2-Ethyl-1-Hexanol (CAS #104-76-7) GreenScreen™ Assessment

Prepared for:

GreenScreen™ Training

October 26, 2012

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GreenScreen™ Assessment for 2-Ethyl-1-Hexanol (CAS #104-76-7)

GreenScreen™ Version 1.2 Draft Assessment
Note: Validation Has Not Been Performed on this GreenScreen™ Assessment

Chemical Name: 2-Ethyl-1-hexanol

CAS Number: 104-76-7

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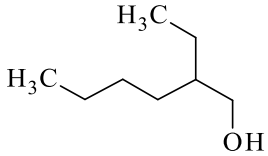
Date: October 26, 2012

Confirm application of the *de minimus* rule[1]: N/A

Chemical Structure(s):



Identify Applications/Functional Uses:
1. Solvent (ESIS 2000)
2. Plasticizer (ESIS 2000)

GreenScreen™ Summary Rating for 2-Ethyl-1-Hexanol[2]: ToxServices assigned a GreenScreen™ Benchmark Score of 2 to 2-ethyl-1-hexanol based on Moderate Developmental Toxicity (D). This corresponds to GreenScreen™ benchmark classification 2e in CPA 2011a. Data gaps (dg) exist for Reproductive Toxicity (R), Endocrine Activity (E), Neurotoxicity (N) (not listed, but not tested), and Respiratory Sensitization (SnR). As outlined in CPA (2011c) Section III(1)(Benchmarking Chemicals With Data Gaps), 2-ethyl-1-hexanol meets the requirements for a GreenScreen™ Benchmark Score of 2, despite the hazard data gaps. In a worst-case scenario, if 2-ethyl-1-hexanol were assigned a High score for E, it would become a GreenScreen™ Benchmark 1 chemical.

Figure 1: GreenScreen™ Hazard Ratings for 2-Ethyl-1-Hexanol

Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
L	**L**	*dg*	**M**	*dg*	**M**	*dg*	**L**	*dg*	*dg*	**L**	*dg*	**M**	**H**	**M**	*L*	*vL*	*vL*	*L*	**M**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values and lower confidence. Hazard levels in **BOLD** font reflect values based on test data (See Guidance).
Note: Please see Appendix A for a glossary of hazard acronyms.

[1] Every chemical in a material or formulation should be assessed if it is:
1. intentionally added and/or
2. present at greater than or equal to 100 ppm

[2] For inorganic chemicals with low human and ecotoxicity across all hazard endpoints and low bioaccumulation potential, persistence alone will not be deemed problematic. Inorganic chemicals that are only persistent will be evaluated under the criteria for Benchmark 4.

Transformation Products and Ratings:
Identify relevant fate and transformation products (i.e., dissociation products, transformation products, valence states) **and/or moieties of concern**[3]

Functional Use	Life Cycle Stage	Transformation Pathway	Transformation Products	CAS #	On CPA Red List[4]?	GreenScreen™ Rating[5]
n/a	**End**	Combustion	Carbon Monoxide	**630-08-0**	**Y**	**n/a**
n/a	**End**	Combustion	Carbon Dioxide	**124-38-9**	**N**	**n/a**

Introduction

2-Ethyl-1-hexanol is an alcohol that is a colorless liquid at room temperature with a slighty floral odor. 2-Ethyl-1-hexanol is used as a solvent for dyes, oils and resins as well as a plasticizer for PVC resins and a wetting agent. It can be manufactured by the hydrogenation of 2-ethyl-1-hexenal (HSDB 2003).

ToxServices assessed 2-ethyl-1-hexanol against GreenScreen™ Version 1.2 (CPA 2011a) following procedures outlined in ToxServices' SOP 1.37 (GreenScreen™ Hazard Assessment) (ToxServices 2012).

GreenScreen™ List Translator Screening Results

The GreenScreen™ List Translator identifies specific authoritative or screening lists that should be searched to identify GreenScreen benchmark 1 chemicals (CPA 2012). Pharos (2012) is an online list-searching tool that is used to screen chemicals against the List Translator electronically. The output indicates benchmark or possible benchmark scores for each human health and environmental endpoint. The output for 2-ethyl-1-hexanol can be found in Appendix B and a summary of the results can be found below:

- German FEA - Substances Hazardous to Waters (VwVwS): Hazard to Waters (Water Hazard Class 2)

PhysioChemical Properties of 2-Ethyl-1-Hexanol:

Table 1: Physical and Chemical Properties of 2-Ethyl-1-Hexanol

Property	Value	Reference
Molecular formula	$C_8H_{18}O$	ESIS 2000
SMILES Notation	CCCCC(CC)CO	
Molecular weight	130.2	ESIS 2000
Physical state	Liquid	ESIS 2000
Appearance	Colorless	HSDB 2003
Melting point	-70°C	ESIS 2000
Vapor pressure	0.144 hPa @ 20°C	ESIS 2000
Water solubility	1 g/L @ 20°C	ESIS 2000
Dissociation constant	N/A	
Density/specific gravity	0.83	ESIS 2000
Partition coefficient	2.28	ESIS 2000

