Substance Profile for The Challenge
Naphthalene
CAS No. 91-20-3

Introduction

The *Canadian Environmental Protection Act, 1999* (CEPA 1999) required the Minister of Health and Minster of the Environment to categorize the approximately 23 000 substances on the Domestic Substances List (DSL). Categorization involved identifying those substances on the DSL considered to be persistent (P) and/or bioaccumulative (B), based on criteria set out in the *Persistence and Bioaccumulation Regulations* (Government of Canada, 2000), and "inherently toxic" (iT) to humans or other organisms, or that present, to individuals in Canada, the greatest potential for exposure (GPE).

Further to this activity, the Act requires the Minister of the Environment and the Minister of Health to conduct screening assessments of substances that meet the categorization criteria. A screening assessment involves a scientific evaluation of available information for a substance using available information to determine whether the substance meets the criteria set out in section 64 of CEPA 1999. Based on the results of a screening assessment, the Ministers can propose taking no further action with respect to the substance, adding the substance to the Priority Substances List (PSL) for further assessment or recommending the addition of the substance to the List of Toxic Substances in Schedule 1 of CEPA 1999 and, where applicable, the implementation of virtual elimination of releases to the environment.

A number of substances have been identified by the Ministers as high priorities for action based on the information obtained through the categorization process. This includes substances:

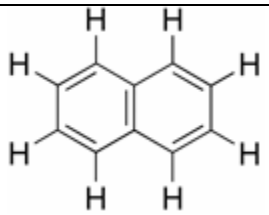
- that were found to meet all of the ecological categorization criteria, including persistence, bioaccumulation potential and inherent toxicity to aquatic organisms (PBiT), and that are known to be in commerce in Canada, and/or
- that were found either to meet the categorization criteria for GPE or to present an intermediate potential for exposure (IPE), and were identified as posing a high hazard to human health based on available evidence on carcinogenicity, mutagenicity, developmental toxicity or reproductive toxicity.

Based on a consideration of the ecological and/or human health concerns associated with these substances, and the requirement under section 76.1 of CEPA 1999 for the Ministers to apply a weight of evidence approach and the precautionary principle when conducting and interpreting the results of an assessment, sufficient data are currently available to consider these substances as meeting the criteria under Section 64 of CEPA 1999.

As such, the Ministers have issued a Challenge to industry and other interested stakeholders through publication in Canada Gazette Part I December 9, 2006 to submit, within the timelines stated in the Challenge section of this document, below, specific information that may be used to develop and benchmark best practices for risk management and product stewardship.

The substance naphthalene was identified as a high priority for action as it was determined to have a high potential for exposure to individuals in Canada (GPE or IPE), and is considered to present a high hazard to human health. The technical human health and ecological information that formed the basis for the prioritization of this substance is contained in Appendices I and II, respectively.

Substance Identity

CAS Registry Number (NCI)	*91-20-3*
Inventory names	*Naphthalene*
Other names	*Albocarbon; Camphor Tar; Dezodorator; Mighty 150; Mighty RD1; Moth Balls; Moth flakes; Naftalen; Naphtalene; Naphthalin; Naphthaline; Naphthene; Tar Camphor; White tar*
Chemical group	*Discrete organics*
Chemical sub-group	*Aromatic*
Chemical formula	$C_{10}H_8$
Chemical structure	
SMILES	*c(c(ccc1)ccc2)(c1)c2*
Molecular mass	*128.18 g/mol*

Based on information submitted in response to a legal Notice published in 2001 under section 71 of CEPA 1999, 29 Canadian companies reported either importing or manufacturing a total quantity of 100,000,000 to 1,000,000,000 kg of naphthalene in 2000. Naphthalene is reported to be used in Canada for a variety of uses in a number of sectors, including pesticide/herbicide/biocide/disinfectant/repellent, metallurgical, chemical manufacturing/analysis, paint and coating, fuel and fuel additive, and petroleum and natural gas. Other uses of the substance in Canada include as a binder, solvent/carrier, and oil additive. It can also be used in plating and surface finishing.

THE CHALLENGE

Respecting direction under section 76.1 of CEPA 1999, information obtained during conduct of categorization is sufficient to conclude that criteria under Section 64 of CEPA 1999 are met for this substance in that it "may enter the environment in a quantity or concentration or under conditions that constitute or may constitute a danger in Canada to human life or health". As such, the Ministers are prepared to recommend to the Governor in Council that this substance be added to the List of Toxic Substances in Schedule 1 of CEPA 1999 with the intent of initiating the development of risk management measures taking into account socio-economic considerations. The measures will be subject to review in light of new scientific information, including monitoring and ongoing assessment activities.

