Screening Assessment for the Challenge

Propanedinitrile [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]-

Chemical Abstracts Service Registry Number
54079-53-7

Environment Canada
Health Canada

September 2011

Synopsis

Pursuant to section 74 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), the Ministers of the Environment and of Health have conducted a screening assessment on Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]- (CHPD), Chemical Abstracts Service Registry Number 54079-53-7. This substance was identified as a high priority for screening assessment and included in the Challenge because it was found to meet the ecological categorization criteria for persistence, bioaccumulation potential and inherent toxicity to non-human organisms and is believed to be in commerce in Canada.

The substance CHPD was not considered to be a high priority for assessment of potential risks to human health, based upon application of the simple exposure and hazard tools developed by Health Canada for categorization of substances on the Domestic Substances List. Therefore, this assessment focuses principally on information relevant to the evaluation of ecological risks.

A decision on the screening assessment of CHPD was published in the *Canada Gazette*, Part I, on July 5, 2008, as part of Batch 1 of the Challenge initiative under the Chemicals Management Plan. New data received since that publication have led to a re-evaluation and new proposed conclusions as published in this final screening assessment.

CHPD is an organic substance that is used in Canada and elsewhere as a yellow colorant dye in plastics. The substance is not naturally produced in the environment. Between 100 and 1000 kg of CHPD were imported into Canada in 2000 and in 2006, for use mainly in the colorants and plastics industry. The quantity of CHPD imported into Canada, along with consideration of likely industrial use and handling, indicate that it could potentially be released into the Canadian environment.

Based on certain assumptions such as reported use patterns, most of the substance ends up in waste disposal sites. Small proportions are estimated to be released to water (3.4%), air (0.4%) and soil (0.2%). CHPD has a very low solubility in water, is not volatile and has a tendency to partition to particles. For these reasons, CHPD will be likely found mostly in sediments and, to a lesser extent, in soil. It is not expected to be significantly present in other environmental media. It is also not expected to be subject to long-range atmospheric transport.

Based on its physical and chemical properties, CHPD does not degrade quickly in the environment. It is therefore expected to be persistent in water, soil and sediments. Following the consideration of a recent laboratory bioaccumulation study among the lines of evidence, CHPD has been determined to have a low potential to accumulate in organisms and is not likely to biomagnify in trophic food chains. The substance has been determined to meet the persistence criterion but not the bioaccumulation criterion as set out in the *Persistence and Bioaccumulation Regulations*.

Empirical and modelled acute aquatic toxicity values suggest that the substance is highly hazardous to certain aquatic organisms (LOEC/LC_{50} < 1.0 mg/L). For this final screening assessment, a conservative but refined exposure scenario was used to estimate the aquatic concentration of the substance resulting from an industrial discharge. The predicted environmental concentration in water was below the predicted aquatic no-effect concentration. This indicates that exposure is unlikely to be high enough to cause harm to aquatic organisms. Exposure for organisms in other media is expected to be negligible.

Based on the information available, it is concluded that CHPD is not entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity or that constitute or may constitute a danger to the environment on which life depends. CHPD meets the persistence criterion but does not meet the bioaccumulation criterion as set out in the *Persistence and Bioaccumulation Regulations*.

Since exposure of the general population to CHPD in Canada is expected to be low, and since no data were identified to indicate that CHPD poses a high hazard to human health based on the limited information available, it is concluded that CHPD is not entering the environment in a quantity or concentration or under conditions that constitute or may constitute a danger in Canada to human life or health.

This substance will be considered for inclusion in the Domestic Substances List inventory update initiative. In addition and where relevant, research and monitoring will support verification of assumptions used during the screening assessment.

Based on the information available, it is concluded that CHPD does not meet any of the criteria set out in section 64 of CEPA 1999.

Introduction

The *Canadian Environmental Protection Act, 1999* (CEPA 1999) (Canada 1999) requires the Minister of the Environment and the Minister of Health to conduct screening assessments of substances that have met the categorization criteria set out in the Act to determine whether these substances present or may present a risk to the environment or to human health.

Based on the information obtained through the categorization process, the Ministers identified a number of substances as high priorities for action. These include substances that

- met all of the ecological categorization criteria, including persistence (P), bioaccumulation potential (B) and inherent toxicity to aquatic organisms (iT), and were believed to be in commerce in Canada; and/or
- met the categorization criteria for greatest potential for exposure (GPE) or presented an intermediate potential for exposure (IPE) and had been identified as posing a high hazard to human health based on classifications by other national or international agencies for carcinogenicity, genotoxicity, developmental toxicity or reproductive toxicity.

The Ministers therefore published a notice of intent in the *Canada Gazette*, Part I, on December 9, 2006 (Canada 2006), that challenged industry and other interested stakeholders to submit, within specified timelines, specific information that may be used to inform risk assessment, and to develop and benchmark best practices for the risk management and product stewardship of those substances identified as high priorities.

The substance Propanedinitrile [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]-, referred to as "CHPD," was identified as a high priority for assessment of ecological risk as it was found to be persistent, bioaccumulative and inherently toxic to aquatic organisms and is believed to be in commerce in Canada.

The Challenge for this substance was published in the *Canada Gazette* on February 2, 2007 (Canada 2007). A substance profile was released at the same time. The substance profile presented the technical information available prior to December 2005 that formed the basis for categorization of this substance. As a result of the Challenge, submissions of information pertaining to the uses and quantities in Canada of the substance were received.

A first draft of the screening assessment on CHPD was published in the *Canada Gazette*, Part I, for a 60-day public comment period on January 19, 2008. Comments received during that period were considered and the screening assessment was revised accordingly. The final screening assessment on the substance was published in the *Canada Gazette*, Part I, on July 5, 2008. Following this publication, a fish dietary bioaccumulation study was carried out and submitted to Environment Canada in August 2009. The analysis of the study has led to a re-evaluation, a draft of which was published

on July 3, 2010, for public comments, and new conclusions as published in this final screening assessment.

Although CHPD was determined to be a high priority for assessment with respect to the environment, it did not meet the criteria for GPE or IPE and high hazard to human health based on classifications by other national or international agencies for carcinogenicity, genotoxicity, developmental toxicity or reproductive toxicity. Therefore, this assessment focuses principally on information relevant to the evaluation of ecological risks.

Screening assessments focus on information critical to determining whether a substance meets the criteria for defining a chemical as toxic as set out in section 64 of CEPA 1999. Screening assessments examine scientific information and develop conclusions by incorporating a weight-of-evidence approach and precaution.

This final screening assessment includes consideration of information on chemical properties, hazards, uses and exposure, including the additional information submitted under the Challenge. Data relevant to the screening assessment of this substance were identified in original literature, review and assessment documents, stakeholder research reports and from recent literature searches, up to April 2010 for the exposure, effects and ecological sections of the document. Key studies were critically evaluated; modelling results may have been used to reach conclusions.

When available and relevant, information presented in hazard assessments from other jurisdictions was considered. The final screening assessment does not represent an exhaustive or critical review of all available data. Rather, it presents the most critical studies and lines of evidence pertinent to the conclusion.

This final screening assessment was prepared by staff in the Existing Substances Programs at Health Canada and Environment Canada and incorporates input from other programs within these departments.

This final screening assessment builds upon the final screening assessment that was published in 2008, and revised assessment published in 2010, that have undergone external peer review/consultation. While external comments were taken into consideration, the final content and outcome of the screening assessment remain the responsibility of Health Canada and Environment Canada.

The critical information and considerations upon which the final assessment is based are summarized below.