[3] A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.
[4] The CPA "Red List" refers to chemicals: 1). flagged as Benchmark 1 using the GreenScreen™ List Translator, or 2). flagged as Benchmark 1 or 2 using the GreenScreen™ List Translator and further assessed and assigned as Benchmark 1. The most recent version of the GreenScreen™ List Translator should be used (CPA 2011b).
[5] GreenScreen™ reviews of transformation products depends on the GreenScreen™ Benchmark Score of the parent chemical (See Guidance).

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M or L): L
2-Ethyl-1-hexanol was assigned a score of Low for carcinogenicity based on no evidence of carcinogenic effects following two-year and eighteen month carcinogenicity studies, as well as not being classifiable as a GHS (2011) carcinogenic compound.

- Not listed as a known carcinogen by IARC, NTP, U.S. EPA, or CA Prop 65.
- ESIS 2000 –
    - A GLP compliant 2 year chronic toxicity/carcinogenicity assay (method not reported) was conducted using male and female Fischer 344 rats (50/sex/group). Rats were administered doses of 0, 50, 150, and 500 mg/kg of the test substance (99.8% purity) via oral gavage (vehicle: 0.005% aqueous cremophor EL) for 2 years. 2-Ethylhexanol was not carcinogenic under the tested conditions. In both sexes the sum of primary tumors, malignant tumors, and benign tumors was lower than the control groups.
    - A GLP compliant 18 month chronic toxicity/carcinogenicity assay (method not reported) was conducted using male and female $B6C3F_1$ mice (50/sex/group). Mice were administered doses of 0, 50, 200, and 750 mg/kg of the test substance (99.8% purity) via oral gavage for 18 months. 2-Ethylhexanol was not carcinogenic in the mouse. A slight increase in tumors occurred when compared to the control group dosed with the emulsion vehicle. However, this increase was not significant when compared to the control group dosed with water. No significant increases occurred in male rats. 2-ethylhexanol was reported as not carcinogenic under the tested conditions by study authors.
- 2-Ethyl-1-hexanol is not classifiable as a GHS (2011) carcinogenic compound as not increases in neoplasms were identified following a two-year carcinogenicity assay or an 18 month carcinogenicity assay.

Mutagenicity/Genotoxicity (M) Score (H, M or L): L
2-Ethyl-1-hexanol was assigned a score of Low for mutagenicity based on negative results for mutagenicity and clastogenicity both *in vivo* and *in vitro*.

- ESIS 2000 –
    - Multiple Ames bacterial reverse mutation assays were identified for 2-ethylhexanol utilizing *Salmonella typhimurium* tester strains TA98, TA100, TA1535, TA1537, and TA1538 at concentrations of up to 5,000 µg/plate, with and without metabolic activation. 2-ethylhexanol was reported as negative for mutagenicity under all tested conditions.
    - A (GLP status not reported) bacterial gene mutation assay utilizing *Bacillus subtilis* tester strain H17/M45 was conducted at concentration of up to 500 µg/plate. 2-ethylhexanol was reported as negative for mutagenicity under the tested conditions. No further details were provided.
    - A GLP compliant HGPRT assay (method not reported) was conducting using Chinese Hamster Ovary (CHO) cells at concentrations of up to 400 nl/ml (purity not reported) with and without metabolic activation. 2-ethylhexanol was reported as negative for mutagenicity under the tested conditions by study authors.
    - A GLP compliant mouse lymphoma assay (method not reported) was conducted utilizing L5178Y TK +/- cells at concentrations up to 0.24 µl/ml (> 99.7% purity) in the presence and absence of metabolic activation. 2-Ethylhexanol was reported as negative for mutagenicity under the tested conditions by study authors.
    - A GLP compliant *in vivo* cytogenetic assay (method not reported) was conducted using male Fischer 344 rats (5/group). Rats were administered doses of 0.01, 0.07 and 0.21 ml/kg (> 99.7% purity) for 5 days. No significant increases in chromatid and chromosome breaks or structural rearrangements were reported. 2-ethylhexanol was reported as negative for clastogenicity under the tested conditions by study authors.
    - A GLP compliant *in vivo* dominant lethal assay (method not reported) was conducted using male and female ICR mice (number not reported). Mice were administered doses of 0, 250, 500, and 1,000 mg/kg (> 99.7% purity) for 5 days. The fertility indices and average number of dead and total implants per pregnancy were within normal ranges. 2-ethylhexanol was reported as negative for genotoxicity under the tested conditions.

