SIDS INITIAL ASSESSMENT PROFILE

Chemical Category	**C_{14}-C_{20} Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category**
Chemical Names and CAS Registry Numbers	**Substance Name** — **CAS Number** ***n-Paraffins Subcategory*** n-Tetradecane — 629-59-4 Pentadecane — 629-62-9 Hexadecane — 544-76-3 Paraffins, petroleum, normal C_{5-20} — 64771-72-8† Alkanes, C_{14-16} — 90622-46-1† Alkanes, C_{14-17} — 90622-47-2† ***Iso-Paraffins Subcategory*** Alkanes, $C_{13-16,}$ iso- — 68551-20-2† Distillates, petroleum, alkylate — 64741-73-7† ***Multi-constituent Subcategory*** Raffinates, petroleum, sorption process — 64741-85-1† Distillates, petroleum, solvent-refined middle — 64741-91-9† Distillates, petroleum, hydrotreated middle — 64742-46-7† Distillates, petroleum, hydrotreated light — 64742-47-8†
Structural Formula and CAS Registry Numbers	**Structural Formula** — **CAS Number** ***n-Paraffins Subcategory*** $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_{12}$-$\mathbf{C}H_3$ — 629-59-4 $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_{13}$-$\mathbf{C}H_3$ — 629-62-9 $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_{14}$-$\mathbf{C}H_3$ — 544-76-3 $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_8$-$\mathbf{C}H_3$ to CH_3-(CH_2)$_{16}$-CH_3 — 64771-72-8† $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_{12}$-$\mathbf{C}H_3$ to CH_3-(CH_2)$_{14}$-CH_3 — 90622-46-1† $\mathbf{C}H_3$-($\mathbf{C}H_2$)$_{12}$-$\mathbf{C}H_3$ to CH_3-(CH_2)$_{15}$-CH_3 — 90622-47-2† ***Iso-Paraffins Subcategory*** $\mathbf{C}H_3$ $\mathbf{C}H_3$ $\mathbf{C}H_3$-$\dot{\mathbf{C}}H$-$\mathbf{C}H_2$-$\dot{\mathbf{C}}H_2$-($\mathbf{C}H_3$)$_6$ $\dot{\mathbf{C}}H_3$ Various isomers of primarily C_{13}, C_{14}, C_{15}, and C_{16} alkyl-branched hydrocarbons — 68551-20-2† Various isomers of primarily C_{11}, C_{12}, C_{13}, $C_{14,}$ C_{15}, C_{16} and/or C_{17} alkyl-branched hydrocarbons — 64741-73-7† ***Multi-constituent Subcategory**** UVCB† substances containing aliphatic (linear, branched, and/or cyclic paraffins) molecules of carbon and hydrogen, predominantly in the C_{14} to C_{20} range — 64741-85-1†, 64741-91-9†, 64742-46-7†, 64742-47-8 Individual category member substances are comprised of aliphatic hydrocarbon molecules whose carbon numbers range between C14 and C20; approximately 80% of the aliphatic constituents for a given substance fall within the C14-C20 carbon range. * It should be noted that other substances defined by the same CAS RNs may have boiling ranges outside the range of 220-350 degrees Celsius 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 C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category contains some multi-constituent substances (UVCBs) that have a variable composition due to their chemistries and method of manufacturing. The substances in this category contain >99% hydrocarbons. The C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents typically contain < 2% aromatics; a few members contain up to 2% total aromatics (either one- or 2-ring molecules). Benzene is intentionally removed to levels less than 0.01% and sulfur and nitrogen compounds are removed by the refining process. 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 petroleum process streams with the same CAS numbers as those belonging to the C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category.

Identification of chemicals defined by processing procedures	Typical Carbon Number Range (%)										
	< C11	**C12**	**C13**	**C14**	**C15**	**C16**	**C17**	**C18**	**C19**	**C20**	**C21+**
n-Tetradecane (CAS RN 629-59-4)				>99							
Pentadecane (CAS RN 629-62-9)					>99						
Hexadecane (CAS RN 544-76-3)						>99					
Paraffins, petroleum, normal C5-20 (CAS RN 64771-72-8) Boiling Range ~35-345°C	~2		~10	~31	~25	~14	~9	~4			
Alkanes, C14-16 (CAS RN 90622-46-1)				~ 63	~ 28	~ 9					
Alkanes, C14-17 (CAS RN 90622-47-2)				~ 27	~ 50	~ 19	~ 3	~ 1			
Alkanes, C13-16, iso- (CAS RN 68551-20-2)	~ 1	~ 6	~ 13	~ 47	~ 32	~ 1					
Distillates, petroleum, alkylate (CAS RN 64741-73-7) Boiling Range ~205 - 320°C	~1	~3	~14	~38	~30	~14					
Raffinates, petroleum, sorption process (CAS RN 64741-85-1) Boiling Range ~35 - 400°C			~1	~3	~6	~9	~17	~20	~15	~11	~18

