Methylethylketoxime (CAS# 96-29-7) GreenScreen® for Safer Chemicals (GreenScreen®) Assessment

Prepared for:

Washington State Department of Ecology

Prepared by:

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October 17, 2014

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GreenScreen® Executive Summary for Methylethylketoxime (CAS# 96-29-7)

Methylethylketoxime is a chemical that functions as an antiskinning agent in alkyd coating resins to prevent formation of a solid or gelatinous skin in the container (HSDB, 2014).

Methylethylketoxime was assigned a GreenScreen® Benchmark Score of LT-1 which may be considered equivalent to a Benchmark 1 ("Avoid-Chemical of High Concern") chemical using the full GreenScreen® method as it has High Group I Human Toxicity (carcinogenicity (C). This corresponds to GreenScreen® benchmark classification 1e in CPA 2011. Additional authoritative A listings were sufficient to assign hazard scores for acute toxicity (A), skin sensitization (SnS*), and eye irritation (IrE). Under the scope of this project, ToxServices screened all paint components against Clean Production Action's GreenScreen® List Translator (LT). Those identified as List Translator Benchmark 1 chemicals ("LT-1") do not undergo a full GreenScreen® evaluation to save time and resources. Per the scope of work, only those hazard scores driven by authoritative listings in the List translator search were to be assigned. Upon inspection of the dataset, ToxServices expanded the assessments for all LT-1 chemicals in order to evaluate aquatic toxicity and environmental fate, as these endpoints are highly relevant to the alternatives assessment of nonbiocide boat paints. The expanded environmental fate and toxicity literature search or modeling for methylethylketoxime did not identify any additional Benchmark 1 score combinations.

GreenScreen® Benchmark Score for Relevant Route of Exposure:

As a standard approach for GreenScreen® evaluations, all exposure routes (oral, dermal, and inhalation) were evaluated together, so the GreenScreen® Benchmark Score of 1 ("Avoid-Chemical of High Concern") is applicable for all routes of exposure.

GreenScreen® Hazard Ratings for Methylethylketoxime

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*										
H	NA	NA	NA	NA	**M**	NA	NA	NA	NA	**H**	NA	NA	**vH**	**H**	**M**	*M*	**vL**	NA	NA

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms. NA: Not assessed.

GreenScreen® Assessment for Methylethylketoxime (CAS# 96-29-7)

Method Version: GreenScreen® Version 1.2[1]
Assessment Type[2]: Certified

Chemical Name: Methylethylketoxime

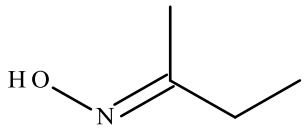
CAS Number: 96-29-7

GreenScreen® Assessment Prepared By:
Name: Nikki Maples-Reynolds, M.S.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 13, 2014
Assessor Type: Licensed GreenScreen® Profiler

Quality Control Performed By:
Name: Bingxuan Wang, Ph.D.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 17, 2014

Confirm application of the *de minimus* rule[3]: N/A

Chemical Structure(s):



Also called: 2-Butanone oxime, 4-01-00-03250 (Beilstein Handbook Reference), BRN 1698241, Butanone oxime, CCRIS 1382, EINECS 202-496-6, Ethyl methyl ketone oxime, Ethyl methyl ketoxime, Ethyl-methylketonoxim, Ethyl-methylketonoxim [Czech], MEK-oximeMethyl ethyl ketone oxime, Methyl ethyl ketoxime, NSC 442, Skino #2, Troykyd anti-skin B, UNII-51YGE935U9, USAF AM-3, USAF EK-906 (ChemIDplus 2014)

Chemical Structure(s) of Chemical Surrogates Used in the GreenScreen®:
No surrogates were used as methylethylketoxime is an LT-1 chemical.

Identify Applications/Functional Uses:
1. Anti-skinning agent for paint and lacquers
2. Blocking agent in coatings such as isocyanate urethane coatings for wire and in magnetic tape coatings and resins
3. Catalyst, oxygen scavenger in steam generation, extraction of silver

[1] Use GreenScreen® Assessment Procedure (Guidance) V1.2
[2] GreenScreen® reports are either "UNACCREDITED" (by unaccredited person), "AUTHORIZED" (by Authorized GreenScreen® Practitioner), "CERTIFIED" (by Licensed GreenScreen® Profiler or equivalent) or "CERTIFIED WITH VERIFICATION" (Certified or Authorized assessment that has passed GreenScreen® Verification Program)
[3] 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

GreenScreen® Summary Rating for Methylethylketoxime[4]: Methylethylketoxime was assigned a GreenScreen® Benchmark Score of LT-1 which may be considered equivalent to a Benchmark 1 ("Avoid-Chemical of High Concern") chemical using the full GreenScreen® method as it has High Group I Human Toxicity (carcinogenicity (C). This corresponds to GreenScreen® benchmark classification 1e in CPA 2011, 2012a. Additional authoritative A listings were sufficient to assign hazard scores for acute toxicity (A), skin sensitization (SnS*), and eye irritation (IrE). Under the scope of this project, ToxServices screened all paint components against Clean Production Action's GreenScreen® List Translator (LT). Those identified as List Translator Benchmark 1 chemicals ("LT-1") do not undergo a full GreenScreen® evaluation to save time and resources. Per the scope of work, only those hazard scores driven by authoritative listings in the List translator search were to be assigned. Upon inspection of the dataset, ToxServices expanded the assessments for all LT-1 chemicals in order to evaluate aquatic toxicity and environmental fate, as these endpoints are highly relevant to the alternatives assessment of nonbiocide boat paints. The expanded environmental fate and toxicity literature search or modeling for methylethylketoxime did not identify any additional Benchmark 1 score combinations.

Figure 1: GreenScreen® Hazard Ratings for Methylethylketoxime

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*										
H	NA	NA	NA	NA	**M**	NA	NA	NA	NA	**H**	NA	NA	**vH**	**H**	**M**	*M*	**vL**	NA	NA

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms. NA: Not assessed.