Reproductive Toxicity (R) Score (H, M, or L): dg

- No relevant data were available for 2-ethyl-2-hexanol.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M or L): M

2-Ethyl-1-hexanol was assigned a score of Moderate for developmental toxicity based on being categorized as a GHS Category 2 reproductive toxicant.

- ESIS 2000 –
    - A GLP compliant developmental toxicity study (87/302/EEC) was conducted using female Wistar rats (10/group). Rats were administered doses of 0, 130, 650, and 1,300 mg/kg via oral gavage on gestation days 6 through 15. At 1,300 mg/kg significantly reduced food consumption was reported in all parental dose groups. Severe clinical symptoms were observed including abdominal or lateral position, unsteady gait and apathy. Discoloration of the liver, lung edema, and emphysema were also reported in parental animals of the top dose group. An increased number of resorptions and markedly increased post implantation loss, along with increased resportions, decreased fetal body weights and increased incidence of fetuses with dilated renal pelvis and/or skeletal malformations. At 650 mg/kg the only reported maternal effects were two dams with piloerection. Pups displayed a reduction in mean fetal body weights and increased frequency of fetuses with skeletal variations and retardations. At 130 mg/k no substance related effects were reported. Based on available data, ToxServices established a NOAEL and LOAEL of 130 and 650 mg/kg due to reduced fetal body weights and increased skeletal variations in pups.
    - A (GLP status not reported) developmental toxicity study (method not reported was conducted using female Wistar rats (number not reported). Rats were administered doses of 0, 833, and 1,666 mg/kg of the test substance (purity not reported) on day 12 of gestation. At 833 mg/kg slight increases (2%) in malformed fetuses were reported). At 1,666 mg/kg mean fetal body weights were reduced (22%) and increased fetal malformation were observed including hydronephrosis (7.8%), tail anomalies (4.9%), and anomalies of the extremities (9.7%). Based on available data, ToxServices established a NOAEL and LOAEL of 833 and 1,666 mg/kg.
    - A GLP compliant developmental toxicity study (method not reported) was conducted using female CD-1 mice (n=50). Mice were administered does of 0 and 1,525 mg/kg on days 7 through 14 of gestation. Results from this test are not applicable to the developmental toxicity endpoint. One dose was administered, which resulted in severe maternal toxicity including the death of ~30% of the test animal. Due to severe maternal toxicity the results of this study are not relevant as it is not possible to determine if toxic effects are primary, or secondary to maternal toxicity.
    - A GLP compliant developmental toxicity study (method not reported) was conducted using female F344 rats (25/group). Rats were exposed to 0, 252, 840, and 2,520 mg/kg (> 99.7% purity) via occluded cutaneous application on days 6 to 15 of gestation. No developmental toxicity or increased incidence of malformation was reported at any dose. A NOAEL of > 2,250 mg/kg was reported for developmental toxicity by the study authors. No further details were available.
    - A (GLP status not reported) developmental toxicity study (method not reported) was conducted using female Sprague-Dawley rats (number not reported). Rats were exposed to concentrations of 0, and 0.85 mg/L of the test substance (> 99% purity) via inhalation on days 1 to 19 of gestation. 2-Ethylhexanol reduced maternal feed intake. No fetal toxicity or increased malformations were reported. A NOAEL of 0.850 mg/L was established by the study authors. No further details were available.
- Based on data in Wistar rats from a GLP compliant study following EEC guidelines, a significant increase in pup body weights and skeletal variations occurred in the absence of significant maternal toxicity. Therefore, following GHS (2011) criteria, ToxServices categorized 2-ethyl-1-hexanol as a GHS category 2 reproductive toxicant.

Endocrine Activity (E) Score (H, M or L): dg

2-Ethyl-1-hexanol has been assigned a data gap for endocrine activity. Although it is not a known endocrine disruptor, endocrine disruption testing has not performed on the chemical.

- Not listed as a potential endocrine disruptor on the EU Priority List of Suspected Endocrine Disruptors.
- Not listed as a potential endocrine disruptor on the OSPAR List of Chemicals of Possible Concern.
- Not listed as a potential endocrine disruptor on the Red List of Chemicals (CPA 2011d).
- ACD/Labs 2012 –

  - ACD/I-Lab Estrogen Receptor Binding Affinity predicts that 2-Ethyl-1-hexanol is not expected to bind to the estrogen receptor. Refer to Appendix C for the ACD/I-Lab prediction report.
- Insufficient data are available to fully address the endocrine activity endpoint. While no evidence from available studies or QSAR modeling suggests that a potential effect on the endocrine system exists, a two-generation reproductive toxicity study has not been performed and sufficient details from developmental toxicity studies and chronic/sub-chronic toxicity studies were not available to assess the potential effects of 2-ethyl-1-hexanol upon the thyroid or male sex glands. Additionally, adequate QSAR modeling has not been identified to address potential androgenic or thyroid effects. Therefore, a data gap has been assigned for endocrine activity.