Distillates, petroleum, solvent-refined middle (CAS RN 64741-91-9) Boiling Range ~15 - 345°C			~1	~6	~8	~18	~24	~21	~11	~7	~4
Distillates, petroleum, hydrotreated middle (CAS RN 64742-46-7) Boiling Range ~ 205 - 400°C			~ 0.5	~ 3	~ 11	~ 19	~ 28	~ 25	~ 8	~ 5	~ 0.5
Distillates, petroleum, hydrotreated light (CAS RN 64742-47-8) Boiling Range ~150 - 290°C			~ 5	~ 29	~ 24	~ 18	~ 14	~ 7	~ 2	~ 1	

SUMMARY CONCLUSIONS OF THE SIAR

Category Definition/Justification

The C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category is comprised of 12 CAS registry numbers (CAS RNs) that are associated with pure and multi-constituent aliphatic hydrocarbon solvent commercial chemicals, which typically contain <2% aromatics with a few members containing up to approximately 2% total aromatics (toluene and xylene). Benzene is intentionally removed to levels less than 0.01% and sulfur and nitrogen compounds are removed by the refining process. Substances in the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category contain >99% hydrocarbons. Carbon (C) numbers and initial boiling points (IBPs) are typically used to physically characterize substances in this category. The constituent C numbers range primarily from 14 to 20. Although the CAS definitions for some category members suggest that a wider C number range exists, the narrower C_{14} to C_{20} range is confirmed by the distillation temperature for category members, which range from approximately 220 to 350°C (428 to 662°F) for the category.

Assignment of CAS RNs to hydrocarbon substances is generally based on a hierarchy of considerations including hydrocarbon type(s), carbon number and/or range, distillation temperature and/or range, and last processing step in the production process. One documented source of criteria for assignment of CAS RNs for multi-constituent hydrocarbon substances 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 differing hydrocarbon and petroleum-derived substances (hydrocarbon streams) with somewhat different compositions and applications (e.g., solvents, fuels, lubricants, etc.). Similarly, different CAS RNs can be applied to substances of similar composition and application.

Members in the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category are fully saturated hydrocarbons and have or are expected to have similar toxicokinetics, mammalian and ecological toxicological properties. No acute toxicity was noted at the limit doses, no irritation was noted in ocular or skin (semi-occlusive) irritation studies, minimal to no toxicity was noted in read-across studies for repeated dose and reproductive/developmental studies, and the substances (or read-across substances) were not mutagenic in *in vitro* and *in vivo* studies. In the environment, the toxic mode of action of the aliphatic constituents is non-polar narcosis, which results in disruption of the biological membrane. The critical body residue (CBR) is the internal concentration of a substance that causes adverse effects. Only substances with sufficient water solubility to reach the CBR will demonstrate toxicity. Category members do not demonstrate suitable water solubility to reach the CBR in acute and chronic aqueous exposure studies.

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.

Production of C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category is differentiated from other refinery streams such as gasoline and diesel fuel by additional processing steps leading to finished substances with narrower distillation ranges, removal of sulfur- and nitrogen-containing compounds, and low color. Category members (CAS RN 64741-85-1, 64741-91-9, 64742-46-7 and 64742-47-8) 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. However, linear C14 paraffin, n-tetradecane (CAS Registry Number (RN) 629-59-4), linear C15 paraffin, n-pentadecane (CAS RN 629-62-9), and linear C16 paraffin, n-hexadecane (CAS RN 544-76-3) have specific molecular formulas and so they are not considered UVCBs. 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 naphthenics (cyclics), and aromatics. The first three are mentioned when present in the substance at a level between 10 and 80%. Aromatics will be indicated as per the High Production Volume category and when present as a smaller fraction, identified at levels less than or greater than 2%.

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).

Based on structure and composition, the category has been divided into three subcategories to more accurately characterize member physico-chemical and environmental endpoints. Sub-categorisation was not needed for human health endpoints and therefore in the human health sections the whole category is evaluated. CAS RNs and a general description of compositions of subcategory members are as follows:

n-Paraffins Subcategory - 6 CAS RNs, three are composed of a single, normal paraffin

629-59-4	linear C_{14} paraffin, n-tetradecane
629-62-9	linear C_{15} paraffin, n-pentadecane
544-76-3	linear C_{16} paraffin, n-hexadecane
64771-72-8†	linear C_{5-20} paraffin, a complex combination of n-paraffins, paraffins, petroleum, normal C_{5-20}
90622-46-1†	a multi-constituent substance that can be composed predominantly of linear C_{14-16} normal paraffins, Alkanes C_{14-16}
90622-47-2†	a multi-constituent substance that can be composed predominantly of linear C_{14-17} normal paraffins, Alkanes C_{14-17}