Transformation Products and Ratings:

Identify feasible and relevant fate and transformation products (i.e., dissociation products, transformation products, valence states) **and/or moieties of concern**[5]

Transformation products were not assessed, as methylethylketoxime is an LT-1 chemical and its score will not be impacted by those of transformation products.

Introduction

Methylethylketoxime functions as an antiskinning agent in alkyd coating resins to prevent formation of a solid or gelatinous skin in the container (HSDB, 2014)

ToxServices assessed methylethylketoxime against GreenScreen® Version 1.2 (CPA 2013) following procedures outlined in ToxServices' SOP 1.69 (GreenScreen® Hazard Assessment) (ToxServices 2013).

[4] 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.

[5] 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.

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 2012b). Pharos (Pharos 2014) is an online list-searching tool that is used to screen chemicals against the List Translator electronically. It checks all of the lists in the List Translator with the exception of the U.S. Department of Transportation (U.S. DOT) lists (U.S. DOT 2008a,b) and these should be checked separately in conjunction with running the Pharos query. The output indicates benchmark or possible benchmark scores for each human health and environmental endpoint. The output for methylethylketoxime can be found in Appendix C and a summary of the results can be found below:

- Carcinogenicity
  - German MAK – Carcinogen Group 2 – considered to be carcinogenic to man
  - EU Risk Phrase R40 – limited evidence of a carcinogenic effect
  - GHS Hazard Statement H351 – suspected of causing cancer
  - EC CLP Inventory (EU CMR(2)) Category 2 Suspected human carcinogen
  - GHS-New Zealand 6.7B (Category 2) – Suspected human carcinogen
  - GHS-Japan – Category 2 – Carcinogenicity 2
- Mammalian
  - GHS-Japan – Category 1 – Specific target organs/systemic toxicity following repeated exposure
  - EU Risk Phrase R21 – Harmful if contact with skin
  - GHS Hazard Statement H312 – harmful in contact with skin
  - GHS-New Zealand 6.1D (Category 4) – acutely toxic (dermal)
  - GHS-New Zealand 6.1D (Category 4) – acutely toxic (inhalation)
  - GHS-New Zealand 6.1D (Category 4) –acutely toxic (oral)
  - GHS-Japan – Category 3 – Acute toxicity (dermal)
  - GHS-Japan – Category 4 – Acute toxicity (oral)
  - GHS-New Zealand 6.9B (Category 2) – (single exposure) harmful to human target organ or system (inhalation)
  - GHS-New Zealand 6.9B (Category 2) – (single exposure) harmful to human target organ or system (oral)
- Skin Sensitization
  - German MAK – Sensitizing Substance Sh – Danger of skin sensitization
  - GHS-Japan – Category 1 – Skin sensitizer
  - EU Risk Phrase R43 – may cause sensitization by skin contact
  - GHS Hazard Statement H317 – my cause an allergic skin reaction
  - GHS-New Zealand 6.5B (Category 1) contact sensitizer
- Eye irritation
  - GHS Hazard Statement H318 – Causes serious eye damage
  - EU Risk Phrase R41 – Risk of serious damage to eyes
  - GHS-Japan – Category 1 – serious eye damage/eye irritation
  - GHS-New Zealand 6.4A (Category 2A) – irritating to the eye
- Skin irritation
  - GHS-New Zealand 6.3B (Category 3) – mildly irritating to the skin
- Chronic Aquatic
  - GHS-New Zealand 9.1C (Category 3) - Harmful in the aquatic environment (algal)
- PBT
  - Environment Canada – DSL – substance that is persistent

- Flammability
    - GHS- New Zealand 3.1C - (Category 3) – Flammable Liquids: medium hazard
- Restricted List
    - German FEA – (VwVwS) Class 1 Low hazard to water
    - Environment Canada – DSL inherently toxic to humans
    - Environment Canada – Sched 1 (CEPA) – CEPA Toxic

PhysicoChemical Properties of Methylethylketoxime

Methylethylketoxime is a liquid under standard temperature and pressure. It has a vapor pressure of 1.07 kPa indicating that it will likely exist mainly in the liquid phase. It has a log P_{ow} estimated to be 0.63, indicating that it is less soluble in octanol than in water and that it does not have a high potential to bioaccumulate in aquatic biota, as evident with the low bioconcentration factor of 0.5-0.6.

Table 1: Physical and Chemical Properties of Methylethylketoxime (CAS# 96-29-7)

Property	Value	Reference
Molecular formula	C4-H9-N-O	ChemIDplus 2014
SMILES Notation	C(\CC)(=N/O)C	ChemIDplus 2014
Molecular weight	87.1211	ChemIDplus 2014
Physical state	Liquid	ECHA 2014
Appearance	Colorless liquid	ECHA 2014
Melting point	-29.5°C	ECHA 2014
Vapor pressure	1.07 kPa at 20°C	ECHA 2014
Water solubility	soluble (1000-10000 mg/L) at 25°C	ECHA 2014
Dissociation constant	12.45 at 25°C	ECHA 2014
Density/specific gravity	0.92 at 20ºC	ECHA 2014
Partition coefficient	Log P_{ow} = 0.63	ECHA 2014
Bioavailability	BCF 0.5 - 0.6	ECHA 2014

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M, or L): H

Methylethylketoxime was assigned a score of High for carcinogenicity based on presence on authoritative lists. GreenScreen® criteria classify chemicals as a High hazard for carcinogenicity when the chemical is listed on the German MAK Group 2 (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* German MAK – Carcinogen Group 2
    - *Authoritative:* EU Risk Phrase R40 – limited evidence of a carcinogenic effect
    - *Authoritative:* GHS Hazard Statement H351 – suspected of causing cancer
    - *Authoritative:* EC CLP Inventory (EU CMR(2)) Category 2 Suspected human carcinogen
    - *Screening:* GHS-New Zealand 6.7B (Category 2) – Suspected human carcinogen
    - *Screening:* GHS-Japan – Category 2 – Carcinogenicity 2