Opportunity to Submit Additional Information on Current Uses and Existing Control Measures to Inform the Risk Management Approach for this Substance

The Ministers of Health and Environment are inviting the submission of additional information that is deemed beneficial by interested stakeholders, relating to the extent and nature of the management/stewardship of substances listed under the Challenge.

Organizations that may be interested in submitting additional information in response to this invitation include those that manufacture, import, export or use this substance whether alone, in a mixture, in a product or in a manufactured item.

Additional information is being invited in the following areas:

- Import, manufacture and use quantities
- Substance and product use details
- Releases to the environment and spill management
- Current and potential risk management and product stewardship actions
- Existing legislative or regulatory programs controlling/managing the substance
- Information to support the development of a regulatory impact assessment.

A questionnaire is available which provides a detailed template as an example for the submission of this information. Guidance on how to respond to the challenge questionnaire is also available. Interested stakeholders are invited to provide available additional information, recognizing that not all questions in the questionnaire may be relevant to a particular substance, use, or industrial sector.

Copies of the questionnaire and associated guidance are available from the Government of Canada Chemicals Portal (www.chemicalsubstanceschimiques.gc.ca)**,** or from the contact provided below.

Responses to the questionnaire should be received at the address provided below by June 5, 2007.

Request for Documents and Submission of Information

Documents and instructions may be requested from the following contact. Information in response to the above Challenge must be submitted to this address.

DSL Surveys Coordinator
Place Vincent Massey, 20th Floor
351 Saint Joseph Boulevard
Gatineau QC K1A 0H3
Tel: 1-888-228-0530 / 819-956-9313
Fax: 1-800-410-4314 / 819-953-4936
Email: DSL.surveyco@ec.gc.ca

Appendix I
Human Health Information to Support The Challenge for Naphthalene CAS No. 91-20-3

Introduction

Under the *Canadian Environmental Protection Act, 1999* (CEPA, 1999), Health Canada undertook to categorize all substances on the Domestic Substances List (DSL) to identify those representing the greatest potential for human exposure (GPE) and those among a subset of substances considered persistent (P) and/or bioaccumulative (B) that are also considered to be "inherently toxic" to humans.

In order to efficiently identify substances that represent the highest priorities for screening assessment from a human health perspective, Health Canada developed and applied a Simple Exposure Tool (SimET) to the DSL to identify those substances that meet the criteria for GPE, Intermediate Potential for Exposure (IPE) or Low Potential for Exposure (LPE), and a Simple Hazard Tool (SimHaz) to identify those substances that pose a high or a low hazard.

Naphthalene is considered to meet the criteria for GPE under SimET and for high hazard under SimHaz. This document summarizes the currently available information used to support the inclusion of this substance in the Challenge.

Exposure Information from Health Related Components of DSL Categorization

As mentioned above, SimET was developed and used to identify substances on the DSL considered to represent GPE. This approach was based on three lines of evidence: 1) the quantity in commerce in Canada, 2) the number of companies involved in commercial activities in Canada (i.e., number of notifiers), and 3) the consideration by experts of the potential for human exposure based on various use codes. The proposed approach was released for public comment in November 2003 and also enabled designation of substances as presenting an Intermediate (IPE) or Lowest Potential for Exposure (LPE), based on criteria for quantity and nature of use (Health Canada, 2003).

Results of the Application of SimET

Naphthalene been determined to be GPE based on a consideration of the DSL nomination information listed below.

Nomination Information for DSL

Quantity in Commerce

The quantity reported to be manufactured, imported or in commerce in Canada during the calendar year 1986 was 21,200,000 kg.

Number of Notifiers

The number of notifiers for the calendar years 1984-1986 was 13.

Use Codes and Description

The following DSL use codes have been identified for the substance:

05- Analytical reagent
10- Chemical intermediate- organic
21- Formulation component
22- Fragrance/perfume/ deodorizer/ flavouring agent
23- Fuel/ fuel additive
31- Pesticide/ herbicide/ biocide/ disinfectant/ repellent
44- Solvent/ carrier
51- Function other than that listed in codes 02-50
57- Biotechnology
71- Metallurgical
76- Organic chemicals, industrial
80- Paint and coating
82- Petroleum and natural gas
88- Plating, surface finishing
93- Soap and cleaning products

Results of Responses to Section 71(1)(b) Notice under CEPA, 1999 from November, 2001(Environment Canada, 2006)

A *Notice with Respect to Certain Substances on the Domestic Substances List (DSL)* was published on November 17th, 2001 pursuant to section 71 of the *Canadian Environmental Protection Act, 1999* requesting industrial information on manufactured and imported quantities, uses and release levels for the year 2000, for substances listed in the notice. Naphthalene was listed in the notice and any person who manufactured or imported naphthalene, alone, as a mixture or in a product, in a total quantity above 10,000 kilograms was legally obligated to provide information. For substances, mixtures or products containing naphthalene at a concentration of less than (<1% w/w), only the CAS registry number was required..

