty-one painters had been exposed during the latest week before examination. The following odds ratios (OR) for painters compared to bricklayers were found for the development of fatigue, poor memory, difficulty in concentration, emotional lability and depression: high exp.: OR= 5.0 ($p < 0.05$) and medium exp.: OR= 3.6 ($p < 0.05$). In 9 of the 14 "don't-hold" tests, the low exposed painters performed better than the bricklayers; highly exposed painters performed worse than the brick layers in 13 out of 14 tests. Only when the medium and high exposure painters are grouped together is there a statistically significant effect in the following "don't hold" tests: symbol digit ($p = 0.0016$), and block design time ($p= 0.033$). In CT scanning, the cerebral atrophy index significantly ($p<0.0014$) correlated with exposure. However, the CT scanner was an early model and produced poor quality images and the authors did not state whether the measurements were outside the normal range. As the exposure assessment did not consider dermal exposure or fully consider the work patterns of the painters, for example the use of thinners was not considered. The authors conclude that the risk of developing neurological conditions seems to be increased for accumulated exposure levels above ~15 (l/d) years, corresponding to ~6 years with a daily time weighted average exposure to 100 ppm of organic solvent.

In a cross-sectional study, 135 house painters and 71 house carpenters, affiliated with their respective trade unions for at least 10 years before 1970, were assessed using a neuropsychological test battery (12 psychometric tests). Solvent identity was not determined, though the author states that in the latter part of the 1950s and in the 1960s, white spirit was the dominating solvent in alkyd-based paints; though the authors acknowledge that co-exposure to xylene and toluene also occurred. Their lifetime organic solvent exposure was evaluated through the aid of an interview. Painters were divided into three categories: low (130 exposure-limit months), intermediate (130 – 250 exposure-limit months), and high (>250 exposure-limit months). The exposure-limit was estimated to be 540 mg/m^3. Twelve psychometric tests were used to evaluate the group. Only in the block design test did the painters perform worse than the carpenters; the painters' performance decreased with increasing cumulative exposure and was likely confounded by recent solvent exposure. In the majority of the psychometric tests, the carpenters (no exposure) performed worse than painters with low exposure. Painters with the largest cumulative dose tended to perform worse than the painters. The 52 painters with the heaviest cumulative exposures and 45 carpenters were examined for psychiatric diagnosis, with electroencephalography and auditory evoked potential. These three investigations showed no difference between the painters and the carpenters. The "profile of mood state" was not different between any of the groups. Magnetic resonance tomography of the brain for 15 painters and 15 age-matched carpenters was conducted; there were no statistical differences in the T1 relaxation in white matter or in ventricle width. The authors considered that the symptoms were causally related to the solvent exposures and that the cumulative exposure to solvents below 130 exposure-limit months does not lead to functionally lasting disturbance of the nervous system. The authors concluded that exposure > 250 exposure-limit months could be associated with a higher risk of symptoms as evident by decreased performance on a few psychometric tests. However, aside from the block design test, painters in the high dose only had a statistically significant decrease in the Corsi block (backward; $p = 0.05$) and the finger tap (maximum frequency; $p = 0.04$) tests.

Human Experience/Epidemiology - Other Effects

Chronic exposure to high concentrations of white spirit can produce health effects. Follicular dermatitis can develop rapidly on repeated immersion of the hands and forearms in Stoddard solvent and combined percutaneous and inhalation exposure of Stoddard solvent (at concentrations associated with nausea) has been held responsible for production of frank hepatic toxicity and jaundice. A number of fatalities due to aplastic anemia have been ascribed to occupational and consumer use of Stoddard-type solvents. Unquantified occupational exposure to white spirits (83% paraffins, 17% aromatics) for 4-months produced nausea and vomiting in workers. One individual developed aplastic anemia; bone marrow depression was confirmed on sternal biopsy. This employee died several months later of septicemia. Although approximate boiling point ranges are variably reported, none of these isolated cases of anemia reported included chemical characterization of the particular solvents.