Iso-Paraffins Subcategory - 2 CAS RNs, composed of a range of isoparaffins predominantly in the C_{13} to C_{16}, or C_{11} to C_{17} range

68551-20-2†	alkyl-branched C_{13} to C_{16} isoparaffin, Alkanes, C_{13-16}, iso-
64741-73-7†	a multi-constituent substance that can be composed predominantly of branched C_{11} through C_{17} isoparaffin isomers, Distillates, petroleum, alkylate

Multi-constituent Subcategory - 4 CAS RNs composed of paraffins predominantly in the C_{14} to C_{20} range with varying concentrations of normal paraffins, isoparaffins, and/or cycloparaffins, that can include members and constituents from the normal and isoparaffin subcategories

- 64741-85-1† raffinates, petroleum, sorption process
- 64741-91-9† distillates, petroleum, solvent-refined middle
- 64742-46-7† distillates, petroleum, hydrotreated middle
- 64742-47-8† distillates, petroleum, hydrotreated light

For the environment, ECOSAR and read-across approaches have been used to address and support the data gaps for the category members. The available toxicology data show that the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents have similar levels of toxic potency under a variety of experimental conditions.

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

The conclusions of this assessment do not necessarily apply to substances with the same CAS number but different purity/impurity profiles or compositions.

† Denotes a UVCB substance.

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 124-18-15; n-decane

CAS RN 1120-21-4; Undecane

CAS RN 112-40-3; n-dodecane

CAS RN 1921-70-6; pristane; (2, 6, 10, 14-tetramethylpentadecane, an iso- (branched) alkane)

CAS RN 64742-48-9; Hydrocarbons, C9-C11, n-alkanes, isoalkanes, cyclics, < 2% aromatics

CAS RN 90622-57-4; Hydrocarbons, C_{10}-C_{12}, isoalkanes, <2% aromatics

CAS RN 64741-65-7; Hydrocarbons, C10-C12, isoalkanes, < 2% aromatics

CAS RN 64742-48-9; Hydrocarbons, C10-C13, n-alkanes, isoalkanes, cyclics, < 2% aromatics

CAS RN 64742-47-8; Hydrocarbons, C12-C16, n-alkanes, isoalkanes, cyclics, < 2%

CAS RN 60908-77-2; Isohexadecane

CAS RN 8008-20-6; Jet-A and JP-8 (having a carbon range of 8-16 carbons)

CAS RN 64742-54-7; C20-C50 hydrotreated oil

CAS RN 52845-07-5; Iso-eicosane

CAS RN 64771-72-8; hydrocarbons, C10-C13, n-alkanes, <2% aromatics

CAS RN 93924-07-3; C10-C13, n-, iso-, cycloalkanes, <2% aromatics

The nine of the read-across substances form a physical-chemical continuum with the C_{14}-C_{20} Aliphatic [≤2% 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_{14}-C_{20} Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category.

The read-across candidates have comparable toxicities to those of the C_{14}-C_{20} Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category. Hydrocarbon absorption is inversely related to the number of carbon atoms; that is to say that the lower the number of carbons in a substance, the greater is its potential to be absorbed in the intestine. While hydrocarbon molecules in the range of C9 to C14 are absorbed from the intestinal tract, they are poorly absorbed through the skin. The C9 to C14 aliphatic hydrocarbons are orally absorbed at a greater rate than hydrocarbon molecules with C14 to C20. The read-across substances above are fully saturated hydrocarbons. Minimal to no toxicity was noted in read-across studies for repeated doses, reproductive/developmental studies, in *in vitro* and *in vivo* studies. Since no toxicity was observed in these substances, using a read-across strategy, substances in the C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category would be interpolated to have similar properties.

The Jet-A, Jet-8, and C20-C50 hydrotreated oil substances are wide cut hydrocarbon streams and are less refined than the hydrocarbon solvents. Typically, Jet-A, Jet-8, and C20-C50 hydrotreated oil contain more aromatics than the C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category and are not as severely refined. Test results from these substances could be considered a "worst-case" scenario when using the data to read-across to the C_{14}-C_{20} Aliphatic (≤2% aromatic) Hydrocarbon Solvents Category.