Distribution of Companies and Ranges of Quantities Imported and Manufactured in Canada for the year 2000:

Eighteen importers of naphthalene, CAS No. 91-20-3, reported for year 2000, with 3 falling in the 1,000 to 10,000 kg/year range, 6 in the 10,000 to 100,000 kg/year range, 5 in the 100,000 to 1,000,000 kg/year range, 1 in the 1,000,000 to 10,000,000 kg/year range and 3 over the 10,000,000 kg/year import level.

Twelve Canadian manufacturers of naphthalene reported for year 2000, with 1 falling in the 100 to 1,000 kg/year range, 3 in the 10,000 to 100,000 kg/year range, 3 in the 100,000 to 1,000,000 kg/year range, 4 in the 1,000,000 to 10,000,000 kg/year range and 1 reporting over 10,000,000 kg manufactured/year in Canada.

Based on the above reported quantities, the total quantity of naphthalene imported and manufactured in Canada for the year 2000 was between 100,000,000 to 1,000,000,000 kg. In comparison, data compiled when the DSL was being prepared estimated that in Canada between 1984 and 1986, more than 1,000,000 kg of naphthalene was manufactured, imported or found in commerce.

Trade and Product Names

The following is a list of products and trade names that were reported by companies who either didn't request any confidentiality or who specified confidentiality for quantities only. This list includes crude Coal Tar, cooling tower emission, Hitec 4110, pyrolysis gasoline, light oil, coal tar, automotive finish intermediates and resale, fuel additive, binder (resin), glid-guard epoxy, paint solvent, purge solvent, plastisol FV-8048, MOBILAD G310B, Solvesso 150 Solvent, Solvesso 200 Solvent, VARSOL 140 Solvent, crude oil, shellsol A150, Diaryl Sulphate, Octel Starreon and Octel Starreon Stadis 4.

Industrial and Consumer Uses

The reported industrial use patterns for naphthalene are destructive, dispersive, non-dispersive, cosmetics and pharmaceuticals.

The reported consumer use patterns for naphthalene are destructive, dispersive and non-dispersive.

Industrial Use Patterns

For the industrial uses, one company reported that crude coal tar is used in the manufacturing of construction materials and electrodes e.g. for the aluminium industry.

Light oil containing naphthalene is used as a chemical industry feedstock and coal tar containing naphthalene is used as construction industry feedstock. Another company reported that Pyrolysis gasoline is a contaminant in feedstock that is exported for olefins aromatics production. Crude oil containing naphthalene is also a known feedstock.

One company reported four trade names along with its industrial uses: Binder (resin) is mixed into sand to harden core, Glid-guard epoxy is used as a purge solvent, paint and purge solvents are both used as paint solvents and that plastisol FV-8048 is used as a sealer solvent.

Another company reported four trade names along with its industrial uses: MOBILAD G310B is used as a gear oil additive; Solvesso 150 Solvent, Solvesso 200 Solvent and VARSOL 140 Solvent are all used as solvents. In addition, another company reported that naphthalene in Diaryl Sulphate is used as a solvent, whereas, naphthalene in Octel Starreon Satacen and Octel Starreon Stadis 4 are used as a fuel additives.

Shellsol A150 is used as solvent and pharmaceutical or agricultural products intermediate and Cooling Tower Emission is used for emissions.

Consumer Use Patterns

Naphthalene is known to be used in wood preservatives, driveway sealants and in moth preventatives which may occur in various forms such as mothballs and flakes.

One company reported that naphthalene was used as a professional application of paint and its products are not sold directly for consumer use but rather are marketed to industrial customers who in turn produce products for consumer applications.

Naphthalene is also used in paint and fuel additive products. An example of the latter is Hitec 4110 for diesel fuels.

Hazard Information from Health Related Components of DSL Categorization

Simple Hazard Tool (SimHaz)

SimHaz is a tool that has been used to identify, among all of the approximately 23 000 substances on the DSL, those considered to present either high or low hazard to human health based on formalized weight of evidence criteria and/or peer review/consensus of experts. This tool has been developed through extensive compilation of hazard classifications of Health Canada and other agencies and consideration of their robustness based on availability of transparent documentation of both process and criteria (Health Canada, 2005).