Group II and II* Human Health Effects (Group II and II* Human)

Note: Group II and Group II* endpoints are distinguished in the v 1.2 Benchmark system. For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints and test data for single or repeated exposures may be used. If data exist for single OR repeated exposures, then the endpoint is not considered a data gap. If data are available for both single and repeated exposures, then the more conservative value is used.

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M or L): M

2-Ethyl-1-hexanol was assigned a score of Moderate for acute mammalian toxicity based on oral LD_{50} values between 300 and 2,000 mg/kg (CPA 2011a).

- ESIS 2000 –
  - Oral LD_{50} values of 1,516 to 7,000 mg/kg were identified in (strain not reported) rats.
  - Oral LD_{50} values of 2,500 to 4,460 mg/kg were identified in (strain not reported) mice.
  - Oral LD_{50} values of 1,180 to 1,470 mg/kg were identified in (strain not reported) rabbits.
  - Oral LD_{50} values of 600 to 2,820 mg/kg were identified (strain not reported) guinea pigs.
  - A Dermal LD_{50} value of greater than 3,000 mg/kg was identified in (strain not reported) rats.
  - Dermal LD_{50} values of 1,980 to 2,600 mg/kg were identified in (strain not reported) rabbits.
  - Insufficient data were provided to assess acute inhalation toxicity.

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)
Group II Score (single dose) (vH, H, M or L): dg

- No relevant data were identified.

Group II* Score (repeated dose) (H, M, L): L

2-Ethyl-1-hexanol was assigned a score of Low for systemic toxicity/organ effects based on repeated exposure as it was not classified as a GHS (2011) repeated dose specific target organ toxicant.

- ESIS 2000 –
  - A non-GLP compliant 3 month oral toxicity study (method not reported) was conducted using male and female Wistar rats (10/sex/group). Rats were administered doses of 0, 9, 40, 230, 1,152 mg/kg in males and 0, 12, 64, 320, and 1,602 mg/kg in females daily in the diet for 3 months. In the top dose group increased liver weights, cortical degeneration of the kidney (in males), focal liver congestion and/or swelling (in females). In the top two dose groups an increased incidence and distribution of transitory hepatic diffuse cloudy swelling and cloudy swelling of the proximal convoluted kidney tubule was observed. No further details were provided. Based on reported data, ToxServices assigned a NOAEL and LOAEL of 40 and 230 mg/kg, respectively.
  - A GLP compliant 3 month oral toxicity study (method not reported) was conducted using male and female Fischer 344 rats (10/sex/dose). Rats were administered doses of 0, 25, 250, and 500 mg/kg (> 99.8% purity) 5 days/week for 3 months via oral gavage. The oral administration of 2-ethylhexanol led to reduced food consumption and body weight gain in male and female rats in the top dose group. In addition, increased relative liver and stomach weights (both sexes), increased absolute stomach weight (females) decrease in alanine-aminotransferase, glucose, and cholesterol (both sexes), decrease in alkaline phosphatase (males), single or multiple elevated foci in the mucosa of the fore-stomach (both sexes), and focal or multifocal acanthosis in the mucosa of the fore-stomach in both sexes. At 250 mg/kg, increased relative liver weights in both sexes, increased relative stomach weights in females, decreases in alkaline phosphatase and glucose in males, and a decrease in alanine-

aminotransferase in females. A NOAEL and LOAEL of 125 and 250 mg/kg were reported by the study authors.
    - A GLP compliant 3 month oral toxicity study was conducted using B6C3F$_1$ mice (10/sex/group). Mice were administered doses of 0, 25, 125, 250, and 500 mg/kg (purity not reported) 5 days/week for 3 months via oral gavage. Limited details were available for this study. Increased weights and slight focal and multifocal acanthosis in the mucosa of the fore-stomach were reported in the top dose of both sexes, and in the 250 mg/kg males. No further details were provided for this study. A NOAEL and LOAEL of 125 and 250 mg/kg was reported.
- 2-Ethyl-2-hexanol is not classified as a GHS specific target organ toxicant as no effects were reported within the 10 to 100 mg/kg recommended guidance values (GHS 2011). Furthermore, a consistent target organ was not identified and it was not clear or reported if improper gavage techniques may have played a role on the reported stomach effects.

Neurotoxicity (N)
Group II Score (single dose)**(vH, H, M or L):** dg
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006).
- Not listed as a potential neurotoxicant on the Red List of Chemicals (CPA 2011b).
- No relevant data were identified for 2-ethyl-1-hexanol.