Substance Identity

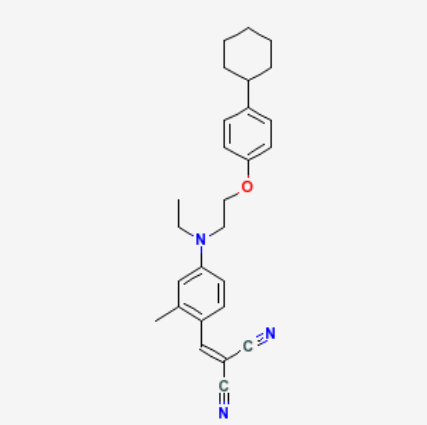
Substance Name

For the purposes of this report, this substance will be referred to as "CHPD" ("cyclohexylphenoxy dinitrile"), which has been derived from the DSL inventory name. Other names and identifying characteristics of the substance are presented in Table 1.

Table 1. Substance identity for CHPD

Chemical Abstracts Service Registry Number (CAS RN)	**54079-53-7**
DSL name	**Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]-**
Inventory names[1]	*Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]-* (TSCA, AICS, PICCS, ASIA-PAC, NZIoC)*; [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]malononitrile* (EINECS)
Trade names (Technical Data Sheet 2005; Environment Canada 2007a)	*Macrolex Yellow 6G, Macrolex Yellow 6G Gran*
Color Index Names, Part I (Technical Data Sheet 2005)	*Solvent Yellow 179; Disperse Yellow 201*
Other names	*[[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl] methylene] malononitrile; [4-[[2-(4-Cyclohexylphenoxy)ethyl] ethylamino]-2-methylbenzylidene] malononitrile; N-2-[(4-Cyclohexyl) phenoxy]ethyl-N-ethyl-4-(2,2-dicyanoethenyl)-3-methylaniline*
Chemical group	Discrete organics
Chemical sub-groups	Anilines; tertiary aromatic amines; aliphatic amines
Industrial Chemical Description (Technical Data Sheet 2005)	Methine dyestuff; Solvent dye
Chemical formula	$C_{27}H_{31}N_3O$

Chemical structure (NCBI)



SMILES[2] N#CC(=Cc1c(cc(N(CCOc2ccc(cc2)C2CCCCC2)CC)cc1)C)C#N

Molecular mass 413.555 g/mol

1 **Source**: National Chemical Inventories (NCI). 2007: AICS (Australian Inventory of Chemical Substances); ASIA-PAC (Asia-Pacific Substances Lists); EINECS (European Inventory of Existing Commercial Chemical Substances); NZIoC (New Zealand Inventory of Chemicals); PICCS (Philippine Inventory of Chemicals and Chemical Substances); and TSCA (Toxic Substances Control Act Chemical Substance Inventory).

2 Simplified Molecular Input Line Entry System.

Physical and Chemical Properties

Table 2 contains experimental and modelled physical and chemical properties of CHPD that are relevant to its environmental fate. Key studies from which experimental data were reported for some of these properties were critically reviewed for validity.

Table 2. Physical and chemical properties for CHPD

Property	Type	Value	Temperature (°C)	Reference
Physical state	Experimental	Low dusting microgranulate (solid)	Not mentioned	Technical Data Sheet 2005
Melting point (ºC)	Experimental	115 (approx)		Technical Data Sheet 2005
	Modelled	243.8		MPBPWIN 2000
Boiling point (ºC)	Modelled	566.7		MPBPWIN 2000
Density (kg/m^3)	Experimental	1130 (approx) (1.13 g/cm^3)	23	Technical Data Sheet 2005
Vapour pressure (Pa)	Modelled	3.07 x 10^{-10} (2.3×10^{-12} mm Hg)	25	MPBPWIN 2000
Henry's Law constant (Pa·m^3/mol)	Modelled	3.74 x 10^{-7} (3.69×10^{-12} atm-m^3/mole)	25	HENRYWIN 2000
Log K_{ow} (Octanol-water partition coefficient) (dimensionless)	Modelled	7.88	25	KOWWIN 2000
Log K_{oc} (Organic carbon-water partition coefficient) (dimensionless)	Modelled	6.28	25	PCKOCWIN 2000
Water solubility (mg/L)	Experimental	Insoluble	23	Technical Data Sheet 2005
	Experimental	0.004–0.006	21–25	Study Submission 2008a
	Experimental	< 0.0007	20	Study Submission

Property	Type	Value	Temperature (°C)	Reference
				2008b
	Experimental (analogue)	0.0017	20	Environment Canada 2008c
	Modelled	0.0002544	25	WSKOWWIN 2000
Other solubilities (g/L)	Experimental (acetone)	200	23	Technical Data Sheet 2005
	Experimental (benzyl alcohol)	65	23	
	Experimental (butyl acetate)	90	23	
	Experimental (ethanol)	2.0	23	
	Experimental (methyl methacrylate)	120	23	
	Experimental (methylene chloride)	550	23	
	Experimental (styrene - monomer)	340	23	
	Experimental (xylene)	130	23	
pK_a (Acid dissociation constant) (dimensionless)	Modelled	1.56	25	ACD/pKaDB 2005

Sources

The substance CHPD is not reported to be naturally produced in the environment.

Information submitted in response to the Challenge indicates that CHPD was not manufactured by any company in Canada in a quantity above the reporting threshold of 100 kg in 2006 (Environment Canada 2007a). However, one company imported between 100 and 1000 kg in Canada in the year 2006 whether alone, in a product, in a mixture or in a manufactured item (Environment Canada 2007a).

As a result of a survey conducted under section 71 of CEPA 1999 for the year 2000 (Canada 2001), (i) one company reported importing between 100 and 1000 kg of CHPD into Canada in 2000; (ii) no companies reported manufacturing CHPD in Canada in a quantity meeting the 100 kg reporting threshold in 2000; and (iii) no companies reported manufacturing or importing CHPD in a mixture or product at a concentration less than 10 g per kg (< 1% w/w) in the year 2000.

In the United States, in the years 1994, 1998 and 2002, CHPD was imported or used in quantities of between 4.5 and 225 tonnes per year (US EPA 2007). According to the Substances in Preparations in Nordic Countries database (SPIN 2006), this chemical was used in Sweden and Denmark in the years 1999–2004. However, information on exact use quantities and use patterns is not publicly available.

Uses

The company that submitted information on CHPD as part of the Challenge indicated that most of the quantity imported into Canada in 2006 was sold to four Canadian companies involved mainly in plastics manufacturing (Environment Canada 2007a). The use pattern code number given by the company is defined as #15: Colorant – pigment – stain – dye – ink, and the NAICS code given is #325130: “Synthetic Dye and Pigment Manufacturing. This Canadian industry comprises establishments primarily engaged in manufacturing synthetic organic and inorganic dyes, pigments, lakes and toners.”

In Europe, CHPD has been used for dyeing many types of plastics—polystyrene, acrylonitrile-butadiene-styrene, styrene acrylonitrile copolymer, acrylic, polycarbonate, polyethylene terephthalate and unplasticized polyvinyl chloride (Technical Data Sheet 2005). Some of these may be used in manufactured items. In the U.S., CHPD is additionally used in textiles (polyester) (CII 2005).

CHPD is not currently listed on the Cosmetic Ingredient Hotlist (Health Canada 2009) and no products containing CHPD were notified to Health Canada’s Cosmetics Notification System (CNS) database (CNS 2010).