Results of the Application of SimHaz

Naphthalene is considered to be a potentially high hazard substance based on its classification for carcinogenicity by the European Commission, United States National Toxicology Program (NTP), International Agency for Research on Cancer (IARC) and the United States Environmental Protection Agency (US EPA).

The European Commission has classified Naphthalene as Category 3 for carcinogenicity (Causes concerns for humans owing to possible carcinogenic effects). The European Commission noted that the 'available information is not adequate for making a satisfactory assessment' of carcinogenic effects in humans. 'There is some evidence for carcinogenicity from appropriate animal studies but it is insufficient to place the substance in Category 2' (European Commission, 2002; European Chemicals Bureau, 2003; European Commission, 2004; ESIS, 2006).

The NTP has classified Naphthalene as 'Reasonably anticipated to be a human carcinogen' based on sufficient evidence from studies in experimental animals' (NTP, 2004).

IARC has classified Naphthalene as Group 2B (Agent is possibly carcinogenic to humans) (IARC, 2002). IARC noted that there is 'inadequate evidence in humans for the carcinogenicity of naphthalene', but there is 'sufficient evidence in experimental animals for the carcinogenicity of naphthalene' (IARC, 2002).

The US EPA has classified Naphthalene as Group C (Possible human carcinogen) 'based on inadequate data of carcinogenicity in humans' and 'limited evidence of carcinogenicity in animals via the oral and inhalation routes' (US EPA, 1998).

Uncertainties

SimET and SimHaz have been developed as robust tools for effectively identifying substances from the DSL that are considered to be human health related priorities for further consideration. It is recognized that they do not include a number of elements normally considered in a human health risk assessment such as a comprehensive characterization of exposure and hazard, a comparison of exposure metrics to hazard metrics and a detailed analysis of uncertainties. However, as a result of the combination of the severe hazard properties of these substances and their high potential for exposure to humans, evaluation of whether there is a need for preventative and protective actions is required.

References

Environment Canada. 2006. Naphthalene Preliminary Report of Section 71 (CEPA, 1999) Notice with Respect to Certain Substances on the Domestic Substances List (DSL) Version 2.0 December PROTECTED B Confidentiality

ESIS. 2006. CAS No. 91-20-3. Naphthalene. ESIS Version 4.50 European Chemical Substances Information System. http://ecb.jrc.it/esis/

European Chemicals Bureau. 2003. European Union Risk Assessment Report: Naphthalene, Volume 33. European Commission - Joint Research Centre, Institute for Health and Consumer Protection, European Chemicals Bureau. EUR 20763 EN. http://ecb.jrc.it/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/naphthalenereport020.pdf

European Commission. 2002. Summary Record: Meeting of the Commission Working Group on the Classification and Labelling of Dangerous Substances, ECB Ispra, 30 May-1 June 2001. ECBI/42/01 Rev. 4 24 January 2002. European Commission- Joint Research Centre, Institute for Health and Consumer Protection, European Chemicals Bureau. http://ecb.jrc.it/classification-labelling/MEETINGS/public.htm

European Commission. 2004. Naphthalene. Commission Directive 2004/73/EC of 29 April 2004. Annex 1B. Official Journal of the European Communities 16.6.2004. L 216/28. European Commission. 29th ATP. http://ecb.jrc.it/documents/Classification-Labelling/ATPS_OF_DIRECTIVE_67-548-EEC

Health Canada. 2003. Proposal for Priority Setting for Existing Substances on the Domestic Substances List under the Canadian Environmental Protection Act, 1999: Greatest Potential for Human Exposure. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/existsub/exposure/greatest_potential_human_exposure-risque_exposition_humaine_e.pdf

Health Canada. 2005. Proposed Integrated Framework for the Health-Related Components of Categorization of the Domestic Substances List under CEPA 1999. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/contaminants/existsub/framework-int-cadre_e.pdf

IARC. 2002. IARC Monographs on the evaluation of the carcinogenic risk of chemicals to humans: Volume 82. Some Traditional herbal medicines, some mycotoxins, naphthalene and styrene. World Health Organization. International Agency for Research on Cancer. Lyon, France. p 367-435. http://monographs.iarc.fr/ENG/Monographs/vol82/volume82.pdf

NTP. 2004. Report on Carcinogens, 11th edition. Substance Profiles: Naphthalene. U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program. Accessed October 25, 2006 on the World Wide Web: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s116znph.pdf

US EPA. 1998. Toxicological Review of Naphthalene (CAS No. 91-20-3) In support of summary information on the Integrated Risk Information System (IRIS). United States Environmental Protection Agency. 116 pp. http://www.epa.gov/iris/subst/0436.htm

Appendix II
Ecological Information
to Support The Challenge for
Naphthalene
CAS No. 91-20-3

Introduction

The information in this document will form the basis of a screening assessment under section 74 of CEPA, 1999. Data relevant to an ecological screening assessment were identified in original literature, review documents, commercial and government databases prior to December 2005. Properties and characteristics may also have been estimated using Quantitative Structure Activity Relationship (QSAR) models. In addition, an industry survey was conducted for the year 2000 through a Canada Gazette Notice issued pursuant to section 71 of CEPA 1999 (Environment Canada, 2001). This Notice requested data on the Canadian manufacture, import, uses and releases of the substance.