Group II* Score (repeated dose)**(H, M, L):** dg
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006).
- Not listed as a potential neurotoxicant on the Red List of Chemicals (CPA 2011b).
- No relevant data were identified for 2-ethyl-1-hexanol.

Skin Sensitization (SnS) Group II* Score (H, M or L): L
2-Ethyl-1-hexanol was assigned a score of Low for skin sensitization based on not being sensitizing following a human repeat patch test.
- ESIS 2000 –
    - A non-GLP compliant human patch test (method not reported) was conducting using male and female human volunteers (n=29). Subjects were administered five 48-hour patch tests within a 10-day period using a 4% concentration in a petrolatum. No positive reactions were shown during the induction phase, or when challenged 10-14 days later. 2-Ethylhexanol was reported as non-sensitizing by the study authors.

Respiratory Sensitization (SnR) Group II* Score (H, M or L): dg
- No relevant data were identified.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): M
2-Ethyl-1-hexanol was assigned a score of Moderate for skin irritation/corrosivity based on being classified as a GHS (2011) Category 2 skin irritant.
- ESIS 2000 –
    - A non-GLP compliant acute dermal irritation/corrosion study (OECD 404) was conducted using (strain not reported) rabbits (n=3). Rabbits were exposed to (concentration not reported) 2-ethylhexanol under occlusion for 4 hours. A primary irritation index of 3.33 for redness and 4.00 for erythema were reported. Following GHS criteria a chemical with a score between 2.3 and 4.0 is classified as a Category 2 Irritant (GHS 2011).
    - Several other irritation studies were identified and reported 2-ethylhexanol as moderately to highly irritating.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): H
2-Ethyl-1-hexanol was assigned a score of High for eye irritation/corrosivity based on being classified as a GHS (2011) Category 2A Eye Irritant.
- ESIS 2000 –
    - A non-GLP compliant acute eye irritation/corrosion study (OECD 405) was conducted using (strain not reported) rabbits (number not reported). Scores of 1.44 were reported for corneal opacity and 2.56

for conjunctival redness. Following GHS criteria, a score of above 1 for corneal opacity and above 3 for conjunctival redness classifies this chemical as a Category 2A eye irritant.
- Multiple other studies were reported in the IUCLID document, and reports ranged from minimally to highly irritating. Very limited details were provided.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M or L): M
2-Ethyl-1-hexanol was assigned a score of Moderate for acute aquatic toxicity based on L/EC_{50} values identified between 10 and 100 mg/L, the cutoffs for Moderate acute aquatic toxicity (CPS 2011a).

- ESIS 2000 –
  - An LC_{50} value of 27 to 29.5 mg/L was identified for *Pimephalas promelas* (fish, 96-hr).
  - An LC_{50} value of 17.1 mg/L was identified for *Leuciscus idus meanotus* (fish, 96-hr).
  - An LC_{50} value of 32 to 37 mg/L was identified for *Salmo gairdneri* (fish, 96-hr).
  - An EC_{50} value of 39 mg/L was identified for *Daphnia magna* (invertebrate, 48-hr).
  - An EC_{50} value of 19 mg/L was identified for *Artemia salina* (invertebrate, 24-hr).
  - An EC_{50} value of 10 to 50 mg/L was identified for *Chlorella emersonii* (algae, 48-hr).
  - An EC_{50} value of 11.5 mg/L was identified for *Scenedesmus subspicatus* (algae, 72-hr).

Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): L
2-Ethyl-1-hexanol was assigned a score of Low for chronic aquatic toxicity based on being readily biodegradable and having a low potential for bioaccumulation.

- 2-Ethyl-1-hexanol is not classifiable for chronic toxicity following GHS criteria as it is expected to be readily biodegradable and not expected to bioaccumulate in aquatic species (GHS 2011)[6].

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): vL
2-Ethyl-1-hexanol was assigned a score of Very Low for persistence based on reported and modeled data support this chemical being readily biodegradable within a 10-day window (CPA 2011a).

- ESIS 2000 -
  - A GLP compliant modified strum test (Directive 84/449/EEC, C.5, similar to OECD 301B) was conducted under aerobic conditions in domestic activated sludge. 2-Ethylhexanol was reported as reaching 55% to 68% biodegradation after 17 days.
  - A non-GLP compliant Inherent biodegradability: Modified Zahn-Wellens tests (OECD 302B) was conducted under aerobic conditions using industrial activated sludge. 2-Ethylhexanol was reported as 95 to 100% biodegradable after 5 days.
- U.S. EPA 2011 –
  - Test data do not specify if 2-ethyl-1-hexanol meets the 10-day biodegradation window. However, BIOWIN[7] modeling indicates that this chemical is likely to meet the 10-day biodegradation window (as shown in Appendix D).