CHPD is not listed in the *Food and Drugs Regulations* under section C.01.04.2(3), therefore this substance is not permitted for use in pharmaceutical drugs or veterinary drugs in Canada as a colorant (Canada 1978). CHPD is not listed in the Natural Health Products Ingredients Database (NHPID) nor the Licensed Natural Health Products Database (LNHPD) as an acceptable medicinal or non-medicinal ingredient (NHPID 2010, LNHPD 2010). CHPD is not listed as an approved food additive in Division 16, Part B of the *Food and Drug Regulations* (C.R.C. c.870).

CHPD has been identified for use as a pigment as Disperse Yellow 201 in food packaging materials and as a colourant in the manufacture of PET bottles for carbonated beverages.

Releases to the Environment

The company that reported importing this substance in the years 2000 and 2006 did not report any releases of this chemical to the environment. Given the commercial activity for this chemical, CHPD has the potential to be released into the Canadian environment, although the quantities of the releases are unknown.

Mass Flow Tool

To estimate potential release of the substance to the environment at different stages of its life cycle, a Mass Flow tool was used (Environment Canada 2008a). Empirical data concerning releases of specific substances to the environment are seldom available. Therefore, for each identified type of use of the substance, the proportion and quantity of release to the different environmental media are estimated, as is the proportion of the substance chemically transformed or sent for waste disposal. Assumptions and input parameters used in making these estimates are based on information obtained from a variety of sources including responses to regulatory surveys, Statistics Canada, manufacturers' websites and technical databases. Of particular relevance are emission factors, which are generally expressed as the fraction of a substance released to the environment, particularly during its manufacture, processing, and use associated with industrial processes. Sources of such information include emission scenario documents, often developed under the auspices of the Organisation for Economic Co-operation and Development (OECD), and default assumptions used by different international chemical regulatory agencies. It is noted that the level of uncertainty in the mass of substance and quantity released to the environment generally increases further down the life cycle.

Table 3. Estimated releases of CHPD to environmental media, based on the Mass Flow tool[1]

Medium or process	Proportion of the mass (%)	Major life cycle stage
Soil	0.2	Use
Air	0.4	Processing and use
Water	3.4	Processing
Groundwater	0.0	-
Transformation	2.5	Waste management
Waste disposal	92.3	Waste management
Hazardous waste	1.3	Waste management

[1] For CHPD, information from the following emission scenario documents was used to estimate releases to the environment and distribution of the substance, as summarized in this table: OECD 2004; Brooke and Crookes 2007. Values presented for releases to environmental media do not account for possible additional mitigation measures that may be in place in some locations (e.g., partial removal by sewage treatment plants). Specific assumptions used in derivation of these estimates are summarized in Environment Canada 2008b.

Results indicate that CHPD can be expected to be found largely in waste management sites (96.1%), due to the eventual disposal of manufactured items containing it. The calculations assume that there is no release of the substance from these sites. Also, CHPD has a low potential to leach into groundwater, surface water and/or soil (see the Environmental Fate section). In addition, a proportion of landfills may have the presence of a liner, a leachate collection system and/or a leachate treatment system (on-site or off-site). A small fraction of solid waste is incinerated, which is expected to result in transformation of the substance. Based largely on information contained in OECD emission scenario documents for processing and uses associated with this substance, it is estimated that 3.4%, 0.4% and 0.2% of CHPD may be released to water, air and soil, respectively. Thus, water is the medium receiving the greatest proportion of CHPD emitted during product manufacturing and processing.

It is anticipated that the majority of the substance bound in the product will be sent to landfills or incinerators for disposal. Although there is the possibility that other consumer/commercial products containing CHPD may be imported into Canada, no information is available on the quantity of such imports. It is anticipated that the life cycle stages and proportional losses resulting from use of these other products would not be significantly different from those considered and estimated above. However, the actual mass of the substance lost from the consumer/commercial use and waste management life cycle stages may be higher than the estimates provided above, if such information were available for consideration.

Environmental Fate

Based on its physical and chemical properties and the Level III fugacity modelling results (Table 4), this substance is expected to partition predominantly to soil and/or sediments, depending on the release scenario.

Table 4. Results of the Level III fugacity modelling (EPIWIN 2004)

	Percentage of substance partitioning into each compartment			
Substance released to:	**Air**	**Water**	**Soil**	**Sediment**
Air (100%)	0.03	0.19	85.2	14.6
Water (100%)	0.00	1.26	0.00	98.7
Soil (100%)	0.00	0.00	99.8	0.19

The fraction of CHPD released to water is expected to strongly adsorb to suspended solids and sediments, given its very high log K_{oc} value of ~6.3 (Table 2) and Level III fugacity modelling results. Volatilization from water surfaces is not expected, based upon an estimated Henry's Law constant of 3.74×10^{-7} Pa m^3/mol (Table 2).

The relatively low dissociation constant (pK_a) of 1.56 (Table 2) indicates that protonation of the carbon-nitrogen sites to form the ionized species will only occur at very low pH. In water bodies at environmentally relevant pHs (6–9), 100% of CHPD will be undissociated, which indicates that the partitioning of CHPD is by incorporation of the neutral chemical into lipid-rich tissues of organisms by passive diffusion, and that little partitioning will occur through other sorption mechanisms. Given, the very low proportion of ionized chemical, the log K_{ow} and K_{oc} values are likely to be relevant to predicting the environmental fate of the substance.

When released to soil, CHPD is expected to have extremely high adsorptivity to soil, i.e., expected to have very low mobility in this environmental compartment, based upon an estimated log K_{oc} of ~6.3 (Table 2). Volatilization from moist soil surfaces is expected to be an unimportant fate process based upon an extremely low Henry's Law constant of 3.74×10^{-7} Pa m^3/mol. Also, this chemical will not volatilize from dry soil surfaces based upon an estimated vapour pressure of 3×10^{-10} Pa.

In air, CHPD is expected to exist solely in the particulate phase in the ambient atmosphere based on its extremely low vapour pressure of 3×10^{-10} Pa (Table 2), such that most of the substance would be deposited or partition into soil or sediments (Table 4). Since CHPD is expected to have very low releases to air (Table 3) and is not expected to partition significantly to air (Table 4), the behaviour of this substance in air will not be further discussed.

According to the Mass Flow tool results presented in Table 3, CHPD is mainly released to water during processing (3.4%). Based on results in Table 4, when released to water, most of the substance released ends up in sediments (98.7%). If there is consideration that

a certain percentage of CHPD may be removed during a sewage treatment process and later applied to soil as sludge, a proportion may then be released to soil. Of the 92.3 % of CHPD that is sent to waste disposal (buried in landfills), any potential releases of CHPD from the degradation of plastics will presumably remain in the soil (99.8%) of the landfill. No leaching or volatilization is expected, considering the properties of CHPD as reflected by the 100% release to soil scenario (Table 4). Overall, based on the information on releases and the results of fugacity modelling, sediment—and to a lesser extent, soil—are expected to be the major receiving media for this chemical.

Persistence and Bioaccumulation Potential

Environmental Persistence

Once released into the environment, CHPD appears to be relatively persistent in water, soil and sediment, according to the modelled biodegradation values in Table 5 and based on evidence from quantitative structure-activity relationship (QSAR) models (Environment Canada 2007b). Note that there are no empirical biodegradation data available for CHPD.

Table 5. Modelled data for persistence

Medium	Fate process	Degradation value	Degradation endpoint	Reference
Water	Biodegradation	182	Half-life (days)	BIOWIN 2000
Water	Biodegradation	0.0106	Probability	BIOWIN 2000
Water	Biodegradation	0.0782	Probability	BIOWIN 2000
Water	Biodegradation	0	Probability	TOPKAT 2004
Soil	Biodegradation	182	Half-life (days)	Boethling et al. 1995[1]
Sediment	Biodegradation	728	Half-life (days)	Boethling et al. 1995[1]

[1] Values were derived from the modelled half-life in water using extrapolation factors from Boethling et al. (1995): $t_{1/2\ water} : t_{1/2\ soil} : t_{1/2\ sediment} = 1:1:4$.