Physical and Chemical Properties

Table 1 contains experimental and modelled physical-chemical properties of *Naphthalene* which are relevant to its environmental fate.

Manufacture, Importation, and Uses

Manufacture and Importation

Refer to Appendix I

Uses

Refer to Appendix I

Pesticidal uses of naphthalene are registered under the *Pest Control Products Act* and as such are not covered under CEPA.

Table 1. Physical and chemical properties for naphthalene.

Property	Type	Measured	Temperature (C°)	Reference
Molecular formula		$C_{10}H_8$		American Chemical Society. 2000
Molecular mass		128.19		ATSDR, 1995
Melting point	Experimental	80.5°C		ATSDR, 1995
Boiling point	Experimental	218°C		ATSDR, 1995
Density	Experimental	1.145 g/mL		ATSDR, 1995
		1.175 g/mL	20°C	GDCh-Advisory Committee, 1989
Vapour pressure	Experimental	8.7E-2 mm Hg		ATSDR, 1995
		7.8E-2 mmHg	25°C	IPCS, 1998
		4.89E-2 mmHg	20°C	
Henry's Law constant	Experimental	4.6E-4 atm-m3/mole		ATSDR, 1995
		1.179E-3 atm-m3/mole		Mackay, D. et al.
		3.75E-4 atm-m3/mole		Mackay, D. et al.
Log K_{ow}	Experimental	3.20-3.59		GDCh-Advisory Committee, 1989
		3.29		ATSDR, 1995
		3.4		IPCS, 1998
		3.01-4.7		Environment Canada, 1995
Water solubility	Experimental	22-33.5 mg/L	25°C	GDCh-Advisory Committee, 1989
		23.5	20°C (SW)	GDCh-Advisory Committee, 1989
		31.7 mg/L	20°C	ATSDR, 1995
Other solubilities	Experimental	20 g/L	20-25°C alcohol	GDCh-Advisory Committee, 1989
		1130 g/L	41°C Benzene	GDCh-Advisory Committee, 1989
		910 g/L	41°C toluene	GDCh-Advisory Committee, 1989
Log Koc	Experimental	2.97		ATSDR, 1995
		3.02		Chin, Y.P. and W.J.J.R Weber, 1989
		2.74-3.12		Syracuse Research Corporation, Chemfate: Http://esc_plaza.syyres.com

Releases, Fate and Presence in the Environment

Releases

Also refer to Appendix I

Naphthalene is released naturally to the environment during forest fires as it is a natural combustion product of wood (IARC, 2002).Entry of naphthalene in the environment however, is mainly from anthropogenic sources, primarily from combustion of wood for the purposes of residential heating (~50%), or the use of naphthalene in moth repellants (ASTDR, 1995; IPCS, 1998). Approximately 10% can be attributed to coal production and distillation. Naphthalene would also be released by the same sources as other polycyclic aromatic hydrocarbons (PAH) that have been assessed under the Priority Substance Assessment Program (EC, 1994) and are now listed on CEPA's schedule 1 List of toxic substances. Direct naphthalene production is believed to result in comparatively low releases (<1% of all emissions) due to the use of a closed system and recycling (IARC, 2002). The National Pollutant Release Inventory (NPRI) has tracked the release of naphthalene from industrial facilities in Canada since the 1990s. Most recent reporting (2005) indicates on-site releases of 119.682 tonnes, which is an increase from previous years.(EC, 2006). The Great Lakes Commission estimated 7577.84 tonnes of Naphthalene were emitted to air by the eight Great Lake States and the Province of Ontario combined in 1998 (Great Lakes Commission, 2002).

Fate

Aquatic fate

The log K_{oc} value of 2.97 (Table 1) indicate that adsorption of Naphthalene to sediment and suspended organic matter will be relatively small, it is expected that only a small fraction (<10%) of naphthalene in typical surface water would be associated with particulate matter (Thomann and Mueller 1987). Volatilization from water surface to the atmosphere, based upon the Henry's Law constant range of experimental values (3.75×10^{-4} atm · m^3/mole – 1.179×10^{-3} atm · m^3/mole), is likely an important route of naphthalene loss from water. Thus, if released to water, Naphthalene is expected to mainly remain in water, with a small amount partitioning to air and sediment, which is illustrated by the results of Level III Fugacity modelling (Table 2).