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vL*
2-Ethyl-1-hexnaol was assigned a score of Very Low for bioaccumulation based on a BCF of less than 100, which is the cut-off value for a Very Low classification following GreenScreen™ criteria (CPA 2011a).

- ESIS 2000 –
  - 2-Ethylhexanol has a reported BCF of 27 based on calculations from water solubility indicating that it is unlikely to bioaccumulate. No further details were provided.

[6] Table 4.1.1 of the GHS Purple Book.
[7] BIOWIN estimates the probability of rapid aerobic and anaerobic biodegradation of an organic compound in the presence of mixed populations of environmental microorganisms.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M or L): *L*
2-Ethyl-1-hexanol was assigned a score of Low for reactivity based on not having any chemicals or functional groups expected to contain high energy bonds or oxidizing species which may cause reactivity.

- 2-Ethyl-1-hexanol would not be classified as an oxidizing chemical as it structure does not contain a halogen, and oxygen atoms are only bonded to carbon or hydrogen (GHS 2011). In addition, 2-Ethyl-1-hexanol is not expected be explosive as it does not contain structural groups that would cause concern for explosion.

Flammability (F) Score (vH, H, M or L): M
2-Ethyl-1-hexanol was assigned a score of Moderate for flammability based on being classified as a GHS Category 4 Flammable Liquid. Category 4 Flammable Liquids are assigned a score of Moderate following GreenScreen™ criteria (CPA 2011a).

- ESIS 2000 –
    - 2-Ethylhexanol has a flashpoint between 73 and 82°C. Following GHS criteria, chemicals with a flashpoint between 60 and 93°C are considered a Category 4 flammable liquid (GHS 2011)[8].

[8] Table 2.6.1 of the GHS Purple Book.

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APPENDIX A: Hazard Benchmark Acronyms
(in alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(Cr) Corrosion/ Irritation (Skin/ Eye)

(D) Developmental Toxicity

(E) Endocrine Activity

(F) Flammability

(IrE) Eye Irritation/Corrosivity

(IrS) Skin Irritation/Corrosivity

(M) Mutagenicity and Genotoxicity

(N) Neurotoxicity

(P) Persistence

(R) Reproductive Toxicity

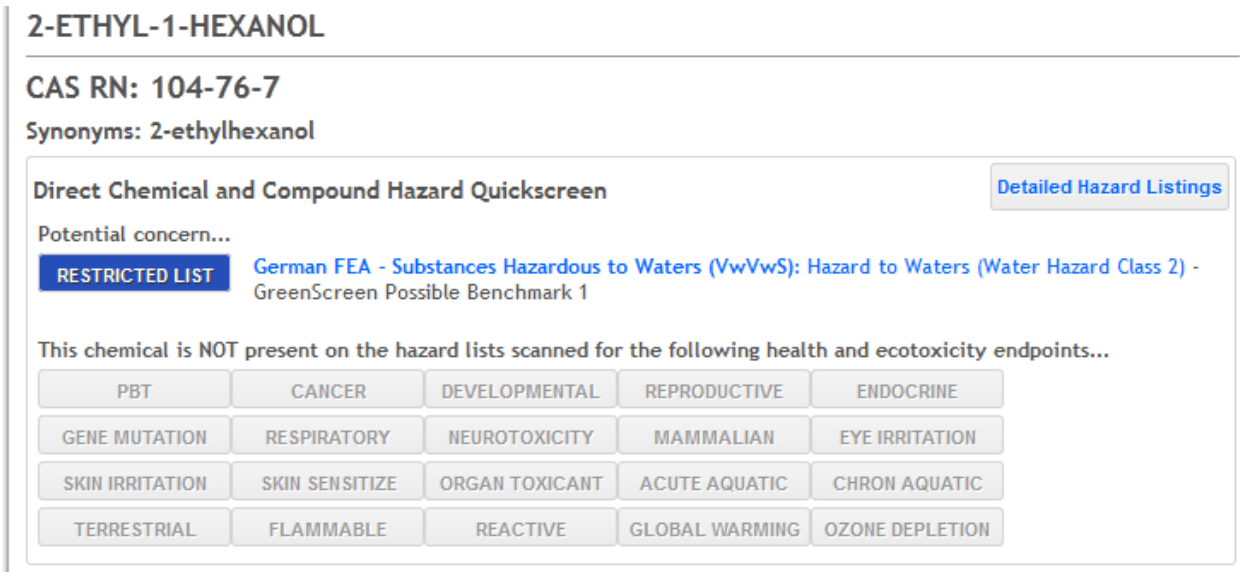
(Rx) Reactivity

(SnS) Sensitization- Skin

(SnR) Sensitization- Respiratory

(ST) Systemic/Organ Toxicity

APPENDIX B: Pharos List Translator Results



2-ETHYL-1-HEXANOL

CAS RN: 104-76-7

Synonyms: 2-ethylhexanol

Direct Chemical and Compound Hazard Quickscreen

Detailed Hazard Listings

Potential concern...