It is therefore considered that CHPD meets the persistence criteria for water, soil (half-life ≥ 182 days) and sediments (half-life ≥ 365 days) as set out in the *Persistence and Bioaccumulation Regulations* (Canada 2000).

Potential for Bioaccumulation

Background

A final screening assessment of CHPD was published in the *Canada Gazette*, Part 1, on July 5, 2008, as part of Batch 1 of the Chemicals Management Plan Challenge. It was concluded that CHPD was bioaccumulative; modelled bioconcentration factor (BCF) and bioaccumulation factor (BAF) values exceeded 5000, the criterion used to define substances as bioaccumulative in the *Persistence and Bioaccumulation Regulations* (Canada 2000). The screening assessment for CHPD published in July 2008 used a precautionary approach to assessing bioaccumulation potential. No empirical information was available at the time, and the physical and chemical property profile of the substance (e.g., relatively low melting point) suggested that perhaps some bioavailability in aquatic systems could exist to permit uptake of the substance from water and the diet. The modelling of bioaccumulation potential, albeit acknowledged as uncertain for CHPD, was nonetheless conducted to determine bioaccumulation values because no other data existed at the time.

Following the publication of the above screening assessment report, a fish dietary bioaccumulation study was carried out and submitted to Environment Canada in August 2009. This information was determined to be of acceptable quality and of significant relevance to the determination of the bioaccumulation potential for CHPD. The following section thus presents the re-assessment of the bioaccumulation potential of CHPD to consider the fish dietary data. This also provides an opportunity to re-examine the original bioaccumulation modelling performed for the Batch 1 release of CHPD and apply improvements in bioaccumulation modelling that have been developed since that time.

Bioaccumulation Re-assessment

The modelled log K_{ow} value for CHPD (7.88) (Table 2), when viewed in isolation, suggests that this chemical has the potential to bioaccumulate in the environment. However, the partitioning behaviour of solid particulate substances (many disperse and solvent dyes are rigid crystals), like CHPD, may not obey first-order uptake-rate kinetics and are generally very poorly soluble in lipids and water. The prediction and measurement of log K_{ow} thus becomes extremely difficult and very uncertain. Uncertain or erroneous log K_{ow} values will propagate errors to bioaccumulation model output, because log K_{ow} is the only input parameter. Therefore, Environment Canada considers many non-water-soluble dye classes, including solvent and disperse dyes such as CHPD, to be difficult to model for bioaccumulation. It is also likely that poorly water soluble and denser-than-water compounds such as CHPD present little if any bioavailability to pelagic biota when released to water. Consequently, the use of BCF for bioaccumulation assessment of CHPD presents significant uncertainty and a high potential to result in a false positive conclusion. This assessment, therefore does not consider BCF model results to evaluate the bioaccumulation status of CHPD.

Several BCF laboratory studies have been performed on disperse and solvent azo dyes. While these compounds may not present the best structural relationship to CHPD, their physical and chemical properties that govern bioavailability are comparable. Anliker et al. (1981) reported experimental fish bioaccumulation values for 18 disperse monoazo dyes, performed according to test methods specified by the Japanese Ministry of International Trade and Industry (MITI). These log bioaccumulation factors, expressed on the basis of wet body weight of the fishes, ranged from 0.00 to 1.76 (Anliker et al. 1981). A lack of reporting of chemical registry numbers and chemical structures limited the utility of this study for read-across purposes. However, follow-up studies that provided the chemical structures confirmed low bioaccumulation potential for ten nitroazo dyes, with reported log bioaccumulation factors ranging from 0.3 to 1.76 (Anliker and Moser 1987; Anliker et al. 1988). Studies available from MITI also indicate low bioaccumulation potential for disperse azo dyes. Reported BCFs for three disperse azo dyes (CAS RN 40690-89-9, 61968-52-3 and 71767-67-4) tested at a concentration of 0.01 mg/L were in the range of < 0.3 to 47 (MITI 1992). An accumulation study by Brown (1987) also showed that none of the twelve disperse dyes tested accumulated during an eight-week study with carp. Finally, Hu and Shen (2008) also showed a lack of detection of Disperse Orange in fish extracts (< 0.028 mg/L), suggesting a limited solubility in lipids and/or limited potential to partition into fish tissue from aqueous systems.

Given its physical and chemical profile, the likely exposure to CHPD in the aquatic environment will be by dietary uptake via a benthic-pelagic foodweb. No field studies measuring the BAF or trophic magnification factor of CHPD are available. Modelling of BAF is also subject to the same error as BCF, primarily because of the high potential error of the log K_{ow}, but also due to uncertainty in estimated metabolic rate constants and dietary assimilation efficiency. Nonetheless, the BAF does account for dietary exposures. BAF modelling using the kinetic mass-balance approach of Arnot and Gobas (2003), which has been parameterized in the BCFBAFWIN model (Arnot et al. 2009), was run to show possible worst-case bioaccumulation potential, assuming that CHPD presents some bioavailability to benthic and aquatic organisms. The predicted BAF for the middle trophic level fish is 47 424 using a log K_{ow} of 7.88, a normalized metabolic rate constant of 0.034 (1/days) for the middle trophic level fish (equivalent to a half-life of 20 days) and a dietary uptake rate of 0.008 (kg/kg-day). The predicted metabolic pathway for elimination is via the Phase I arene and aliphatic C-oxidation generated using the Baseline Bioaccumulation Model with Mitigating Factors (Dimitrov et al. 2005).The domain of applicability of the kinetic mass-balance BCFBAFWIN model for CHPD was also considered. While no comparable structures to CHPD have been used to derive the basis of the mass-balance model, this domain (structural domain) is secondary to the global parameter (molecular weight range, log K_{ow}) and mechanistic (passive diffusion) domains. This is because the model is based on first principles of equilibrium partitioning driven by hydrophobicity and lipophilicity. CHPD cannot be excluded from either of these domains. CHPD is a neutral organic chemical expected to undergo passive diffusion as the principle uptake and storage mechanism. However, as a predicted log K_{ow} of ~7.9 was used to derive the BAF reported above, the result must still be considered

uncertain for another reason: fewer than 1% of all BCF and BAF data points used to derive the curve equations for the kinetic mass-balance model are at this log K_{ow} and above (Arnot and Gobas 2006). Therefore, variation at this extreme of the data distribution cannot be determined and results at the extremes of log K_{ow} must be considered uncertain.

ETAD (1995) has stated that the molecular characteristics that indicate the absence of bioaccumulation are a molecular weight of > 450 g/mol and a cross-sectional diameter of > 1.05 nm. Recent investigation by Dimitrov et al. (2002, 2005) suggests that the probability of a molecule crossing cell membranes as a result of passive diffusion declines significantly with increasing maximum cross-sectional diameter (D_{max}). Sakuratani et al. (2008) have also investigated the effect of cross-sectional diameter on passive diffusion from a test set of about 1200 new and existing chemicals. They observed that substances that do not have a very high bioconcentration potential often have a D_{max} > 2.0 nm and an effective diameter D_{eff} > 1.1 nm. Arnot et al. (2009) have noted exceptions to these criteria and have stated that strict cut-off rules related to molecular dimensions should not be used by themselves to determine bioaccumulation potential. These dimension cut-offs can, however, help to support multiple lines of evidence determinations.