Table 2: Results of the Level III fugacity modelling (EPIWIN V3.04) for Naphthalene

Receiving media	% in Air	% in Water	% in Soil	% in Sediment
Air (100%)	90.5	4.81	4.44	0.218
Water (100%)	2.19	93.5	0.107	4.23
Soil (100%)	0.143	0.379	99.5	0.0172
Air, water, soil (33.3% each)	1.03	12.8	85.6	0.578

Terrestrial fate

Based on the range of experimentally obtained log K_{oc} values (2.74-3.12) (Table 1), depending on the amount of organic carbon, naphthalene should have moderate sorption to soil and, therefore, moderate mobility in this environmental compartment. Volatilization of this chemical from aerated soil surfaces is expected given its vapour pressure (4.89×10^{-2} - 8.7×10^{-2} mmHg) and Henry's Law constant (3.75×10^{-4} atm · m^3/mole – 1.179×10^{-3} atm · m^3/mole). however, if released to soil, naphthalene is expected to remain mainly in soil, which can be illustrated by the results of Level III Fugacity modelling (Table 2).

Atmospheric fate

If released to the atmosphere, naphthalene is expected to undergo · OH radical reaction degradation (Table 3). Given naphthalene's low water solubility, physical removal from the atmosphere would be mainly by dry deposition processes. It is expected that a small amount of naphthalene will thereby partition to both water and soil, as illustrated by the results of Level III Fugacity modelling (Table 2).

Presence in the Environment

Naphthalene has been detected in ambient air, groundwater, surface water and sediments in Canada (Environment Canada, 1995; Howard, P.H, 1989; Environment Canada & Health Canada, 1994), but monitoring data relating to the measure of the substance in environmental media (air, water, soil and sediment) have not been comprehensively compiled for this document.

Evaluation of P, B and iT Properties

Environmental Persistence

The empirical biodegradation data (MITI 1992), showed 2% biodegradation over 28 days in a ready-biodegradation test (302C) for Naphthalene (Table 3). Biodegradation results obtained from the National Institute of Technology and Evaluation (NITE) database may be considered equivocal, and such data should be used with caution in a weight of evidence approach to determine biodegradability when possible. Of particular concern are the tests of reduced exposure period and the inocula used in the tests. A study of microbial diversity indicated that the methods used to supply inocula to the 302C test may result in selective enrichment of microbial strains (Liu et al. 1997). The authors of this study noted that the diversity of the microbial population produced for the 302C test was more similar to that of a groundwater sample than to that of a wastewater treatment plant sample. This reduced diversity may make biodegradation more difficult to achieve using this protocol than other standard tests. Also, some evidence is available that

suggests that the NITE biodegradability test protocol may yield lower degradation results than other protocols (Gerike and Fisher, 1979).[1]

As a polycyclic aromatic hydrocarbon (PAH), naphthalene was included in a risk assessment of PAHs previously conducted under CEPA's Priority Substance Assessment Program (Government of Canada 1994). In this assessment, PAHs in general were a concern for persistence in the environment, but naphthalene was identified as one of the more labile substances, with half lives in sediment ranging from 0.3 to 129 days. In addition, the SRC review of aerobic biodegradation (SRC 1999) indicated that this substance was readily degraded. A study provided by the Institute (Exxonmobil 2004a) demonstrated 80% mineralization in 28 days in a manometric respirometry test (OECD 301F, OECD 1992).

Considering the information above and the experimentally derived half-lives for all four compartments, air, water, soil and sediment (Table 3), the empirical evidence demonstrates that naphthalene does not meet the persistence criteria (half-lives in soil and water ≥182 days, in sediments ≥365 days) as set out in the Persistence and Bioaccumulation Regulations (Government of Canada, 2000).

Table 3. Empirical data for persistence

Medium	Fate Process	Degradation Value	Endpoint/Units	Reference
Air	·OH radical reaction	24.0	Half-life, hours	Güsten et al. 1984
Air	·OH radical reaction	19.0	Half-life, hours	Klöpffer et al 1986
Air	·OH radical reaction	8.9	Half-life, hours	Atkinson, Aschmann 1987
Air	·OH radical reaction	8.2	Half-life, hours	Biermann et al. 1985
Air	·OH radical reaction	8.0	Half-life, hours	Masclet, Mouvier 1988
Air	·OH radical reaction	8.0	Half-life, hours	Biermann et al. 1985
Air	·OH radical reaction	7.4	Half-life, hours	Atkinson, Aschmann 1986
Soil	Degradation	Appx. 2	Half-life, days	Park et al., 1990
Soil	Degradation	Appx. 2	Half-life, days	Park et al., 1990
Sediment	Biodegradation	0.125-31	Half-life, days	ATSDR, 1995
Sludge	Biodegradation	2	Biodegradation, %	MITI 1992

[1] However, for other substances, in the absence of other experimental data or grouping information, these test results will carry greater weight.