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

Analogue (CAS RN)	**Composition**	**Endpoint(s) Characterized**
124-18-5	n-decane	*In vivo* mutagenicity Reproductive toxicity

112-40-3	n-dodecane	*In vivo* mutagenicity
1120-21-4	n-undecane	Reproductive toxicity
1921-70-6	2, 6, 10, 14-tetramethylpentadecane	Toxicokinetics, metabolism, and distribution
8008-20-6	Jet A, JP8, JP(100)	Acute toxicity (dermal) Reproductive toxicity (oral)
60908-77-2	Isohexadecane	Acute toxicity (oral) Irritation (dermal, eye) *In vitro, in vivo* mutagenicity
52845-07-5	iso-eicosane	Irritation (dermal)
64742-54-7	C20-C50 hydrotreated oil	Repeat dose toxicity (inhalation)
64741-65-7	hydrocarbons, C10-C12, isoalkanes, <2% aromatics	Subchronic toxicity (inhalation)
64771-72-8	hydrocarbons, C10-C13, n-alkanes, <2% aromatics	*In vivo* mutagenicity
64742-48-9	hydrocarbons, C9-C11, n-alkanes, isoalkanes, cyclics, <2% aromatics	*In vivo* mutagenicity
93924-07-3	C10-C13, n-, iso-, cycloalkanes, <2% aromatics	*In vivo* mutagenicity
90622-57-4	C_{10}-C_{12}, isoalkanes, <2% aromatics	Acute fish and invertebrate toxicity Alga toxicity Biodegradation *In vivo* mutagenicity

Substances in the C_{14}-C_{20} Aliphatic Hydrocarbon [≤2% aromatics] Solvents Category can be composed of a single chemical or a range of hydrocarbons that can include n-paraffinic, isoparaffinic, and/or cycloparaffinic (naphthenic) structures that fall predominantly within a C number range of 14 to 20. As a result, some category member's physicochemical properties can be characterized by a range of values as a function of composition because a single value is not possible. For example, a multi-constituent hydrocarbon substance will not exhibit a single P_{ow} value, but rather a range based on its 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 some 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 from C_{14} to C_{20} (see the following list). Chemicals with single multi-carbon chains and/or multiple methyl groups were chosen to provide the most comprehensive range of expected values.

Chemical Name	**CAS RN**
n-tetradecane	629-59-4
n-pentadecane	629-62-9
n-hexadecane	544-76-3
n-octadecane	593-45-3
eicosane	112-95-8
2,5,6,9-tetramethyldecane	n/a

2,5,8-trimethyl-tridecane	n/a
2,5,6,9,11-pentamethyl-tridecane	n/a
2,3,6,7-tetramethyldecalin	n/a
1,6-di-n-propyldecalin	n/a
1,6-di-n-pentyldecalin	n/a

n/a = not available

Physical-chemical Properties

The members of the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents [≤2% aromatics] Category are liquids at room temperature. The melting point values range from -42 to -69 ^{o}C. The boiling points range from 170 to 335 ^{o}C. The vapor pressure values range from <0.001 to 0.78 hPa at 25 ^{o}C. Water solubility values range from <0.001 to 0.13 mg/L (at 25 ^{o}C) with a relative density range of 0.70 to 0.86 g/cm^3 (at 15 to 20 ^{o}C). The log K_{ow} values for the category members range from 5.9 to 10.2 (at 25 ^{o}C). Physical-chemical properties for category members include both measured and calculated values.

Human Health

Toxicokinetics, Metabolism, and Distribution

It is estimated that ~ 50% (37% - 61%) of a C14-C20 hydrocarbon solvent would be absorbed when ingested. C14-C20 aliphatic, <2% 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. This is supported in repeated dose studies with analogue substances (see table above) where hypertrophy of the liver was observed; this is an adaptive change in order to metabolize the test material.

There have not been any *in vivo* dermal absorption studies of C14 - C20 aliphatic, <2% aromatic hydrocarbon fluids, but there have been *in vitro* studies of similar constituents, including one category member, hexadecane (CAS RN 544-76-3). Dermal absorption of hexadecane was determined to be only 0.18% of the applied dose; other constituents are expected to have similarly low dermal absorption rates.

Acute Toxicity Summary

The available acute toxicity data demonstrate that hydrocarbon solvent substances tested in the C14-C20 Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category did not demonstrate acute toxicity at the limit dose by the oral, dermal, and inhalation routes of exposure.

Acute Inhalation Toxicity

Acute inhalation LC_{50} values in rats for C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) (C14-C16 n-Paraffins, CAS RN 90622-46-1) ranged from >5266 to >5800 mg/m^3 (aerosol, the highest achievable concentration). Concentrations were dependent on the inherent physical-chemical properties of the test material, e.g., volatility, thus limiting the study design to the maximum achievable saturated vapor/aerosol concentration.

Acute Dermal Toxicity

Three acute dermal toxicity studies were conducted on commercial C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) products. All studies were conducted similarly to OECD TG 402 without GLP compliance. The dermal LD_{50} in rabbits was greater than 2000 mg/kg bw (Hydrocarbons, C14-C17, n-alkanes, <2% aromatics, CAS RN 90622-47-2; C14-C16 n-Paraffins, 90622-46-1). No data were available for the other subcategories.