Mutagenicity/Genotoxicity (M) Score (H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Reproductive Toxicity (R) Score (H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Endocrine Activity (E) Score (H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- High Throughput Screening (HTS) Data –
  - HTS data were identified for methylethylketoxime using PubChem (http://pubchem.ncbi.nlm.nih.gov/).
  - The data included the following results:
    - Methylethylketoxime was active in 0/6 androgen receptor agonist assays and 0/12 androgen receptor antagonist assays.
    - Methylethylketoxime was active in 0/6 estrogen receptor-alpha agonist assays and 0/12 estrogen receptor-alpha antagonist assays.
    - Methylethylketoxime was active in 0/2 thyroid receptor agonist assays and 0/6 thyroid receptor antagonist assays.
    - The activity of methylethylketoxime towards the thyroid stimulating hormone receptor was not evaluated.
- These data are insufficient to assign a score 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

Methylethylketoxime was assigned a score of Moderate for acute mammalian toxicity based on presence on authoritative lists. GreenScreen® criteria classify chemicals as a Moderate hazard for acute mammalian toxicity when the chemical is listed with the EU H phrase H312 (CPA 2012a).

- *Authoritative:* EU Risk Phrase R21 – Harmful if contact with skin
- *Authoritative:* GHS Hazard Statement H312 – harmful in contact with skin
- *Screening:* GHS-New Zealand 6.1D (Category 4) – acutely toxic (dermal)
- *Screening:* GHS-New Zealand 6.1D (Category 4) – acutely toxic (inhalation)

- *Screening:* GHS-New Zealand 6.1D (Category 4) –acutely toxic (oral)
- *Screening:* GHS-Japan – Category 3 – Acute toxicity (dermal)
- *Screening:* GHS-Japan – Category 4 – Acute toxicity (oral)

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)
***Group II Score (single dose)* (vH, H, M, or L): Not Assessed**

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* GHS-New Zealand 6.9B (Category 2) – (single exposure) harmful to human target organ or system (inhalation)
  - *Screening:* GHS-New Zealand 6.9B (Category 2) – (single exposure) harmful to human target organ or system (oral)

***Group II* Score (repeated dose)* (H, M, or L): Not Assessed**

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* GHS-Japan – Category 1 – Specific target organs/systemic toxicity following repeated exposure

Neurotoxicity (N)
***Group II Score (single dose)* (vH, H, M, or L): Not Assessed**

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

***Group II* Score (repeated dose)* (H, M, or L): Not Assessed**

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Skin Sensitization (SnS) Group II* Score (H, M, or L): H
Methylethylketoxime was assigned a score of High for skin sensitization based on classification to German MAK Sh. GreenScreen® criteria classify chemicals as a High hazard when classified to German MAK Sh (CPA 2012a).

- *Authoritative:* German MAK – Sensitizing Substance Sh – Danger of skin sensitization
- *Authoritative:* EU Risk Phrase R43 – may cause sensitization by skin contact
- *Authoritative:* GHS Hazard Statement H317 – my cause an allergic skin reaction
- *Screening:* GHS-Japan – Category 1 – Skin sensitizer
- *Screening:* GHS-New Zealand 6.5B (Category 1) contact sensitizer

Respiratory Sensitization (SnR) Group II* Score (H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M, or L): Not Assessed

- *Authoritative:* Not present on any authoritative lists
- *Screening:* GHS-New Zealand 6.3B (Category 3) – mildly irritating to the skin

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M, or L): vH
Methylethylketoxime was assigned a score of Very High for eye irritation based on presence on authoritative lists. GreenScreen® criteria classify chemicals as a Very High hazard when classified GHS Hazard Statement H318 and EU Risk Phrase R41 (CPA 2012a).

- *Authoritative:* GHS Hazard Statement H318 – Causes serious eye damage
- *Authoritative:* EU Risk Phrase R41 – Risk of serious damage to eyes
- *Screening:* GHS-Japan – Category 1 – serious eye damage/eye irritation
- *Screening:* GHS-New Zealand 6.4A (Category 2A) – irritating to the eye

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M, or L): H
Methylethylketoxime was assigned a score of High for acute aquatic toxicity based on the EC_{50} (biomass) value in algae. GreenScreen® criteria classify chemicals as a High hazard for acute aquatic toxicity when the most conservative E/LC_{50} values are between 1 and 10 mg/L (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- ECHA 2014
  - 96h LC_{50} = > 100 mg/L (nominal) (*Oryzias latipes,* fish)(GLP, OECD 203)
  - 96h LC_{50} = 760 mg/L (nominal) (*Poecilia reiculata,* fish)
  - 48h EC_{50} (mobility) = 201 mg/L (nominal) (*Daphnia magna,* daphnia)(GLP, OECD 202)
  - 48h EC_{50} (mobility) = > 500mg/L (nominal) (*Daphnia magna,* daphnia)(EU Method C.2)
  - 72h EC_{50} (growth rate) = 11.8 mg/L (nominal) (*Scenedesmus capricornutum,* algae)(GLP, OECD 201)
  - 72h EC_{50} (biomass) = 6.09 mg/L (nominal) (*Scenedesmus capricornutum,* algae)(GLP, OECD 201)
  - 72h EC_{50} (growth rate) = 83 mg/L (*Scenedesmus subspicatus,* algae)
- ESIS 2000
  - 96h LC_{50} = 843 mg/L (*Pimephales promelas,* fish)
  - 96h LC_{50} = 320 – 1,000 mg/L (*Leuciscus idus,* fish)
  - 96h LC_{50} = 760 mg/L (*Poecilia reticulata,* fish)
  - 48h LC_{50} = 560 mg/L (Orange red-killifish)
  - 48h EC_{50} = > 500 mg/L (*Daphnia magna,* daphnia)
  - 48h EC_{50} = 750 mg/L (*Daphnia magna,* daphnia)
  - 72h EC_{50} = 83 mg/L (*Scenedesmus subspicatus,* algae)
- A score of High was conservatively assigned based on the 72 EC_{50} value of 6.09 mg/L in algae from the GLP-compliant OECD 201 study. Both studies in algae indicate that plants are more sensitive than fish and invertebrates.