RESTRICTED LIST

German FEA - Substances Hazardous to Waters (VwVwS): Hazard to Waters (Water Hazard Class 2) - GreenScreen Possible Benchmark 1

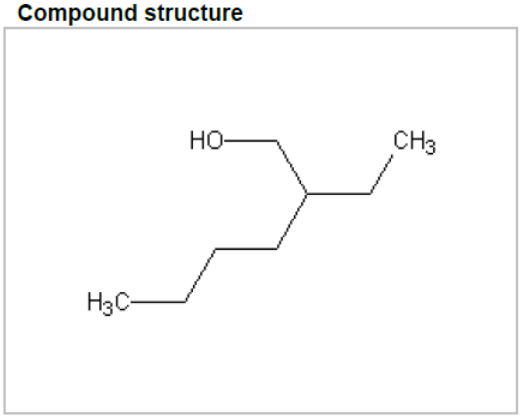
This chemical is NOT present on the hazard lists scanned for the following health and ecotoxicity endpoints...

PBT	CANCER	DEVELOPMENTAL	REPRODUCTIVE	ENDOCRINE
GENE MUTATION	RESPIRATORY	NEUROTOXICITY	MAMMALIAN	EYE IRRITATION
SKIN IRRITATION	SKIN SENSITIZE	ORGAN TOXICANT	ACUTE AQUATIC	CHRON AQUATIC
TERRESTRIAL	FLAMMABLE	REACTIVE	GLOBAL WARMING	OZONE DEPLETION

APPENDIX C: ACD/I-Lab Results

ACD/Labs
I-Lab 2.0 - ilab.acdlabs.com
Friday 26th of October 2012 12:58:13 PM. Algorithm Version: v5.0.0.184

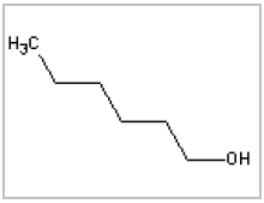
Compound structure



No binding to Estrogen Receptor alpha (LogRBA<-3)

Probability of Estrogen Receptor Binding:
LogRBA > -3: 0.04
LogRBA > 0: 0

Experimental Values for Similar Structures



Hexyl alcohol
CAS: 111-27-3

no binding
Species: rat
References:

- Blair RM et al. Toxicol Sci. 2000; 54(1):138-53.

APPENDIX D: EPISuite Results

Physical Property Inputs:
Log Kow (octanol-water): ------
Boiling Point (deg C) : ------
Melting Point (deg C) : ------
Vapor Pressure (mm Hg) : ------
Water Solubility (mg/L): ------
Henry LC (atm-m3/mole) : ------

Log Octanol-Water Partition Coef (SRC):
Log Kow (KOWWIN v1.68 estimate) = 2.73

Boiling Pt, Melting Pt, Vapor Pressure Estimations (MPBPVP v1.43):
Boiling Pt (deg C): 188.52 (Adapted Stein & Brown method)
Melting Pt (deg C): -25.50 (Mean or Weighted MP)
VP(mm Hg,25 deg C): 0.185 (Mean VP of Antoine & Grain methods)
VP (Pa, 25 deg C) : 24.6 (Mean VP of Antoine & Grain methods)
MP (exp database): -70 deg C
BP (exp database): 184.6 deg C
VP (exp database): 1.36E-01 mm Hg (1.81E+001 Pa) at 25 deg C

Water Solubility Estimate from Log Kow (WSKOW v1.42):
Water Solubility at 25 deg C (mg/L): 1379
log Kow used: 2.73 (estimated)
no-melting pt equation used
Water Sol (Exper. database match) = 880 mg/L (25 deg C)
Exper. Ref: AMIDON,GL ET AL. (1974)

Water Sol Estimate from Fragments:
Wat Sol (v1.01 est) = 1285.3 mg/L

ECOSAR Class Program (ECOSAR v1.00):
Class(es) found:
Neutral Organics

Henrys Law Constant (25 deg C) [HENRYWIN v3.20]:
Bond Method : 3.10E-005 atm-m3/mole (3.14E+000 Pa-m3/mole)
Group Method: 4.66E-005 atm-m3/mole (4.72E+000 Pa-m3/mole)
Exper Database: 2.65E-05 atm-m3/mole (2.69E+000 Pa-m3/mole)
For Henry LC Comparison Purposes:
User-Entered Henry LC: not entered
Henrys LC [via VP/WSol estimate using User-Entered or Estimated values]:
HLC: 2.299E-005 atm-m3/mole (2.329E+000 Pa-m3/mole)
VP: 0.185 mm Hg (source: MPBPVP)
WS: 1.38E+003 mg/L (source: WSKOWWIN)