Acute Oral Toxicity (gavage administration)

The acute 14-day, single dose, oral gavage, toxicity studies were conducted in rats on commercial C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics). The LD_{50} results of the oral studies in rats ranged from >5.0 to 36.0 g/kg bw (CAS RN 90622-46-1, 64771-72-8, and 60908-77-2). However, these C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) products may be an aspiration hazard based on their viscosities. Chemicals with a viscosity of <20.5 mm^2/sec at 40^{o}C should also be considered an aspiration hazard (the accidental inhalation of fluids into the lungs).

Irritation and Sensitisation

Irritation studies were conducted in rabbits on commercial C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) (CAS RN 64742-47-8, 64742-46-7, 90622-47-2, 60908-77-2 (analogue), 90622-46-1, and 52845-07-5 (analogue)). In dermal irritation tests, the average erythema score (24, 48, 72 hours) results were 0.0 to 1.11, but generally below 1.0. The average edema score (24, 48, 72 hours) results were 0.0 to 1.0, but generally 0.0, suggesting that these solvents produce no to minimal irritation to rabbit skin. One study (CAS 90622-46-1) used a prolonged 24 hour exposure and an occlusive dressing. The average erythema score (24, 48, 72 hours) of 3.0 and the average edema score (24, 48, 72 hours) of 1.4 indicate that under prolonged, occluded exposure, hydrocarbons can display an irritancy potential. One study examined the relative irritancy potential of n-tetradecane (CAS RN 629-59-4), n-pentadecane (CAS RN 629-62-9), and n-hexadecane (CAS RN 544-76-3). This study used an occlusive dressing and a 96 hour continuous exposure; under these conditions n-tetradecane was the most irritating substance. Due to the occlusive nature of the dressing, these conditions are not anticipated to be encountered outside of experimental settings.

Several eye irritation studies were conducted in rabbits on commercial C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) (CAS RN 64742-47-8, 90622-47-2, 90622-46-1and 60908-77-2 [analogue]). The average conjunctivae score (24, 48, 72 hours) results were 0.0 to 0.33. The average chemosis score (24, 48, 72 hours) results were 0.0 to 0.1; 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.

Seven studies were available on the irritation and/or sensitisation potential of several types of hydrocarbon solvents in human volunteers (n-alkane UVCB substances: 64771-72-8; n-alkane, iso-alkane, and cyclic alkane UVCB substances:CAS RN: 64742-47-8 and 64742-46-7). Clinical tests were conducted with populations ranging from 24 to 112 patients. N-alkanes did not cause a sensitisation or irritation effect; the mixed aliphatics did not cause a sensitisation or irritation effect. Based on these data, the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) substances are not expected to be sensitizers or skin irritants.

Mild irritation was noted at 75% concentration of Paraffins, petroleum, normal C_{5-20} (CAS RN 64771-72-8; alternative name C14-C17, n-alkane <2% aromatics) under occlusive conditions; one volunteer had a minimal reaction on rechallenge, but when retested, did not develop any reaction. Under occlusive conditions at ≥75%, the Paraffins, petroleum, normal C_{5-20} was determined to be a mild skin irritant. No irritation or sensitisation was noted in a 21-day cumulative patch test on human volunteers when Paraffins, petroleum, normal C_{5-20} (CAS RN 64771-72-8) was applied at 25% concentration under occlusive conditions. Hydrocarbons, C14-C18, n-alkanes, isoalkanes, cyclics, <2% aromatics (CAS RN: 64742-47-8) tested using an occlusive patch at 75% w/w, demonstrated some irritation potential, but did not demonstrate any sensitization potential in the volunteers. When evaporation is prevented through the use of occlusive dressings, the physical properties of the dermis are altered and hydrocarbons can display an irritancy potential. However, this scenario is unlikely to occur during normal use of hydrocarbons.

Based on the data presented above, the category members are not expected to be eye irritants; the category members are not expected to cause skin irritation 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.

Repeated Dose Toxicity (Inhalation)

No inhalation repeated dose studies were located for the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category. Using a read-across approach, a repeated dose inhalation study was conducted in a C9-C14 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category substance. Hydrocarbons, C10 - C12, isoalkanes, < 2% aromatics (CAS RN 64741-65-7, analogue) was administered via inhalation to rats at concentrations of 0, 2600, 5200 or 10400 mg/m^3 (vapor) for 6 hours/day; five days/week for 13 weeks (similar to OECD TG 413). No adverse effects were observed at 10400 mg/m^3. Based on these observations, the repeat inhalation concentration NOAEC is 10400 mg/m^3 (10.4 mg/L) for C9-C14 aliphatic, < 2% aromatic hydrocarbon fluids.