Potential for Bioaccumulation

The experimental log Kow values (3.01-4.7), and the experimental BCFs for Naphthalene do not indicate that this chemical has the potential to bioaccumulate in the environment (Table 1 & 4).

Table 4. Empirical data for bioaccumulation

Test Organism	Endpoint	Value wet wt	Reference
Arenicola marina	BCF	4.07	GDCh-Advisory Committee, 1989
Leucisus idus melanotus	BCF	30.20	GDCh-Advisory Committee, 1989
Chlorella fusca	BCF	128.82	GDCh-Advisory Committee, 1989
Daphina pulex	BCF	131.83	GDCh-Advisory Committee, 1989
Pimephales promelas	BCF	426.58	GDCh-Advisory Committee, 1989
Daphnia magna	BCF	50	Eastmond et al., 1984

The weight of evidence indicates that Naphthalene does not meet the bioaccumulation criterion (BCF, BAF > 5000) as set out in the Persistence and Bioaccumulation Regulations (Government of Canada 2000).

Ecological Effects

In the Aquatic Compartment

There is experimental evidence that Naphthalene is highly hazardous to aquatic organisms at relatively low concentrations (e.g., LC50 < 1 mg/L) [Table 5].

Table 5 Empirical data for aquatic toxicity

Test Organism	Type of Test	Endpoint	Value (mg/L)	Reference
Oncorhynchus gorbuscha	Acute 96 hour	LC50	.096	Rice and Thomas, 1989
Oncorhynchus mykiss	Acute 4 day	LC50	0.11	Black et al. 1983
Oncorhynchus mykiss	Acute 4 day	LC50	0.12	Milleman et al. 1984
Micropterus salmoides	Acute 4 day	LC50	0.51	Black et al. 1983
Micropterus salmoides	Acute 4 day	LC50	0.68	Milleman et al. 1984

In Other Media

No effects studies for non-aquatic non-mammalian organisms were found for this compound.

Potential to Cause Ecological Harm

Based on the available information, naphthalene does not persist in the environment and is not bioaccumulative based on criteria defined in the Persistence and Bioaccumulation Regulations (Government of Canada, 2000). Information on concentrations of this chemical in the environment has not been identified at this time. Experimental ecotoxicological data indicate that naphthalene poses a high hazard for aquatic organisms exposed to a chemical in water (US EPA, 1992). Information on potential impacts in other environmental compartments has not been identified.

References

Agency for Toxic Substances and Disease Registry (ATSDR), 1995. Toxicological profile for Naphthalene/1-Methylnaphthalene/2-Methylnaphthalene. 1995.

ATSDR. Toxicological Profile for Naphthalene. Agency for Toxic Substances and Disease Registry. Atlanta, Georgia. 1995 200 pgs. (Update)

Barker, J.F. Volatile Aromatic and Chlorinated Organic Contaminants in Ground Water at Six Ontario Landfills. Water Pollution Research Journal of Canada 22: 33-48 1987 (PSL2 SIDS)

Boyd, J. et al. Vancouver Harbour Benthic Environmental Quality Studies. Trace Metals and Organic Compounds in Sediments- October 1987. Environment Canada. Conservation and Protection, Pacific & Yukon Region. Vancouver, BC. 1989 62p. (EC, 1994)

BUA. Beratergremium fur Umweltrelevante Altstoffe. BUA Report 39. Naphthalene. German Chemical Society. GDCh-Advisory Committee on Existing Chemicals of Environmental Relevance (BUA). S. Hirzel, Wissenschaftliche Verlagsgesellsschaft, Stuttgart. June 1989 155 pgs.

Chemfate. Naphthalene. Syracuse Research Corporation. Http://esc_plaza.syyres.com

Chin, Y.P. and W.J.J.R Weber. Estimating the Effects of Dispersed Organic Polymers on the Sorption of Contaminants by Natural Solids. 1. A Predictive Thermodynamic Humic Substance-Organic Solute Interaction Model. Environmental Science and Technology 23: 978-84 1989 (in R9)

Dinwoodie, G. Personal Communication, Wastes and Chemicals Division. Alberta Environment 1993 (PSL2 SIDS)

Environment Canada. 2001. Section 71 Notice (CEPA, 1999). *Notice with Respect to Certain Substances on the Domestic Substances List (DSL),* Canada Gazette, November 17, 2001, Vol. 135 #46.