Chronic Aquatic Toxicity (CA) Score (vH, H, M, or L): M
Methylethylketoxime was assigned a score of Moderate for chronic aquatic toxicity based on the NOEC values in algae. GreenScreen® criteria classify chemicals as a Moderate hazard for chronic aquatic toxicity when the most conservative chronic toxicity values are between 1 and 10 mg/L (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* GHS-New Zealand 9.1C (Category 3) - Harmful in the aquatic environment (algal) – Classification based on an EC_{50} of 83 mg/L (*Scenedesmus capricornutum,* algae)

- ECHA 2014
    - 14d NOEC (length in young fish) = 50 mg/L (nominal) (*Oryzias latipes,* fish) (GLP, OECD 204)
    - 14d NOEC (mortality in young fish) = > 100 mg/L (nominal) (*Oryzias latipes,* fish) (GLP, OECD 204)
    - 21d NOEC (reproduction rate) = > 100 mg/L (nominal) (*Daphnia magna,* daphnia)(GLP, OECD 211)
    - 72h NOEC (growth rate) = 2.56 mg/L (nominal)(*Scenedesmus capricornutum,* algae)(GLP, OECD 201)
    - 72h NOEC (biomass) = 1.02 mg/L (nominal)(*Scenedesmus capricornutum,* algae)(GLP, OECD 201)

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): *M*
Methylethylketoxime was assigned a score of Moderate for persistence based on the predicted half-life in soil. GreenScreen® criteria classify chemicals as Moderate hazard for persistence when the half-life in soil is between 16 and 60 days (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Environment Canada – DSL – substance that is persistent
- ECHA 2014
    - Methylethylketoxime was inherently biodegradable in a Zahn-Wellens/EMPA Test (OECD Guideline 302 B) with 70% degraded after 18 days.
    - Methylethylketoxime was not readily biodegradable in a modified MITI Test (I) (OECD 301 C) with 14.5% degraded after 21 days.
- ESIS 2000
    - In two modified Zahn-Wellens Tests (OECD 302 B), methylethylketoxime was inherently biodegradable 70% degraded after 14 days.
    - In two biodegradation tests, methylethylketoxime was inherently biodegradable with 25% degraded after 28 days (GLP).
    - In a MITI-Test, methylethylketoxime was 24.6% degraded after 28 days.
    - In three biodegradation test, methylethylketoxime was 70% degraded after 18 days.
- U.S. EPA 2012
    - The BIOWIN modeling Ready Biodegradable Predictor indicates that methylethylketoxime is expected to be readily biodegradable. Fugacity modeling predicts 68.2% will partition to soil with a half-life of 30 days, 26.4% will partition to water with a half-life of 15 days, and 5.19% will partition to air with a half-life of 7.2days (Appendix D).
- Based on the weight of evidence, a score of Moderate was assigned. Methylethylketoxime was inherently biodegradable in Zahn-Wellens tests (OECD 302 B) but it was not readily biodegradable in MITI tests. Fugacity modeling predicts that methylethylketoxime will partition primarily to soil. When the major compartment is soil, GreenScreen® criteria specify a score of Moderate if the chemical has a half-life of 16 to 60 days. Confidence in this endpoint was reduced due to the use of modeling.

Bioaccumulation (B) Score (vH, H, M, L, or vL): vL
Methylethylketoxime was assigned a score of Very Low for bioaccumulation based on measured data. GreenScreen® criteria classify chemicals as a Very Low hazard for bioaccumulation when the BCF is less than 100 (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- ECHA 2014
  - A BCF of 0.5 – 0.6 was reported for *Cyprinus carpio* exposed to 2 mg/L methylethylketoxime for 42 days.
- ESIS 2000
  - A BCF of 0.5 – 0.6 was reported for *Cyprinus carpio* exposed to 2 mg/L methylethylketoxime for 42 days.
  - A BCF of < 2.5 – 5.8 was reported for *Cyprinus carpio* exposed to 0.2 mg/L methylethylketoxime for 42 days (OECD 305C)
  - BCF values of 0.5 – 0.6 were reported for *Oryzias latipes* exposed to 2 mg/L methylethylketoxime for 42 days in two bioaccumulation studies (GLP, OECD 305C).
  - BCF values of 2.5 – 2.8 were reported for *Oryzias latipes* exposed to 0.2 mg/L methylethylketoxime for 42 days in two bioaccumulation studies (GLP, OECD 305C)
- U.S. EPA 2012
  - BCFBAF predicts a BCF of 1.186 based on a log K_{ow} of 0.63, indicating this chemical is not likely to bioaccumulate because the BCF is less than 1,000 based on a log K_{ow} less than 4.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Flammability (F) Score (vH, H, M, or L): Not Assessed

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* GHS- New Zealand 3.1C - (Category 3) – Flammable Liquids: medium hazard

References

ChemIDplus. 2014. Entry for Methylethylketoxime (CAS# 96-29-7). United States National Library of Medicine. Available: http://chem.sis.nlm.nih.gov/chemidplus/chemidheavy.jsp.

Clean Production Action (CPA). 2011. The GreenScreen® for Safer Chemicals Version 1.2 Benchmarks. Dated October 2011. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012a. The GreenScreen® for Safer Chemicals Version 1.2 Criteria. Dated: November 2012. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012b. List Translator. Dated February 2012. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2013. The GreenScreen® for Safer Chemicals Chemical Hazard Assessment Procedure. Version 1.2 Guidance. Dated August 31, 2013. Available: http://www.greenscreenchemicals.org/.