In a second study, data on a C20-C50 hydrotreated oil (CAS RN 64742-54-7; average carbon number C35, analogue) can be used as read-across to demonstrate minimal toxicity at the upper bound carbon number range. A C20-C50 hydrotreated oil (HO) with 2.4% aromatics is a less refined UVCB than the C14-C20 Aliphatic, ≤ 2% Aromatics Hydrocarbon Solvents and showed minimal toxicity in rats at exposures up to 1000 mg/m^3, aerosol (MMAD 1.1 + 0.1 µm; GSD 1.9 + 0.1). The exposure was conducted for 28 days at aerosol concentrations at 0, 50, 210 or 1000 mg/m^3 for 6 hours per day, 5 days per week (similar to OECD TG 412). The only treatment-related changes were increased lung weight and an increased in associated lymph

nodes weight. Increases in lung weights may have been related to the increased numbers of alveolar macrophages and other cells and/or the presence of residual oil. These findings are consistent with other published studies that showed a progressive accumulation of alveolar macrophages as a result of an increased deposition of aerosolized oil particles. The authors of this paper concluded that the NOEC (No Observed Effect Concentration) was 220 mg/m^3 (analytical) based on the accumulation of macrophages in the lungs; the systemic NOAEC was determined to be 980 mg/m^3 (analytical) based on the lack of any observed systemic toxicity. Mild accumulation of alveolar macrophages is not expected to be an adverse effect in a C14-C20 Aliphatic, ≤ 2% Aromatics Hydrocarbon Solvent due to their lower carbon number, molecular weight, and higher vapor pressure and expected metabolism; these physical-chemical properties would result in increased clearance from the lungs. This study was included to demonstrate the lack of systemic toxicity of higher molecular weight and less refined UVCBs. Based on the read-across data and a weight of evidence approach, substances in the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category are expected to have minimal systemic inhalation toxicity.

Repeated Dose Toxicity (Oral)

No oral repeated dose studies were located for the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category. One available read-across study from the structurally analogous test material Hydrocarbons, C10-C13, n-alkanes, isoalkanes, cyclics, < 2% aromatics (CAS RN 64742-48-9, analogue) was analyzed. All tests were performed in a manner similar or equivalent to currently established OECD TG 408. Exposures were conducted for 90 days by oral gavage in rats at concentrations of 5000 mg/kg bw/day (actual ingested), 2500 mg/kg bw/day (actual ingested), or 500 mg/kg bw/day (actual ingested). Several changes were noted in clinical chemistry, hematological, and organ weights; these effects were considered to be adaptive in response to the administration of the test material and were not considered to be biologically adverse. Except for the α2μ-globulin effects noted in the kidneys in male rats, all effects were reversible in the recovery group. Nephropathy due to α2μ-globulin is a phenomenon well documented in male rats that are exposed to hydrocarbons; it is not relevant to human health. The systemic NOAEL was determined to be higher than 5000 mg/kg bw/day in rats.

No data were available on neurotoxicity.

Based on the analogue data above, the C14-C20 Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category members are expected to have similar or lower toxicity via the oral route than the analogue substances due to predicted lower absorption.

Mutagenicity

Materials in the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) were evaluated in several *in vitro* genotoxicity assays. The results of the Ames Reverse Mutation Assays (OECD TG 471) using the test materials: Hydrocarbons, C14-C18, n-alkanes, isoalkanes, cyclics, <2% aromatics (CAS RN 64742-47-8), Isohexadecane (CAS RN 60908-77-2), and C14-C17, n-alkanes <2% aromatics (CAS RN 64771-72-8) were negative both with and without metabolic activation. An *in vitro* mammalian chromosome aberration test (OECD TG 473), conducted with the structurally analogous test material, Hydrocarbons, C12-C16, n-alkanes, isoalkanes, cyclics, < 2% (CAS RN 64742-47-8, analogue), was negative with and without metabolic activation.

There were no *in vivo* mutagenicity studies located for materials in the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category. However, substances in the C9-C14 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category were evaluated in a mouse micronucleus assay and in a dominant lethal assay. The substance Hydrocarbons, C10-C12, isoalkanes < 2% aromatics (CAS RN 90622-57-4, analogue) was found to be not genotoxic in a dominant lethal assay up to 900 ppm (inhalation) (OECD TG 478). Similarly, Hydrocarbons, C9-C11, n-alkanes, isoalkanes, cyclics, < 2% aromatics (CAS RN 64742-48-9, analogue) was not genotoxic in a dominant lethal assay up to 900 ppm (inhalation) (OECD TG 478, analogue). The read-across test materials, Hydrocarbons, C10-C13, n-alkanes, < 2% aromatics (CAS RN 64771-72-8) and Hydrocarbons, C10-C13, n-alkanes, isoalkanes, cyclics, < 2% aromatics (CAS RN 64742-48-9, analogue), were not clastogenic in two micronucleus assays (OECD TG 474). DNA adduct formation was not observed in an *in vivo* study conducted using the read-across test materials n-decane (CAS RN 124-18-15, analogue) and n-dodecane (CAS RN 112-40-3, analogue).