Environment Canada (EC), 2005. Spreadsheets of Preliminary Decisions for Ecological Categorization of Substances on DSL, Organic Substances (updated) April 2005.

Environment Canada (EC), 2006. 2005 National Pollutant Release Inventory Data. October 2006. http://www.ec.gc.ca/pdb/npri/npri_dat_rep_e.cfm

EUROPEAN COMMISSION JOINT RESEARCH CENTRE, 2003. NAPHTHALENE Summary Risk Assessment Report, 2003.

Fox, M. et al. CEH Product Review Naphthalene. Chemical Economics Handbook- SRI International. 1985 (in R6)

Gerike P, Fischer WK. 1979. A correlation study of biodegradability determinations with various chemicals in various tests. Ecotoxicology and Environmental Safety 3:159-173.

Germain, A. and C. Langlois. Contamination des eaux et des sediments en suspension du fleuve Saint Laurent par les pesticides, organochlores, les biphenyles polychlores et d'autres contaminants organiques prioritaires. Water Pollution Research Journal Of Canada 23: 602-11 1988 (PSL2 SIDS)

Government of Canada (GC), 1994, Priority Substance Assessment Program; Polycyclic aromatic hydrocarbons (Priority substances list assessment report). 1994.

Health Canada (HC) , 2002. Draft CEPA 1999 Screening Level Health Assessment Working Document. June 6, 2002

Howard, P.H. Handbook of Environmental Fate and Exposure Data For Organic Chemicals: Volume 1. Large Production and Priority Pollutants. Lewis Publishers, Chelsea, MI. 1989 p.408-20

IPCS. Environmental Health Criteria 202. Selected Non-Heterocyclic Polycyclic Aromatic Hydrocarbons. International Programme on Chemical Safety; World Health Organization, Geneva. 1998

Kieley, K.M. et al. Polynuclear Aromatic Hydrocarbons and Heterocyclic Aromatic Compounds in Sydney Harbour-A 1986 Survey, Nova Scotia. Enviornment Canada. Environmental Protection Service, AtlanticRegion. Dartmouth, N.S. EPS-5-AR-88-7 1988 41pg. (EC, 1994)

Klecka GM, Davis JW, Gray DR, et al. 1990. Natural bioremediation of organic contaminants in ground water: Cliff-Dow Superfund site. Ground Water 28(4):534-543.

Liu, W-T, T. L. Marsh, H. Cheng, and L. J. Forney. 1997. Characterization of microbial diversity by determining terminal restriction fragment length polymorphisms of genes encoding 16S rNA. Appl. Environ. Microbiol. 63:4516-4522.

Mackay, D. et al. Physical-Chemical Properties and Environmental Fate Handbook- CD-ROM

MOE. Volatile Organic Compounds Monitoring Network, Ambient Air Concentration Data Listing 1990. Ontario Ministry of the Environment. Air Resources Branch 1992 ARB-106-92 (PSL2 SIDS)

Murphy, T.P. et al. Assessment of the Coal Tar Contamination near Randle Reef, Hamiltion Harbour. Lakes Research Branch. National Water Research Institute, Burlington, ON. 1993 (EC, 1994)

NCI. National Chemical Inventory Chemical Abstracts Service (CAS) Registry. American Chemical Society. 2000

OECD. 1992. OECD Guidelines for Testing of Chemicals: Guideline 301- Ready Biodegradability. Organization for Economic Cooperation and Development, Paris, France.

PSL2 SIDS. Technical Dossier on Naphthalene from the Proposed Mechanical List-Draft. Document Prepared for the Minister' Expert Panel Advisory Panel on PSL2. Environment Canada. January 1995

SRC. 1999. Aerobic Biodegradation of Organic Chemicals in Environmental Media: A Summary of Field and Laboratory Studies. Environmental Science Center Syracuse Research Corporation. FINAL REPORT. TR 99-002

Thomann RV, Mueller JA. 1987. Principles of surface water quality modeling and control. New York, NY: Harper and Row, Publishers, 508-509.

U.S. National Library of Medicine, 2006. Hazardous Substances Data Bank http://toxnet.nlm.nih.gov June 13, 2006.

US EPA, 1980. Ambient Water Quality Criteria for Naphthalene. October 1980.

US EPA. 1992. Classification criteria for environmental toxicity and fate of industrial chemicals. Washington, DC. Office of Pollution Prevention and Toxics (OPPT), Chemical Control Division (CCD).