A review of the epidemiological literature regarding exposure to white spirit with the CAS RN of 8052-41-3, 64742-82-1, and 64742-88-7 has been conducted. Similar reviews have been conducted by the International Programme on Chemical Safety (IPCS) and Scientific Committee on Occupational Exposure Limit (SCOEL). The IPCS and SCOEL evaluations were also re-evaluated by the ECHA Committee for Risk Assessment (RAC). These evaluations include retrospective epidemiological studies involving painters with long-term exposure to white spirit. Confounding factors in these studies include co-exposure to other solvents and a lack of measured exposure data. Epidemiological studies reported an increased incidence of complaints of memory impairment, fatigue, impaired concentration, irritability, dizziness, headache, anxiety and apathy. Several studies that included neuropsychological tests demonstrated impairment in some of these tests; primarily in the short-term visual memory test and in the symbol-digit test. In some studies, life-time exposure to high concentrations of white spirit was correlated with an increase incidence of effect. Using a weight of evidence approach, the RAC concluded that chronic exposure to these white spirits cause adverse central nervous system (CNS) effects that can progress in severity. These CNS effects can include deficits in psychomotor, perception, memory parameters, and disturbances in mood.

Initial Assessment for Human Health

Based on a review of the available toxicology data, members of the C9-C14 Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category have a low potential for acute toxicity by the oral, dermal, and inhalation routes of exposure. However, if aspirated into the lungs, they may cause bronchopneumonia that may be fatal within 24 hours. Solvents in this category are slight to mild skin irritants in animals, depending on the duration and conditions of exposure. However, they produce only minimal eye irritation. Prolonged or repeated exposure can lead to severe irritant dermatitis due to defatting of the skin. The available data suggest that solvents in this category are not skin sensitizers, mutagens, or carcinogenic .

A review of the epidemiological literature regarding exposure to white spirit with the CAS RN of 8052-41-3, 64742-82-1, and 64742-88-7 has been conducted by the International Programme on Chemical Safety (IPCS) and Scientific Committee on Occupational Exposure Limit (SCOEL). The IPCS and SCOEL evaluations were also re-

evaluated by the ECHA Committee for Risk Assessment (RAC). These evaluations include retrospective epidemiological studies involving painters with long-term exposure to white spirit. Confounding factors in these studies include co-exposure to other solvents and a lack of measured exposure data. Epidemiological studies reported an increased incidence of complaints of memory impairment, fatigue, impaired concentration, irritability, dizziness, headache, anxiety and apathy. Several studies that included neuropsychological tests demonstrated impairment in some of these tests; primarily in the short-term visual memory test and in the symbol-digit test. In some studies, life-time exposure to high concentrations of white spirit was correlated with an increase incidence of effect. Using a weight of evidence approach, the RAC concluded that chronic exposure to these white spirits cause adverse central nervous system (CNS) effects that can progress in severity. These CNS effects can include deficits in psychomotor, perception, memory parameters, and disturbances in mood.

The C9-14 Aliphatic [2-25% Aromatic] Hydrocarbon Solvents Category substances may possess properties indicating hazard for human health (aspiration and possible skin defatting with repeated exposure). A review of the epidemiological literature indicates prolonged and repeated exposure to high concentrations of white spirits with the CAS RN 8052-41-3, 64742-82-1, and 64742-88-7 are considered to have chronic adverse effects on the central nervous system. Adequate screening-level data are available to characterize the human health hazard for the purposes of the OECD Cooperative Chemicals Assessment Programme.