CHPD has a molecular weight of 413 g/mol, a maximum cross-sectional diameter (D_{max}) of possible conformers ranging from 1.5 to 2.3 nm and an effective diameter (D_{eff}) for possible conformers ranging from 0.9 to 1.3 nm, suggesting that the conformational orientation of CHPD in the environment may be an important mitigating factor reducing the rate of uptake into the tissues of aquatic biota. However, as Arnot et al. (2010) have noted, there are uncertainties associated with the thresholds proposed by Dimitrov et al. (2002, 2005) and Sakuratani et al. (2008), since the BCF studies used to derive them were not critically evaluated. As Arnot et al. (2010) point out, molecular size influences solubility and diffusivity in water and organic phases (membranes), and larger molecules may have slower uptake rates. However, these same kinetic constraints apply to diffusive routes of chemical elimination (i.e., slow in = slow out). Thus, significant bioaccumulation potential may remain for substances that are subject to slow absorption processes, if they are slowly biotransformed or slowly eliminated by other processes. Consequently, when evaluating bioaccumulation potential, molecular size information is considered with care, and used together with other relevant lines of evidence.

In August 2009, a fish dietary bioaccumulation study carried out according to revised draft OECD 305 fish dietary guideline was received by Environment Canada (Study Submission 2009). The most important aspects of this study include the actual biomagnification factor (BMF), tissue residue values and the calculated dietary assimilation efficiency (uptake efficiency). Review of the study quality by Environment Canada determined that despite using a test guideline procedure that is still at the draft stage, study quality and reliability were high. The Robust Study Summary with details of the test is presented in Appendix I. Two test concentrations of 100 µg/g and 1000 µg/g were spiked into food given to the fish. A 20-day uptake phase and a 28-day depuration phase were used. Fish tissues were analyzed using high-performance liquid

chromatography (HPLC) and ultraviolet-visible (UV/VIS) analysis. The limit of quantification (LOQ) for CHPD in tissues was 0.401 µg/g. Recovery rates of CHPD in food were high, ranging from 97.5% to 105.2%. Hexachlorobenzene (HCB) was also used as a positive control and displayed high recovery rates in fish food (87% to 97%). Concentrations of CHPD at the 100 µg/g dosage were below the LOQ (0.401 µg/g) in fish tissues and thus could not be used to generate study rate constants or BMF values. Table 6 below summarizes the primary study results for the 1000 µg/g dosage.

Table 6: Output for CHPD fish dietary biomagnification factor study at 1000 µg/g dosage (reproduced from Study Submission 2009)

Test parameter	Value
Time uptake phase [days]	20
Time depuration phase [days]	28
Food ingestion rate I [g food/g fish*d]	0.03
Food ingestion rate I (fat corrected)	0.039
k overall [day $^{-1}$]	0.084
C_0, depuration [µg/g][1]	1.923
Fish growth rate [day $^{-1}$]	0.013
C_{food} [µg/g]	1000
K depuration (growth corrected) [day $^{-1}$]	0.071
Assimilation efficiency alpha (a)	0.0063
BMF	0.0026
$t_{1/2}$ (growth corrected) [days]	9.706
Fat content food [% lipids]	11.0
Fat content fish at start [% lipids]	8.5

[1] ln = 0.654

The chemical assimilation efficiency (α) is calculated using the following equation:

$$\alpha = \frac{C_{O,depuration} \times k_{overall}}{I \times C_{food}} \times \left[\frac{1}{\left(1 - \exp\left(-k_{overall} \times t\right)\right)} \right]$$

The biomagnification factor is calculated according the equation below.

$$BMF = \frac{I \times \alpha}{k_{depuration}}$$

The growth-corrected half-life is calculated as $t_{1/2} = 0.693 \cdot k_{depuration}^{-1}$.

Where:
α = assimilation efficiency;
$C_{0,depuration}$ = concentration in fish at time zero of the depuration phase (µg/g);
$k_{overall}$ = overall (not growth-corrected) depuration rate constant (day^{-1});
$k_{depuration}$ = growth-corrected depuration rate constant (day^{-1});
I = food ingestion rate (g food/g fish/day);
C_{food} = concentration in food (mg/kg food);

The results of the fish dietary study show that CHPD has a very low dietary assimilation efficiency (0.6%), which is evident in the lack of detection in 100 µg/g treatments and a maximum whole body tissue residue concentration that ranged from below the level of quantification (0.401 µg/g) to 3.0 µg/g in the 1000 µg/g treatment. These results suggest that either CHPD is highly metabolized in the gut of fish or there was a significant lack of bioavailability during the uptake phase (i.e., CHPD passes through the gut and is excreted). In contrast to this, HCB (log K_{ow} of 5.7) in this study had a dietary efficiency of 55%, which is very comparable to reported values for halogenated organics near or at this log K_{ow} (e.g., Kelly et al. 2004). The HCB results suggest that there are no test interferences restricting uptake efficiency and that the reported assimilation efficiency for CHPD is valid.

Lack of appreciable assimilation efficiency and a relatively short growth-corrected half-life of 9.7 days calculated from the depuration rate constant suggest that CHPD is quickly biotransformed. These factors combined will produce little biomagnification, and indeed the BMF and lipid normalized BMF results are << 1 (Table 6). In their review of BMF values from the literature, Kelly et al. (2007) reported that chemicals that have been found to biomagnify in the environment (BMF > 1) almost always have BCF and BAF values much greater than 1000, are not readily metabolized and have a log K_{ow} greater than 3.5. Therefore, it may be expected that the BCF and BAF of CHPD are less than 1000. The weight of evidence for these various values is discussed below.

Conclusion

Modelling the bioaccumulation potential of substances that have low *in-situ* and *in-vivo* bioavailability and that are solid dense particles at environmental temperatures (many disperse and solvent dyes are rigid crystals), and using log K_{ow} values that are also highly uncertain, can only result in uncertain model predictions. Therefore, it cannot be reasonably concluded that results of modelling of CHPD have significant weight. The model uncertainty in this case errs highly on the false positive side. Given that exposure of CHPD to aquatic biota would be via the diet, the newly submitted quality dietary BMF study received high weighting when assessing all available information. While BMF data are not often available for consideration of bioaccumulation potential, BMF data have been included in the weight of evidence for determining bioaccumulation potential in this assessment given the relevancy of a dietary exposure. The physical and chemical property data and molecular characteristics were also considered to have a high weight and are consistent with what would be expected for the use pattern of this chemical. The physical and chemical and molecular information support the hypothesis of low bioavailability and low dietary efficiency leading to low accumulation in biota. This concept was supported by the new dietary study. This reasoning can be applied to suggest that both BCF and BAF would also be much less than 5000 as observed in the analogue BCF data for other disperse dyes.

Therefore, it is concluded that CHPD does not meet the bioaccumulation criterion (BAF, BCF ≥ 5000) as set out in the *Persistence and Bioaccumulation Regulations* (Canada 2000).

Potential to Cause Ecological Harm

Ecological Effects Assessment

A – In the Aquatic Compartment

Experimental and modelled toxicity data of CHPD to aquatic organisms were available for an algae (*Desmodesmus subspicatus*), an invertebrate (*Daphnia magna*) and fish (Tables 7a and 7b).