European Chemicals Agency (ECHA). 2014. REACH Dossier for methylethylketoxime (CAS# 96-29-7). Available: http://apps.echa.europa.eu/registered/data/dossiers/DISS-9d9c87d5-9db6-4ce7-e044-00144f67d249/DISS-9d9c87d5-9db6-4ce7-e044-00144f67d249_DISS-9d9c87d5-9db6-4ce7-e044-00144f67d249.html.

European Chemical Substances Information System (ESIS). 2000. IUCLID Dataset for Butanone Oxime (CAS# 96-29-7). Available through: http://www.ebscohost.com/expub.

Grandjean, P. and P.J. Landrigan. 2006. Developmental neurotoxicity of industrial chemicals. Lancet 368: 2167-2178.

Grandjean, P. and P.J. Landrigan. 2014. Neurobehavioral effects of developmental toxicity. The Lancet 13: 330-338.

Hazardous Substance Database (HSDB). 2014. Entry for methylethylketoxime (CAS# 96-29-7). United States National Library of Medicine. Available: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

Pharos. 2014. Pharos Chemical and Material Library Entry for Methylethylketoxime (CAS# 96-29-7). Available: http://www.pharosproject.net/material/.

ToxServices. 2013. SOP 1.69: GreenScreen® Hazard Assessments. Dated: August 17, 2013.

United States Department of Transportation (U.S. DOT). 2008a. Chemicals Listed with Classification. 49 CFR § 172.101. Available: http://www.gpo.gov/fdsys/pkg/CFR-2008-title49-vol2/pdf/CFR-2008-title49-vol2-sec172-101.pdf.

United States Department of Transportation (U.S. DOT). 2008b. Classification Criteria. 49 CFR § 173. Available: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title49/49cfr173_main_02.tpl.

United States Environmental Protection Agency (U.S. EPA). 2012a. Estimation Programs Interface (EPI) Suite™ Web, v4.11, Washington, DC, USA. Available: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm.

APPENDIX A: Hazard Benchmark Acronyms
(in alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(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: Results of Automated GreenScreen® Score Calculation for Methylethylketoxime (CAS# 96-29-7)

TOXSERVICES
TOXICOLOGY RISK ASSESSMENT CONSULTING

GREEN SCREEN FOR SAFER CHEMICALS

GreenScreen® Score Inspector

Table 1: Hazard Table

			Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
			Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details									S	R *	S	R *	*	*								
Inorganic Chemical?	**Chemical Name**	**CAS#**	**C**	**M**	**R**	**D**	**E**	**AT**	**STs**	**STr**	**Ns**	**Nr**	**SNS***	**SNR***	**IrS**	**IrE**	**AA**	**CA**	**P**	**B**	**Rx**	**F**
No	**Methylethylketoxime**	**96-29-7**	**H**	DG	DG	DG	DG	**M**	DG	DG	DG	DG	**H**	DG	DG	**vH**	**H**	**M**	*M*	**vL**	DG	DG

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	No	No	Yes		
2	STOP						
3	STOP						
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Methylethylketoxime	1

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

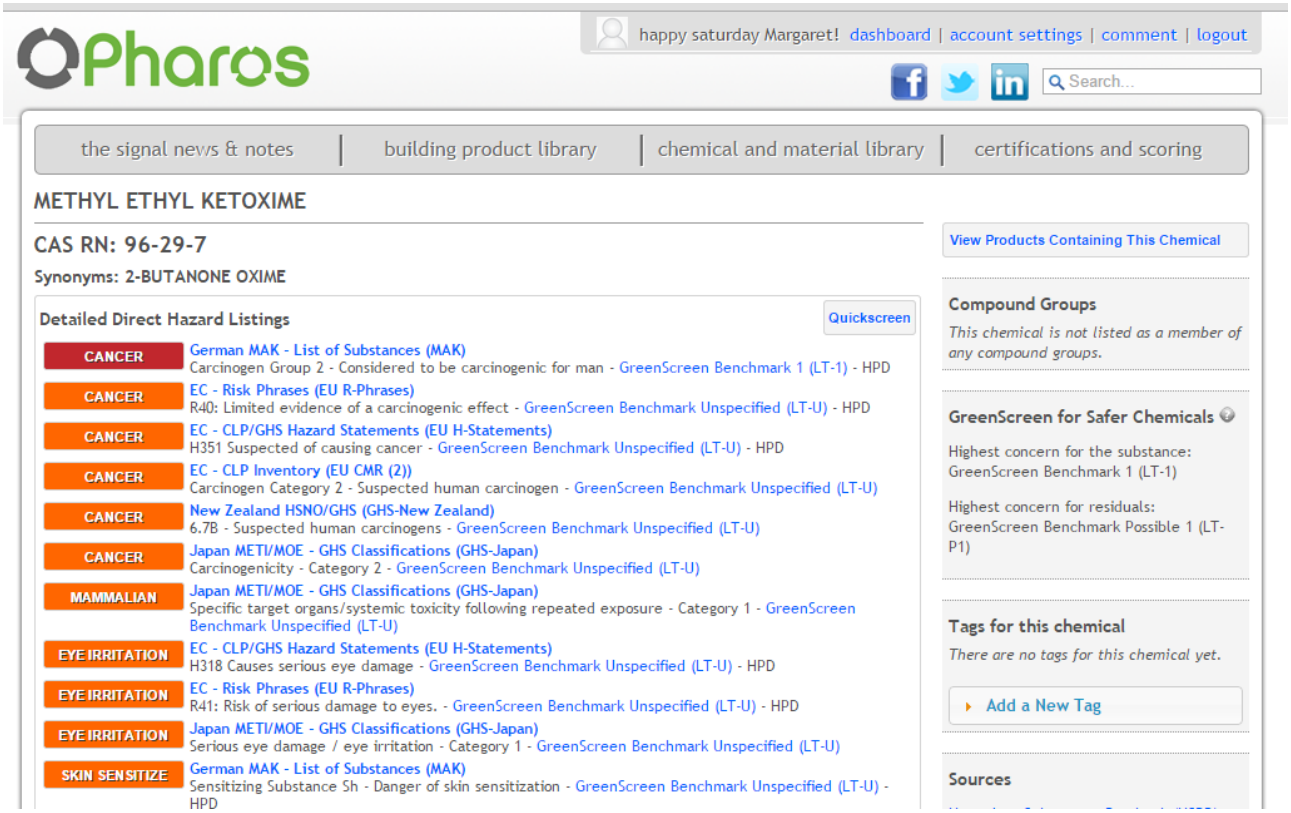
Chemical Name	Final GreenScreen® Benchmark Score
Methylethylketoxime	1