Environment

Members of the C_9-C_{14} Aliphatic [2-25% aromatics] Hydrocarbon Solvents Category have the potential to volatilize from surface waters, based on Henry's Law constants (HLC) representing volatility for category members that range from 46 to 9.7 x 10^5 Pa-m^3/mole (at 25°C). In the air, category members have the potential to rapidly degrade through indirect photolytic processes mediated primarily by hydroxyl radicals ($^{\bullet}$OH) with calculated degradation half-lives ranging from 0.42 to 1.10 days or 10.8 to 26.4 hours based on a 12-hr day and an $^{\bullet}$OH concentration of 1.5 x 10^6 $^{\bullet}$OH/cm^3. Aqueous photolysis and hydrolysis will not contribute to the transformation of category chemical constituents in aquatic environments because they are either poorly or not susceptible to these reactions. These chemicals are unlikely to degrade by hydrolysis as they lack a functional group that is hydrolytically reactive.

Mackay Level III modeling indicates that category member constituents partition mostly to the soil and water compartments rather than air compartment when an equal emission rate (1000 kg/hr) to the air, water, and soil compartment is assumed. When release occurs only to either the air, water, or soil compartment, constituents are indicated in the modeling to partition largely to the compartment to which they are released.

When released primarily to the air compartment, the primary mode of removal would be via indirect photodegradation. Although the substances and their chemical constituents demonstrate a range of water solubility with most constituents having relatively low solubility, wet deposition of category chemical constituents is not likely to play a significant role in their atmospheric fate because of their rapid photodegradation. Volatilization to the air can contribute to the loss of category chemical constituents from aqueous and terrestrial habitats.

Determining the biodegradation potential of UVCBs can be challenging. The result for each multi-constituent substance (UVCB) characterizes the biodegradability of that substance as a whole, but it does not suggest that each constituent of the UVCB is equally biodegradable. As with all ready biodegradation test guidelines, the test system and study design used with these substances (OECD TG 301F) is not capable of distinguishing the relative contribution of the substances' constituents to the total biodegradation measured (constituents with higher branching/cyclic structures may degrade to a lesser extent than linear and less branched structures). The n-paraffin constituents have the potential to biodegrade rapidly based on results that support their characterization as readily biodegradable (80 to 83% in 28 days). In comparison, iso-paraffinic constituents are expected to demonstrate a slower rate of biodegradation based on results for an analogue isoparaffinic substance, which was shown not to be readily biodegradable, but did demonstrate a moderate extent of biodegradation (41%) over an extended period of time (41 days). A multi-constituent member of the category, a C_{9-13} mixed aliphatics and aromatics (19% aromatic) substance (CAS RN. 64742-82-1), biodegraded to an extent of 75% after 28 days and was readily biodegradable based on a study that used the OECD 301F test guideline. The overall conclusion for C_9-C_{14} Aliphatic [2-25% aromatics] Hydrocarbon Solvents Category members: some components of the category members (e.g. n-paraffins) are readily biodegradable, but some (tertiary and quaternary branched components) components may be less biodegradable, not meeting the readily biodegradable criteria.

Category members have a potential to bioaccumulate, based on calculated log BCF values for constituents that range from 2.15 to 4.06, and calculated BCF values of 142 to 11,430 L/kg wet-weight that take into account biotransformation of the chemicals in fish tissue. Results of BCF studies for several constituent chemicals of category members are also available. Reported BCF ranges for n-dodecane of 240 to 2870 l/kg wet weight, using

carp and rainbow trout. Also reported are a BCF value for iso-nonanes of 1468 l/kg wet weight with carp. Additional studies for other constituent chemicals were reported for trimethylbenzene and 1,2,3,4-tetrahydronaphthalene, with values of 154 to 783 (carp and trout), and 147 to 536 l/kg (carp), respectively. Determining the bioaccumulation potential of UVCBs can be challenging. BCF values for n-paraffins, iso-paraffins, and cycloparaffins can be different due to differences in metabolism. Constituents with higher branching/cyclic structures may therefore bioaccumulate to a greater extent than linear and less branched structures. It should be noted that for highly lipophilic constituents uptake through the diet may exceed the direct uptake through water.