As there was no evidence of clastogenicity or genotoxicity in any of the assays, based on a weight of evidence approach, substances in the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category are not expected to be genotoxic.

Reproductive and Developmental Toxicity

There are no studies for reproductive effects conducted with C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Solvents Category products; however, there are data available in three read-across substances; decane, undecane, and JP-8 fuel. A C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category product was tested for developmental toxicity.

There are two reproductive studies available on products from the read-across material from the C9-C14 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics). Undecane (CAS RN 1120-21-4, analogue) was examined in rats in a one generation reproduction study. No effects to reproductive performance or to developmental endpoints were observed at the highest dose tested (NOAEL =1000 mg/kg bw/day). A Combined Repeated Dose Toxicity Study with the Reproduction / Developmental Toxicity Screening Test similar to OECD TG 422 was conducted using decane (CAS RN: 124-18-5, analogue). No effects to reproductive performance or to developmental endpoints were observed at the highest dose tested; the NOAEL = 1000 mg/kg bw/day.

Lower carbon chain molecules are predicted to be absorbed to a greater extent than higher carbon chain molecules when administered orally; decane and undecane are predicted to be absorbed approximately 72 to 77%. It is estimated that ~ 50% (37% - 61%) of a C14-C20 hydrocarbon solvent would be absorbed when ingested. Since the studies for decane and undecane demonstrated no reproductive toxicity and were absorbed to a greater extent than the C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Solvents Category products, substances in this category are unlikely to cause reproductive toxicity.

The read-across test material JP-8(CAS RN: 8008-20-6, analogue) was examined in two, one-generation reproduction studies. JP-8 is a UVCB with an aliphatic carbon range of C8-C16 and may contain up to 25% aromatics.

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 C8-C16, 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 by gavage at 0, 325, 750 or 1500 mg/kg bw/day with neat JP-8 (CAS RN: 8008-20-6; an aliphatic carbon range of C8-C16, aromatics ≤25%) for a total of 21 weeks (90-day plus mating with naive males, gestation and lactation periods) 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 C14-C20 Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category product was tested for developmental toxicity and showed no evidence of causing embryonic or teratogenic effects in rats. Hydrocarbons, C16-C20, n-alkanes, isoalkanes, cyclics, <2% aromatics (CAS RN 64742-46-7) were studied in rats in a Prenatal Developmental Toxicity Study (OECD TG 414). The maternal systemic toxicity NOAEL = 1000 mg/kg bw/day; the developmental toxicity NOAEL = 1000 mg/kg bw/day, the highest dose tested.

In summary, no developmental effects were observed in the category member at the highest dose tested (1000 mg/kg bw/day). No effects to fertility were noted in the read-across substances decane, undecane, and JP-8 fuel up to 3000 mg/kg bw/day. Based on this data, the C14-C20 Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category members are not expected to be reproductive or developmental toxicants.

Carcinogenicity

No carcinogenicity studies for C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category members were located in the scientific literature.

The C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤ 2% Aromatics) Category substances may possess properties indicating hazard for human health (aspiration and possible skin defatting with repeated exposure). 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_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category have a low potential to

volatilize from surface waters, based on Henry's Law constants (HLC) representing volatility for category members that range from 1.8 x 10^4 to 4.6 x 10^6 Pa-m^3/mole. In the air, category members have the potential to degrade through indirect photolytic processes mediated primarily by hydroxyl radicals ($^{\bullet}$OH) with calculated degradation half-lives ranging from 3.8 to 7.6 hours or 0.31 to 0.63 days, based on a 12-hr day and a $^{\bullet}$OH concentration of 1.5 x 10^6 $^{\bullet}$OH/cm^3. These chemicals are unlikely to degrade by hydrolysis as they lack a functional group that is hydrolytically reactive.

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-paraffins sub-category members have the potential to biodegrade rapidly based on results that support their characterization as readily biodegradable. In comparison, members of the iso-paraffins subcategory are expected to demonstrate a slower rate of biodegradation based on results for one of the multi-constituent isoparaffinic substances, which was shown not to be readily biodegradable, but did demonstrate a moderate extent of biodegradation (25%) over an extended period of time (37 days). Multi-constituent subcategory members are not expected to be readily biodegradable.

Mackay Level III fugacity modeling indicates that category member constituents partition mostly to the sediment and soil compartments 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 or soil compartment, members are indicated by the model to partition largely to the compartment to which they are released. When release occurs only to the water compartment, members are indicated in the modeling to partition to the soil and sediment compartments.