Table 7a. Empirical data for aquatic toxicity

Test organism	Type of test	Endpoint	Value (mg/L)	Reference
Desmodesmus subspicatus (algae)	Chronic (24 hours)	LOECr[1] LOECy[2]	≤ 0.041	Study Submission 2008a
Daphnia Magna (invertebrate)	Chronic (21 days)	NOEC[3]	≥ 0.019	Study Submission 2008d

[1] LOECr – The lowest-observed-effect concentration is the lowest concentration in the toxicity test that caused a statistically significant effect in comparison to the controls: growth **r**ate of the algal population.
[2] LOECy – The lowest-observed-effect concentration is the lowest concentration in the toxicity test that caused a statistically significant effect in comparison to the controls: **y**ield of the algal population.
[3] NOEC – The no-observed-effect concentration is the highest concentration in a toxicity test not causing a statistically significant effect in comparison to the controls.

In a first empirical study, green algae cultures (*Desmodesmus subspicatus)* were exposed to CHPD (Study Submission 2008a, Appendix I). The water temperature during the test varied between 21 and 25ºC, pH oscillated between 7.5 and 8.2 and the hardness was 22.5 mg/L as $CaCO_3$. To achieve maximum solubility in water, one milligram of CHPD was added per litre of dilution water, the solution was then treated for 1 hour in an ultrasonic bath and afterwards stirred during 24 hours with a magnetic stirrer. The undissolved test substance was removed by filtration (7–12 µm). Organisms were exposed for 72 hours to the full-strength filtrate (1 mg/L nominal) and a control in 6 replicates for each treatment. CHPD was measured in the test water at the beginning and the end of the exposure period. Concentrations ranged from 0.040 to 0.041 mg/L and from 0.004 to 0.006 mg/L at the beginning and the end of the exposure period, respectively. Concentrations of CHPD in the controls were non detectable (< 0.002 mg/L). There were significant reductions in growth rate and yield (~42%) of algae exposed to CHPD at the limit of saturation after 24 hours compared to the controls (LOECr and LOECy ≤ 0.041 mg/L). The study was found to have a high degree of reliability. The Robust Study Summary with details of the test is presented in Appendix I.

Other studies tested the acute and chronic effect of CHPD on *Daphnia magna* (Study Submission 2008c; 2008d). The acute (48-hr) toxicity study was not found to have a satisfactory degree of reliability because it lacked important pieces of information, such as an empirically measured concentration of the dissolved substance to confirm the actual exposure concentration and details on the mixture composition (Study Submission 2008c). The chronic study was found to have a high degree of reliability (Study Submission 2008d). In this study, *Daphnia magna* were exposed to CHPD for 21 days to assess their reproductive output: the total number of living offspring produced per parent animal alive at the end of the test period. The water temperature during the test varied between 20.2 and 20.7ºC, pH oscillated between 7.8 and 8.0 and the hardness was between 287 and 300 mg/L as $CaCO_3$. The same solution preparation as presented above for algae was performed for this test. Organisms were exposed for 21 days to the full-strength filtrate (1 mg/L nominal) and control in 10 replicates for each treatment. Solutions were renewed two times (semi-static design) during the duration of the experiment. CHPD was measured in test water at the beginning of the test and at days 2, 7, 9, 14 and 16. Concentrations ranged from 0.004 to 0.047 mg/L. Concentrations of CHPD in the controls were non detectable (< 0.002 mg/L). This study revealed no reduction in the number of living offspring produced for exposed daphnids to CHPD at the limit of saturation compared to controls (NOEC ≥ 0.019).

Additionally, QSAR modelling was used to estimate the potential for aquatic toxicity for CHPD. Table 7b contains the predicted acute ecotoxicity value that was considered to be reliable using this approach. This value suggests that the substance is highly hazardous to fish and is in the same range as the one obtained experimentally for algae.

Table 7b. Modelled data for aquatic toxicity.

Test Organism	Type of test	Endpoint	Value (mg/L)	Reference
Fish	Acute (14 days)	LC_{50}[1]	0.004 mg/L	ECOSAR 2004

[1] LC_{50} – The concentration of a substance that is estimated to be lethal to 50% of the test organisms.

Based on all of the above toxicity information, CHPD is considered to be highly hazardous to algae and fish at relatively low concentrations (i.e., acute LOEC/LC_{50} < 1.0 mg/L).

B – In Other Media

No experimental or predicted-effects data for non-aquatic, non-mammalian organisms in any other media were identified for CHPD. However, given the the low bioaccumulation properties of CHPD, it is assumed that uptake from sediment and soil—via benthic and terrestrial invertebrates—into fish, birds and/or mammals is not expected to be significant.

Ecological Exposure Assessment

No data concerning concentrations of this substance in surface water in Canada have been identified. Therefore, environmental concentrations are estimated from available information, including estimated substance quantities, release rates, and size of receiving water bodies. CHPD has been monitored in leachate from 10 landfills in Canada and was not detected (Conestoga-Rovers & Associates 2009). The limit of detection (LOD) was 32 ng/L and the limit of quantification (LOQ) was 108 ng/L (Balakrishnan and Palabrica 2010).

A – Industrial Release

As CHPD is used industrially and is expected to be released to water, a conservative but refined industrial release scenario is used to estimate the aquatic concentration of the substance with the help of Environment Canada's (2009a) Industrial Generic Exposure Tool – Aquatic (IGETA). The scenario is made protective by using the highest quantity of the substance in the reporting range, at a single small and hypothetical industrial facility. The loss to sewer is assumed to be 2.35% of the total quantity in use, resulting mainly from container handling and compounding. The scenario also assumes that the release occurs 250 days per year, typical for small and medium-sized facilities, and is sent to a local primary sewage treatment plant (STP) with an 87.1% removal rate for the substance based on AS Treat 1.0 (Environment Canada 2009b). A small site is selected to have an STP effluent flow at the 10^{th} percentile (3 456 m^3/d) of the STP discharge rates across Canada. The dilution factor is assumed to be 10 to reflect the receiving water dilution capacity for the STP effluent. Based on the above assumptions, the substance total quantity of 1000 kg/yr for industrial use is used as a worst-case condition since it is the highest possible quantity in the reporting range. It yields an aquatic concentration of 0.00035 mg/L (Environment Canada 2009b).

Characterization of Ecological Risk

The approach taken in this ecological screening assessment was to examine various supporting information and develop conclusions based on a weight-of-evidence approach and using precaution as required under CEPA 1999. Lines of evidence considered include results from a conservative risk quotient calculation, as well as information on persistence, bioaccumulation, toxicity, sources and fate of the substance.

CHPD is expected to be persistent in water, soil and sediment, and is also expected to have a low bioaccumulation potential. The importation of CHPD into Canada, along with information on its uses, indicates potential for release into the Canadian environment. Once released into the environment, it will be found mainly in soil and sediments. It has also been demonstrated to have relatively high potential for toxicity to aquatic organisms.

A risk quotient analysis, integrating a worst-case estimate of exposure with toxicity information, was performed for the aquatic medium to determine whether there is potential for ecological harm in Canada. Using the industrial scenario presented above, a predicted environmental concentration (PEC) of 0.00035 mg/L was derived (Environment Canada 2009c). A predicted no-effect concentration (PNEC) was derived from the acute toxicity value of 0.041 mg/L for algae, by dividing this value by an assessment factor of 100 (to account for interspecies and intraspecies variability in sensitivity and to estimate a long-term no-effects concentration from a short-term LC_{50}) to give a value of 0.00041 mg/L. The resulting risk quotient (PEC/PNEC) = 0.86. Given the conservative assumptions used in predicting possible exposure, it is thus concluded that current releases are unlikely to be high enough to cause harm to aquatic organisms.