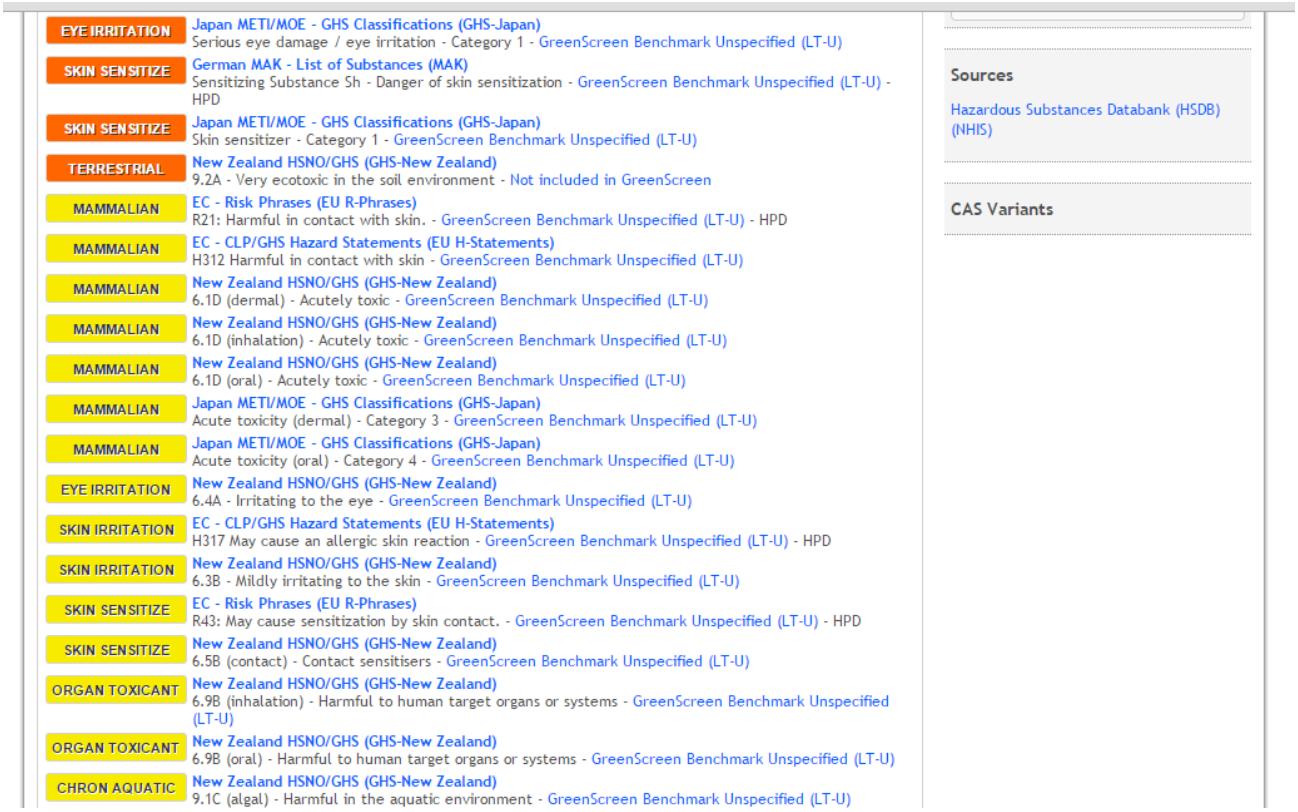
After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

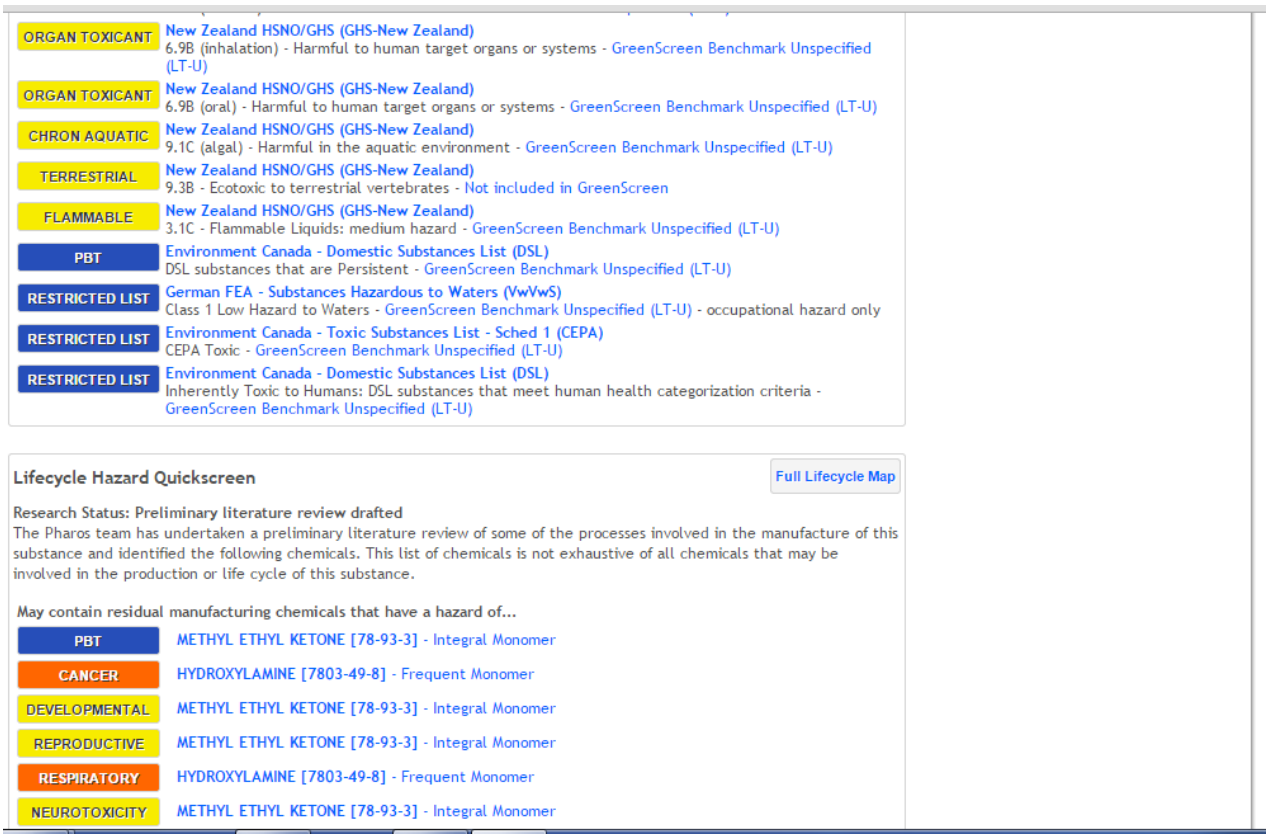
Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												1
2												
3												
4												