Log Octanol-Air Partition Coefficient (25 deg C) [KOAWIN v1.10]:
Log Kow used: 2.73 (KowWin est)
Log Kaw used: -2.965 (exp database)
Log Koa (KOAWIN v1.10 estimate): 5.695
Log Koa (experimental database): None

Probability of Rapid Biodegradation (BIOWIN v4.10):
Biowin1 (Linear Model) : 0.9527
Biowin2 (Non-Linear Model) : 0.9840

Expert Survey Biodegradation Results:
Biowin3 (Ultimate Survey Model): 3.3697 (days-weeks)
Biowin4 (Primary Survey Model) : 4.0584 (days)
MITI Biodegradation Probability:
Biowin5 (MITI Linear Model) : 0.6831
Biowin6 (MITI Non-Linear Model): 0.8649
Anaerobic Biodegradation Probability:
Biowin7 (Anaerobic Linear Model): 0.4561
Ready Biodegradability Prediction: YES (Readily Biodegradable) →Estimate selected

Hydrocarbon Biodegradation (BioHCwin v1.01):
Structure incompatible with current estimation method!

Sorption to aerosols (25 Dec C)[AEROWIN v1.00]:
Vapor pressure (liquid/subcooled): 18.1 Pa (0.136 mm Hg)
Log Koa (Koawin est): 5.695
Kp (particle/gas partition coef. (m3/ug)):
Mackay model : 1.65E-007
Octanol/air (Koa) model: 1.22E-007
Fraction sorbed to airborne particulates (phi):
Junge-Pankow model : 5.98E-006
Mackay model : 1.32E-005
Octanol/air (Koa) model: 9.73E-006

Atmospheric Oxidation (25 deg C) [AopWin v1.92]:
Hydroxyl Radicals Reaction:
OVERALL OH Rate Constant = 13.2292 E-12 cm3/molecule-sec
Half-Life = 0.809 Days (12-hr day; 1.5E6 OH/cm3)
Half-Life = 9.702 Hrs
Ozone Reaction:
No Ozone Reaction Estimation
Fraction sorbed to airborne particulates (phi):
9.61E-006 (Junge-Pankow, Mackay avg)
9.73E-006 (Koa method)
Note: the sorbed fraction may be resistant to atmospheric oxidation

Soil Adsorption Coefficient (KOCWIN v2.00):
Koc : 35.28 L/kg (MCI method)
Log Koc: 1.547 (MCI method)
Koc : 105.6 L/kg (Kow method)
Log Koc: 2.024 (Kow method)

Aqueous Base/Acid-Catalyzed Hydrolysis (25 deg C) [HYDROWIN v2.00]:
Rate constants can NOT be estimated for this structure!

Bioaccumulation Estimates (BCFBAF v3.01):
Log BCF from regression-based method = 1.470 (BCF = 29.48 L/kg wet-wt)
Log Biotransformation Half-life (HL) = -0.6389 days (HL = 0.2297 days)
Log BCF Arnot-Gobas method (upper trophic) = 1.543 (BCF = 34.88)
Log BAF Arnot-Gobas method (upper trophic) = 1.543 (BAF = 34.88)
log Kow used: 2.73 (estimated)

Volatilization from Water:
Henry LC: 2.65E-005 atm-m3/mole (Henry experimental database)
Half-Life from Model River: 26.38 hours (1.099 days)
Half-Life from Model Lake : 383.4 hours (15.98 days)

Removal In Wastewater Treatment:
Total removal: 5.32 percent
Total biodegradation: 0.11 percent
Total sludge adsorption: 3.80 percent
Total to Air: 1.41 percent
(using 10000 hr Bio P,A,S)

Removal In Wastewater Treatment:
Total removal: 93.58 percent
Total biodegradation: 91.97 percent
Total sludge adsorption: 1.40 percent
Total to Air: 0.21 percent
(using Biowin/EPA draft method)

Level III Fugacity Model:

	Mass Amount (percent)	Half-Life (hr)	Emissions (kg/hr)
Air	3.18	19.4	1000
Water	31.9	208	1000
Soil	64.8	416	1000
Sediment	0.0959	1.87e+003	0

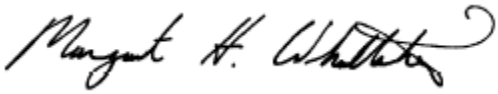
Persistence Time: 255 hr

Authorized Reviewers

2-Ethyl-1-hexanol GreenScreen™ Evaluation Prepared By:

Christopher E. Schlosser, M.F.S.
Associate Toxicologist
ToxServices LLC

2-Ethyl-1-hexanol GreenScreen™ Evaluation QC'd By:



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