When released primarily to the air compartment, the primary mode of removal would be via 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.

Category members are expected to sorb to organic matter in soil, sediment, and wastewater solids based on log K_{oc} values ranging from 5.1 to 8.8. Category members have a potential to bioaccumulate, based on measured and calculated BCF values (based on the GHS criteria of >500). 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 in aquatic organisms. 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.

Sufficient data are available to characterize the fish, invertebrate, and algae acute toxicity of the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents [≤2% aromatics] Category. Category members are not expected to exhibit acute toxic effects to aquatic organisms at or below the limit of water solubility. High treatment loading water-accommodated-fractions from substances in this category, as well as analogue substances from the C_9-C_{14} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category, fail to cause acute mortality and/or effects to both freshwater and marine fish, invertebrates, and algae (at nominal loadings >1000 mg/l). Chronic studies with a substance in the C10-C12 isoparaffinic range indicated an effect (NOEC = 0.025mg/l), but isoparaffins in the C11-C13 range did not. In chronic invertebrate studies, no effects were observed up to 1 and 5 mg/l (highest loading tested) for the C11-C13 and C13-C16 carbon ranges (CAS RN: 90622-58-5, 64742-47-8) respectively. The lack of acute or chronic aquatic toxicity, for the C14-C20 carbon range, is likely due to the low water solubility of their constituent chemicals.

Chemicals in this category do not possess properties indicating a hazard for the aquatic pelagic environment (no observed acute or chronic toxicity at the limit of water solubility). Category members have a potential to bioaccumulate. n-Paraffin category members are readily biodegradable, while isoparaffinic and multi-constituent members are not. Adequate screening-level data are available to characterize the environmental hazard for the purposes of the 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_{14}-C_{20} hydrocarbon solvents:

- n-Tetradecane, CAS RN 629-59-4: 4500-22,500 metric tons (10 million to < 50 million pounds)
- Pentadecane, CAS RN 629-62-9: 450-4500 metric tons (1 million to < 10 million pounds**)**
- Hexadecane, CAS RN 544-76-3: 450-4500 metric tons (1 million to < 10 million pounds**)**
- Paraffins, (petroleum), normal C5-20, CAS RN 64771-72-8: 45,000-225,000 metric tons (100 to <500 million pounds) †
- Alkanes, C_{14}-$_{16}$, CAS RN 90622-46-1: 4500-22,500 metric tons (10 million to < 50 million pounds) †
- Alkanes, C_{14}-$_{17}$, CAS RN 90622-47-2: No data†
- Alkanes, C_{12}-$_{14}$, CAS RN 129813-67-8: No data†
- Alkanes, C_{12}-$_{14}$-iso-, CAS RN 68551-19-9: 450-4500 metric tons (1 million to < 10 million pounds**)** †
- Alkanes, C_{13}-$_{16}$-iso-, CAS RN 68551-20-2: 450-4500 metric tons (1 million to < 10 million pounds**)** †
- Distillates, (petroleum), alkylate, CAS RN 64741-73-7: 450,000 or greater metric tons (1 billion pounds or greater) †
- Raffinates, (petroleum), sorption process, CAS RN 64741-85-1: 450,000 or greater metric tons (1 billion pounds or greater) †
- Distillated, (petroleum), solvent-refined middle, CAS RN 64741-91-9: 45,000-225,000 metric tons (100 to <500 million pounds) †
- Distillates, (petroleum), hydrotreated middle, CAS RN 64742-46-7: 450,000 or greater metric tons (1 billion pounds or greater) †
- Distillates, (petroleum), hydrotreated light, CAS RN 64742-47-8: 450,000 or greater metric tons (1 billion pounds or greater) †

† Denotes a UVCB substance.

Use

Hydrocarbon solvents in the C_{14}-C_{20} range with aromatic contents of less than or equal to 2% have relatively low volatility and are odorless. They are sold for many uses, i.e., ink oils, consumer substances, mineral seal oil, and as light lubricants. The predominant commercial uses of C_{14}-C_{20} aliphatic ≤2% aromatic hydrocarbon solvent substances are in lubrication, ink transfer, insecticide carrier base, and specialized metalworking solvents. This information is based on a survey of the industry sponsors and represents the commercial applications in which these products are sold, which includes the US, European and Japanese markets. Further information was not available.

Exposure

The sources for potential environmental exposure to C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category substances could include releases from chemical and petroleum manufacturing/processing facilities, releases from facilities that use C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category substances, and releases from industrial products that include C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category substances.

Hydrocarbon solvents in the C_{14}-C_{20} Aliphatic Hydrocarbon Solvents (≤2% aromatics) Category are generally used in coatings, cleaning agents, agricultural chemicals, fuel, lubricants, and functional fluids. Exposure includes occupational exposure and consumer use.