APPENDIX C: Pharos Output for Methylethylketoxime (CAS# 96-29-7)







ORGAN TOXICANT	New Zealand HSNO/GHS (GHS-New Zealand) 6.9B (inhalation) - Harmful to human target organs or systems - GreenScreen Benchmark Unspecified (LT-U)
ORGAN TOXICANT	New Zealand HSNO/GHS (GHS-New Zealand) 6.9B (oral) - Harmful to human target organs or systems - GreenScreen Benchmark Unspecified (LT-U)
CHRON AQUATIC	New Zealand HSNO/GHS (GHS-New Zealand) 9.1C (algal) - Harmful in the aquatic environment - GreenScreen Benchmark Unspecified (LT-U)
TERRESTRIAL	New Zealand HSNO/GHS (GHS-New Zealand) 9.3B - Ecotoxic to terrestrial vertebrates - Not included in GreenScreen
FLAMMABLE	New Zealand HSNO/GHS (GHS-New Zealand) 3.1C - Flammable Liquids: medium hazard - GreenScreen Benchmark Unspecified (LT-U)
PBT	Environment Canada - Domestic Substances List (DSL) DSL substances that are Persistent - GreenScreen Benchmark Unspecified (LT-U)
RESTRICTED LIST	German FEA - Substances Hazardous to Waters (VwVwS) Class 1 Low Hazard to Waters - GreenScreen Benchmark Unspecified (LT-U) - occupational hazard only
RESTRICTED LIST	Environment Canada - Toxic Substances List - Sched 1 (CEPA) CEPA Toxic - GreenScreen Benchmark Unspecified (LT-U)
RESTRICTED LIST	Environment Canada - Domestic Substances List (DSL) Inherently Toxic to Humans: DSL substances that meet human health categorization criteria - GreenScreen Benchmark Unspecified (LT-U)

Lifecycle Hazard Quickscreen — Full Lifecycle Map

Research Status: Preliminary literature review drafted

The Pharos team has undertaken a preliminary literature review of some of the processes involved in the manufacture of this substance and identified the following chemicals. This list of chemicals is not exhaustive of all chemicals that may be involved in the production or life cycle of this substance.

May contain residual manufacturing chemicals that have a hazard of...

PBT	METHYL ETHYL KETONE [78-93-3] - Integral Monomer
CANCER	HYDROXYLAMINE [7803-49-8] - Frequent Monomer
DEVELOPMENTAL	METHYL ETHYL KETONE [78-93-3] - Integral Monomer
REPRODUCTIVE	METHYL ETHYL KETONE [78-93-3] - Integral Monomer
RESPIRATORY	HYDROXYLAMINE [7803-49-8] - Frequent Monomer
NEUROTOXICITY	METHYL ETHYL KETONE [78-93-3] - Integral Monomer

APPENDIX D: EPISuite Results for Methylethylketoxime (CAS# 96-29-7)

CAS Number: 96-29-7
SMILES : C(CC)(=NO)C
CHEM :
MOL FOR: C4 H9 N1 O1
MOL WT : 87.12
---------- EPI SUMMARY (v4.11) ----------

Physical Property Inputs:
Log K_{ow} (octanol-water): ------
Boiling Point (deg C): ------
Melting Point (deg C): -29.50
Vapor Pressure (mm Hg): ------
Water Solubility (mg/L): ------
Henry LC (atm-m^3/mole): ------

Log Octanol-Water Partition Coef (SRC):
Log K_{ow} (K_{ow}WIN v1.68 estimate) = 1.69
Log K_{ow} (Exper. database match) = 0.63
Exper. Ref: CHEMICALS INSPECTION AND TESTING INSTITU (1992)

Boiling Pt, Melting Pt, Vapor Pressure Estimations (MPBPVP v1.43):
Boiling Pt (deg C): 157.13 (Adapted Stein & Brown method)
Melting Pt (deg C): -57.96 (Mean or Weighted MP)
VP (mm Hg,25 deg C): 1.17 (Mean VP of Antoine & Grain methods)
VP (Pa, 25 deg C): 157 (Mean VP of Antoine & Grain methods)
MP (exp database): -29.5 deg C
BP (exp database): 152.5 deg C