Although limited data are available, it may be shown that category members are expected to exhibit acute toxic effects to aquatic organisms in the range of 1 to 100 mg/L, based on nominal loading levels, with three studies with category members and three studies with an analogue substance. A chronic study with *Daphnia magna* and a substance in the C_9-C_{13} range (C_{9-13} mixed aliphatics and aromatics (19% aromatic)) indicated a 21-day NOEL of 0.28 mg/L, based on nominal loading levels. Additional chronic work using fish with the analogue JP-8 (C_8-C_{16} range) indicate an NOEC = 1mg/l based on measured concentration for a warm water fish, and a NOEC <1.4 mg/l (LOEC = 1.4 mg/l) for a cold water fish. Chronic studies using *Daphnia magna* with analogue substances in the C10-C12 isoparaffinic range (CAS RN 90622-57-4) indicated an effect (NOEC = 0.025mg/l, based on measured concentration), but isoparaffins in the C11-C13 range showed no observed effects up to 1 mg/L (highest nominal loading tested) for CAS RN: 90622-58-5. QSAR values for the representative constituents (listed on page 4) were generated using EPISuite version 4.10. Acute 96-hour fish toxicity ranged from <0.01 to 3.4 mg/l. Acute 48-hour daphnid toxicity ranged from <0.01 to 2.4 mg/l. And acute 96-hour algae toxicity ranged from <0.01 to 2.3 mg/l. The model indicated that water solubility of the alkanes and isoalkanes may be too low to give rise to acute aquatic toxicity, but the aromatics are expected to have sufficient water solubility to contribute to the acute aquatic toxicity. Calculated values for the three representative aromatic constituents, which are believed to drive the acute aquatic toxicity, ranged from 1.4 to 3.4 mg/l for fish, 1.1 to 2.4 mg/l for daphnids, and 1.3 to 2.3 mg/l for algae.

Table 5 - Selected data that characterize the acute aquatic toxicity of members of the C_9-C_{14} Aliphatic Hydrocarbon Solvents [2-25% aromatics] Category

Substance (CAS RN)	**Freshwater Fish 96-hr (mg/l)**	**Freshwater Invertebrate *(Daphnia magna)* 48-hr (mg/l)**	**Freshwater Alga *(Pseudokirchneriella subcapitata)* 72-hr (mg/l)**
Stoddard solvent (8052-41-3) Hydrocarbons, C9-C13 (aromatics 19%)		96-hr LL_{50} = 3.5 (*Chaetogammarus. marinus*)	EbL_{50} = 2.5 EbC_{50} = 0.58 ErL_{50} = 5.5 ErC_{50} = 1.2 NOELR(b,r) = 0.76 NOEC(b,r) = 0.16
Hydrocarbons, C8-C12, n-alkanes, isoalkanes, cyclics, aromatics (2-25%) CAS RN 64742-82-1	LL_{50} = 41.4 LC_{50} = 2.5	3 - 10 (EL_{50})	1 - 3 (EL_{50}) (growth rate) 1 - 3 (EL_{50}) (biomass) NOEL = 1.0 (growth rate and biomass)
Kerosine, hydrodesulphurized, C8-C15, aromatics (2-25%) CAS RN 64742-81-0 (read-across)	LL_{50} = 25 NOEL = 6.8	EL_{50} = 1.4 NOEL = 0.3	IrL_{50} = 8.3 IbL_{50} = 15 NOEL(b,r) = 4.0 (growth rate and biomass)

Table 6. Chronic aquatic toxicity data for C_{9-14} Aliphatic [2-25% Aromatic] Hydrocarbons Solvents Category members