Following its release to water, CHPD is expected to partition almost entirely to sediments because of its strong hydrophobic properties. As well, CHPD will tend to stay in soil when released from the application of biosludge that is commonly used for soil enrichment and from the landfill disposal of products that degrade and release this substance. The reproductive output of *Daphnia magna* was not reduced in the water compartment, nor was acute toxicity (mortality) observed. Extrapolation from pelagic organism toxicity data to sediment-and soil-dwelling arthropod species is likely to give risk quotients in the same range as for water.

Considering that (1) CHPD current use quantities and resulting releases are relatively low; (2) CHPD has a low bioaccumulation potential and is not likely to accumulate significantly or biomagnify in trophic food chains; and (3) exposures scenarios that include conservative assumptions show that risks to organisms is unlikely, it is concluded that CHPD has low potential to cause ecological harm in Canada.

Uncertainties in Evaluation of Ecological Risk

Given the use of this substance in other countries, it is possible that CHPD is entering the Canadian market as a component of manufactured items and consumer products. Therefore, it is acknowledged that the quantities of CHPD released to certain environmental media may be higher than those estimated here.

Few experimental data for physical and chemical properties, ecotoxicity, degradation or bioaccumulation were identified. QSAR models were therefore used to estimate these properties, both in conjunction with empirical data and on their own. There are uncertainties associated with the use of these QSAR models. In addition, CHPD belongs to the dyes category, which is not well represented in model training sets. With respect to log K_{ow}, it is very difficult to experimentally determine values above 8, so chemicals with estimated log K_{ow} values above 8 are likely outside of the domain of the model and could be overestimated. CHPD has an estimated log K_{ow} of 7.88.

Regarding ecotoxicity, based on the predicted partitioning behaviour of this chemical, the significance of soil and sediment as important media of exposure is not addressed by the

effects data available. Indeed, the only effects data identified apply primarily to pelagic aquatic exposures, although the water column is likely not the medium of primary concern based on partitioning estimates. To reduce this uncertainty, benthic toxicity data would be desirable.

Finally, quantities of CHPD expected to reach the soil and sediment media are expected to be low as estimated by the Mass Flow tool and by subsequent partitioning. Exposure levels could increase in these media due to partitioning, persistence, and the fact that CHPD could accumulate from year to year.

Potential to Cause Harm to Human Health

Based on the information submitted under section 71 of CEPA 1999 (Environment Canada 2007a), the major use of this substance in Canada is as a colorant in plastics.

There were no reported releases of CHPD to air, water, or soil in responses to the section 71 notice under CEPA 1999 (Environment Canada 2007a). In the absence of monitoring and release data, environmental concentrations of CHPD were estimated based on the quantity in commerce reported above the reporting threshold in 2006. The loss percentages to the environmental compartments were estimated by the Mass Flow tool as presented in Table 3 (Environment Canada 2008b).

Using the upper limit of the imported quantity of CHPD, 1000 kg, the upper-bounding release quantities were estimated as 4 kg to air, 34 kg to water and 2 kg to soil. The concentrations of CHPD in environmental media were derived based on these release quantities using a Canada-specific environmental exposure model, ChemCAN (ChemCAN 2003). The upper-bound estimate of exposure from environmental media based on these estimated environmental concentrations was in the order of magnitude of nanograms (10^{-6} mg) per kilogram body weight (kg-bw) per day.

As indicated in the Uses section of this assessment, CHPD has been identified for use as a colourant in the manufacture of PET bottles for carbonated beverages. A conservative potential daily intake (PDI) of 17 ng/kg-bw per day was established for this use (May 10, 2010; personal communication from Food Directorate to Existing Substances Risk Assessment Bureau, Health Canada; unreferenced).

Therefore, the maximum potential for exposure of the general population to CHPD from environmental media and food is estimated to be in a range of nanograms (10^{-6} mg)/kg-bw per day.

No toxicological data were identified for CHPD. The limited data modelled by (Q)SARs indicated a low hazard potential, and CHPD was not identified as posing a high hazard to human health. The (Q)SAR programs (DEREK, TOPKAT, Casetox, Toxtree and Leadscope Model Applier) did not generate predictions indicating hazard flags for this substance. As there were very limited health effects information data available for CHPD, and no health effects information on suitable analogues was identified, the confidence in the health effects database is considered to be very low.

Overall, general population exposure is considered to be low, and hence the risk to human health is likewise considered to be low.

Uncertainties in Evaluation of Risk to Human Health

Confidence in the toxicity database is considered to be very low due to the limited information available. Literature data were not identified for CHPD concentrations in environmental media. However, confidence is high that exposure to CHPD from environmental sources is low. Upper-bounding releases of this substance were estimated based on the total import quantity of CHPD in 2006 and release percentages predicted by the Mass Flow tool; therefore the resulting exposure estimates are considered to be very conservative.

Conclusion

Based on the information presented in this final screening assessment, it is proposed that CHPD is not entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity or that constitute or may constitute a danger to the environment on which life depends.

On the basis of information available with respect to the activity of CHPD in Canada above the reporting threshold, general population exposure in Canada is considered to be low. As there were no identified human health hazards; the risk to human health is likewise considered to be low. Therefore, it is proposed that this substance is not entering the environment in a quantity or concentration or under conditions that constitute or may constitute a danger in Canada to human life or health.

It is therefore concluded that CHPD does not meet the definition of toxic as set out in section 64 of CEPA 1999. Additionally, CHPD meets the criteria for persistence but not for bioaccumulation as set out in the *Persistence and Bioaccumulation Regulations* (Canada 2000).

References

ACD/pK_aDB [Prediction Module]. 2005. Version 9.04. Toronto (ON): Advanced Chemistry Development. Available from: http://www.acdlabs.com/products/pc_admet/physchem/physchemsuite/features.php

Anliker R, Clarke EA, Moser P. 1981. Use of the partition coefficient as an indicator of bioaccumulation tendency of dyestuffs in fish. Chemosphere 10(3):263–274.

Anliker R, Moser P. 1987. The limits of bioaccumulation of organic pigments in fish: their relation to the partition coefficient and the solubility in water and octanol. Ecotoxicol Environ Saf 13:43–52.

Anliker R, Moser P, Poppinger D. 1988. Bioaccumulation of dyestuffs and organic pigments in fish. Relationships to hydrophobicity and steric factors. Chemosphere 17(8):1631–1644.

Arnot JA, Gobas FAPC. 2003. A generic QSAR for assessing the bioaccumulation potential of organic chemicals in aquatic food webs. QSAR Comb Sci 22(3):337–345.

Arnot JA, Gobas FAPC. 2006. A review of bioconcentration factor (BCF) and bioaccumulation factor (BAF) assessments for organic chemicals in aquatic organisms. Environ Rev 14(4):257–297.

Arnot JA, Meylan W, Tunkel J, Howard P, Mackay D, Bonnell M, Boethling RS. 2009. A quantitative structure activity relationship for predicting metabolic biotransformation rates for organic chemcials in fish. Environ Toxicol Chem.28: 168–1177.

Arnot JA, Arnot M, Mackay D, Couillard Y, MacDonald D, Bonnell M, Doyle P. 2010. Molecular size cut-off criteria for screening bioaccumulation potential: fact or fiction? Integrat Environ Assess Manag 6(2):210–224.

Balakrishnan VK, Palabrica V. 2010. Determining the maximum environmental release limit of the toxic dye, CHPD. Can J Chem 88: 393–399.

[BCFWIN] BioConcentration Factor Program for Windows [Estimation Model]. 2000. Version 2.15. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

[BIOWIN] Biodegradation Probability Program for Windows [Estimation Model]. 2000. Version 4.02. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Boethling RS, Howard PH, Beauman JA, Larosche ME. 1995. Factors for intermedia extrapolations in biodegradability assessment. Chemosphere 30(4):741–752.