Water Solubility Estimate from Log K_{ow} (WSK_{ow} v1.42):
Water Solubility at 25 deg C (mg/L): 5.685e+004
log K_{ow} used: 0.63 ($expK_{ow}$ database)
melt pt used: -29.50 deg C
Water Sol (Exper. database match) = 1e+005 mg/L (25 deg C)
Exper. Ref: HEDOC

Water Sol Estimate from Fragments:
Wat Sol (v1.01 est) = 2010.6 mg/L

ECOSAR Class Program (ECOSAR v1.11):
Class(es) found:
Aliphatic Amines

Henrys Law Constant (25 deg C) [HENRYWIN v3.20]:
Bond Method: 1.04E-005 atm-m^3/mole (1.05E+000 Pa-m^3/mole)
Group Method: Incomplete
For Henry LC Comparison Purposes:
User-Entered Henry LC: not entered

Henrys LC [via VP/WSol estimate using User-Entered or Estimated values]:
HLC: 2.359E-006 atm-m^3/mole (2.390E-001 Pa-m^3/mole)
VP: 1.17 mm Hg (source: MPBPVP)
WS: 5.69E+004 mg/L (source: $WSK_{ow}WIN$)

Log Octanol-Air Partition Coefficient (25 deg C) [K_{oa}WIN v1.10]:
Log K_{ow} used: 0.63 (exp database)
Log K_{aw} used: -3.371 (HenryWin est)
Log K_{oa} (K_{oa}WIN v1.10 estimate): 4.001
Log K_{oa} (experimental database): None

Probability of Rapid Biodegradation (BIOWIN v4.10):
Biowin1 (Linear Model): 0.7061
Biowin2 (Non-Linear Model): 0.8547
Expert Survey Biodegradation Results:
Biowin3 (Ultimate Survey Model): 3.0066 (weeks)
Biowin4 (Primary Survey Model): 3.7220 (days-weeks)
MITI Biodegradation Probability:
Biowin5 (MITI Linear Model): 0.5032
Biowin6 (MITI Non-Linear Model): 0.6175
Anaerobic Biodegradation Probability:
Biowin7 (Anaerobic Linear Model): 0.7029
Ready Biodegradability Prediction: YES

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

Sorption to aerosols (25 Dec C)[AEROWIN v1.00]:
Vapor pressure (liquid/subcooled): 140 Pa (1.05 mm Hg)
Log K_{oa} (K_{oa}win est): 4.001
Kp (particle/gas partition coef. (m^3/µg)):
Mackay model: 2.14E-008
Octanol/air (K_{oa}) model: 2.46E-009
Fraction sorbed to airborne particulates (phi):
Junge-Pankow model: 7.74E-007
Mackay model: 1.71E-006
Octanol/air (K_{oa}) model: 1.97E-007

Atmospheric Oxidation (25 deg C) [AopWin v1.92]:
Hydroxyl Radicals Reaction:
OVERALL OH Rate Constant = 1.4834 E-12 cm^3/molecule-sec
Half-Life = 7.211 Days (12-hr day; 1.5E6 OH/cm^3)
Half-Life = 86.527 Hrs.
Ozone Reaction:
No Ozone Reaction Estimation
Fraction sorbed to airborne particulates (phi):
1.24E-006 (Junge-Pankow, Mackay avg)
1.97E-007 (K_{oa} method)
Note: the sorbed fraction may be resistant to atmospheric oxidation

Soil Adsorption Coefficient (K_{oc}WIN v2.00):
K_{oc}: 115.8 L/kg (MCI method)
Log K_{oc}: 2.064 (MCI method)
K_{oc}: 3.519 L/kg (K_{ow} method)
Log K_{oc}: 0.546 (K_{ow} 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 = 0.500 (BCF = 3.162 L/kg wet-wt)
Log Biotransformation Half-life (HL) = -1.0525 days (HL = 0.08862 days)
Log BCF Arnot-Gobas method (upper trophic) = 0.074 (BCF = 1.186)
Log BAF Arnot-Gobas method (upper trophic) = 0.074 (BAF = 1.186)
log K_{ow} used: 0.63 (expk_{ow} database)

Volatilization from Water:
Henry LC: 1.04E-005 atm-m^3/mole (estimated by Bond SAR Method)
Half-Life from Model River: 53.5 hours (2.229 days)
Half-Life from Model Lake: 661.9 hours (27.58 days)

Removal In Wastewater Treatment:
Total removal: 2.43 percent
Total biodegradation: 0.09 percent
Total sludge adsorption: 1.76 percent
Total to Air: 0.58 percent
(using 10000 hr. Bio P,A,S)

Level III Fugacity Model:

	Mass Amount (percent)	Half-Life (hr.)	Emissions (kg/hr.)
Air	5.19	173	1000
Water	26.4	360	1000
Soil	68.2	720	1000
Sediment	0.17	3.24e+003	0

Persistence Time: 464 hr.

Sources to Check for GreenScreen® Hazard Assessment

Note: For a GreenScreen® Hazard Assessment, data queries should be initially limited to the following references. If data gaps exist after these references have been checked, additional references may be utilized.

U.S. EPA High Production Volume Information System (HPVIS):
http://www.epa.gov/hpvis/index.html

UNEP OECD Screening Information Datasets (SIDS):
http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html

OECD Existing Chemicals Database: http://webnet.oecd.org/hpv/ui/SponsoredChemicals.aspx

European Chemical Substances Information System IUCLID Chemical Data Sheets:
http://esis.jrc.ec.europa.eu/index.php?PGM=dat

National Toxicology Program: http://ntp.niehs.nih.gov/

International Agency for the Research on Cancer:
http://monographs.iarc.fr/ENG/Classification/index.php

Human and Environmental Risk Assessment (HERA) on ingredients of household cleaning products:
http://www.heraproject.com/RiskAssessment.cfm

European Chemicals Agency (ECHA) REACH Dossiers: http://echa.europa.eu/

Licensed GreenScreen® Profilers

Methylethylketoxime GreenScreen® Evaluation Prepared by:

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