Test Material (CAS #)	Freshwater Fish (mg/L)	Freshwater Invertebrate *(Daphnia magna)* 21-day (mg/L)	Freshwater alga *(Pseudokirchneriella subcapitata)* 96-hr (mg/L)
Stoddard solvent (8052-41-3) Hydrocarbons, C_9-C_{13} (aromatics 19%)		EiL_{50} = 1.62 EiC_{50} = 0.43 $ErepL_{50}$ = 1.19 $ErepC_{50}$ = 0.33 NOELRig = 1.4 NOECig = 0.37 NOELRrep = 0.28 NOECrep = 0.10	NOELR(b,r) = 0.76 NOEC(b,r) = 0.16
JP-8 C_8-C_{16}, aromatics (25%) CAS RN 8008-20-6	NOEC = 1.0 (*J. floridae*) NOEC < 1.4 LOEC = 1.4 (*O. mykiss*)		
Hydrocarbons, C10-C12, isoalkanes, <2% aromatics CAS RN 90622-57-4		NOECrep = 0.025	
Hydrocarbons, C11-C13, isoalkanes, <2% aromatics CAS RN 90622-58-5		NOELrep = 1	

i Immobilization
rep Reproduction
ig Immobilization and growth
b Biomass
r Growth rate

Environment Conclusion

Chemicals in this category possess properties indicating a potential hazard for the environment (acute toxicity for fish, invertebrates, and algae (in the range of 1 to 100 mg/l) based on nominal loadings; available chronic toxicity data for invertebrates, fish, and algae are in the range of 0.1 – 1.0 mg/l, based on nominal loadings, not excluding that some members of the category might have a toxicity below 0.1mg/l. Category members have a potential to bioaccumulate. Some components of the category members (e.g. n-paraffins) are readily biodegradable, but some components (tertiary and quaternary branched components) may be less biodegradable, not meeting the readily biodegradable criteria. Adequate screening-level data are available to characterize the environmental hazard for the purposes of the OECD Cooperative Chemicals Assessment Programme.

Production/Use/Exposure

Production

As reported to the U.S. Environmental Protection Agency for the year 2006, companies produced or imported the following volumes of C_9-C_{14} Aliphatic [2-25% aromatic] hydrocarbon solvents. Note that the Volume Survey is overall volume for the entire individual CAS RN and includes fuels, solvents and all other uses. It is expected that the solvent portion of the volume for the C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category would be significantly lower than the aggregate production volume:

- Stoddard solvent, CAS RN 8052-41-3: 100 to <500 million pounds (<227000 tonnes)

- Kerosine, petroleum, hydrodesulfurized , CAS RN 64742-81-0: 1 billion lbs and greater (454000 tonnes)
- Naphtha, petroleum, hydrodesulfurized heavy, CAS RN 64742-82-1: 1 billion lbs and greater (454000 tonnes)
- Solvent naphtha, petroleum, medium aliphatic, CAS RN 64742-88-7: 1 billion lbs and greater (454000 tonnes)

Production of these C_9-C_{14} aliphatic [2-25% aromatics] hydrocarbon solvents is differentiated from other refinery substances such as gasoline and diesel fuel by including additional processing steps leading to finished substances with narrow distillation ranges, removal of sulfur- and nitrogen-containing compounds, and low color. The aromatic content in these substances is controlled to meet specific performance characteristics. These additional refining steps provide these hydrocarbon solvents with qualities suitable for applications in consumer goods.

Use

Hydrocarbon solvents in the C_9-C_{14} range with aromatic content between 2 and 25% are considered to have a medium rate of evaporation and have a number of applications, including auto motive products, paints and coatings, degreasers, wood/floor wax, diluent in asphalt applications, and as a pesticide carrier base. The predominant commercial uses of C_9-C_{14} Aliphatic [2-25% aromatic] hydrocarbon solvent substances are in paints and coatings, industrial solvents.

Exposure

The sources for potential environmental exposure to C_9-C_{14} Aliphatic [2-25% aromatic] Hydrocarbon Solvents Category substances could include releases from chemical and petroleum manufacturing/processing facilities, releases from facilities that use C_9-C_{14} Aliphatic [2-25% aromatic] Category substances, and releases from industrial products that include C_9-C_{14} Aliphatic [2-25% aromatic] Category substances.

The occupational exposure in a manufacturing facility would be expected to be relatively low because the process, storage and handling operations are confined by system containment.

Consumers in the general population are expected to be limited due to its infrequent and short-term exposures.