Brooke DN, Crookes MJ. 2007. Emission scenario document on transport and storage of chemicals [Internet]. Bristol (UK): Environment Agency. Product code: SCHO0407BMLK-E-P. Available from: http://publications.environment-agency.gov.uk/pdf/SCHO0407BMLK-e-e.pdf

Brown D. 1987. Effects of colorants in the aquatic environment. Ecotoxicol Environ Saf 13:139–47.

Canada. [1978]. *Food and Drug Regulations,* C.R.C., c.870 as amended. Available from: http://laws.justice.gc.ca/en/showtdm/cr/C.R.C.-c.870

Canada. 1999. *Canadian Environmental Protection Act, 1999*. S.C., 1999, c. 33. Canada Gazette. Part III, vol. 22, no. 3. Available from: http://www.gazette.gc.ca/archives/p3/1999/g3-02203.pdf

Canada. 2000. *Canadian Environmental Protection Act: Persistence and Bioaccumulation Regulations.* P.C. 2000-348, 23 March 2000, SOR/2000-107. Canada Gazette. Part II, vol. 134, no. 7, p. 607−612. Available from: http://www.gazette.gc.ca/archives/p2/2000/2000-03-29/pdf/g2-13407.pdf

Canada, Dept. of the Environment. 2001. *Canadian Environmental Protection Act, 1999*: *Notice with respect to certain substances on the Domestic Substances List (DSL).* Canada Gazette. Part I, vol. 135, no. 46, p. 4194–4210. Available from: http://www.gazette.gc.ca/archives/p1/2001/2001-11-17/pdf/g1-13546.pdf

Canada, Dept. of the Environment, Dept. of Health. 2006. *Canadian Environmental Protection Act, 1999*: *Notice with respect to selected substances identified as priority for action*. Canada Gazette. Part I, vol. 140, no. 9, p. 435–459. Available from: http://www.gazette.gc.ca/archives/p1/2006/2006-03-04/pdf/g1-14009.pdf

Canada, Dept. of the Environment, Dept. of Health. 2007. *Canadian Environmental Protection Act, 1999: Notice of first release of technical information relevant to substances identified in the Challenge.* Canada Gazette. Part I, vol. 141, no. 5, p. 162–165. Available from: http://www.gazette.gc.ca/archives/p1/2007/2007-02-03/pdf/g1-14105.pdf

CASETOX [Prediction module]. 2008. Version 2.0. Beachwood (OH): MultiCASE. [cited 2010 March 30]. Available from: http://www.multicase.com/products/prod03.htm [restricted access].

ChemCAN [Level III fugacity model of 24 regions of Canada]. 2003. Version 6.0. Peterborough (ON): Trent University, Canadian Environmental Modelling Centre. Available from: http://www.trentu.ca/academic/amindd/envmodel/models/CC600.html

[CII] Color Index International [database on the Internet]. 2002– . 4th ed. Research Triangle Park (NC): American Association of Textile Chemists and Colorists. [cited 2006 Dec 11]. Available from: http://www.colour-index.org/

[CNS] Cosmetic Notification System [Proprietary Database]. 2010. Available from Health Canada, Cosmetics Division.

Conestoga-Rovers & Associates. 2009. Sampling for Chemicals Management Plan challenge substances from the waste sector Prepared For: Environment Canada, Prepared By: Conestoga-Rovers & Associates, Ref. No. 054555 (2), 42 pages.

[DEREK] [Prediction model]. 2009. Version 11. Lhasa Limited, Leeds, UK [cited 2010 March 30]. Available from: https://www.lhasalimited.org/derek/ [restricted access].

Dimitrov S, Dimitrova N, Walker J, Veith G, Mekenyan O. 2002. Predicting bioconcentration potential of highly hydrophobic chemicals. Effect of molecular size. Pure Appl Chem 74(10):1823–1830.

Dimitrov S, Dimitrova N, Parkerton T, Comber M, Bonnell M, Mekenyan O. 2005. Baseline model for identifying the bioaccumulation potential of chemicals. SAR QSAR Environ Res 16(6):531–554.

[ECOSAR] Ecological Structural Activity Relationships [Internet]. 2004. Version 0.99h. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Environment Canada. 2007a. Data for Batch 1 substances collected under the *Canadian Environmental Protection Act, 1999*, Section 71: *Notice with respect to certain substances identified in the Challenge, published in the December 9, 2006 Notice of intent to develop and implement measures to assess and*

manage the risks posed by certain substances to the health of Canadians and their environment. Prepared by: Environment Canada, Health Canada, Existing Substances Program.

Environment Canada. 2007b. Guidance for Conducting Ecological Assessments under CEPA, 1999, Science Resource Technical Series, Technical Guidance Module: QSARs. Reviewed Draft Working Document. Gatineau (QC): Environment Canada, Ecological Assessment Division. Available upon request.

Environment Canada. 2008a. Guidance for conducting ecological assessments under CEPA, 1999: Science Resource Technical Series, Technical Guidance Module: Mass Flow Tool. Preliminary draft working document. Gatineau (QC): Environment Canada, Existing Substances Division.

Environment Canada. 2008b. Assumptions, limitations and uncertainties of the Mass Flow tool for CHPD, CAS RN 54079-53-7. Internal draft document. Gatineau (QC): Environment Canada, Existing Substances Division. Available on request.

Environment Canada. 2008c. Submitted to New Substances Program, Environment Canada under New Substance Notification Regulations.

Environment Canada. 2009a. Guidance for Conducting Ecological Assessments under CEPA, 1999, Science Resource Technical Series, Technical Guidance Module: The Industrial Generic Exposure Tool – Aquatic (IGETA). Working document. Gatineau (QC): Environment Canada, Ecological Assessment Division.

Environment Canada. 2009b. IGETA report: CAS RN 54079-53-7, 2009-09-15. Unpublished report. Gatineau (QC): Environment Canada, Ecological Assessment Division.

[EPIWIN] Estimation Programs Interface for Microsoft Windows [Estimation Model]. 2004. Version 3.12. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

[ETAD] Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers Canadian Affiliates, Dayan J, Trebitz H, consultants. 1995. Health and environmental information on dyes used in Canada. Unpublished report submitted to Environment Canada, New Substances Division.

Health Canada. 2009. The Cosmetic Ingredient Hotlist – September 29. Available from: http://www.hc-sc.gc.ca/cps-spc/person/cosmet/info-ind-prof/_hot-list-critique/hotlist-liste-eng.php

[HENRYWIN] Henry's Law Constant Program for Microsoft Windows [Estimation Model]. 2000. Version 3.10. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Hu S, Shen G. 2008. Bioconcentration test of C.I. Disperse Blue 77 in fish. Prepared by the Environmental Testing Laboratory, Shanghai Academy of Environmental Sciences, Shanghai, China for Dystar in the name of Ecological and Toxicological Association of the Dyes and Organic Pigments Manufacturers (ETAD) Basel, Switzerland. Report No. S-071-2007. Submitted to Environment Canada in April 2008.

Kelly BC, Gobas FAPC, McLachlan MS. 2004. Intestinal absorption and biomagnification of organic contaminants in fish, wildlife and humans. Environ Toxicol Chem 23(10):2324–2336.

Kelly BC, Ikonomou MG, Blair JD, Morin AE, Gobas FAPC. 2007. Food web–specific biomagnification of persistent organic pollutants. Science 317(5835):236–239.

[KOWWIN] Octanol-Water Partition Coefficient Program for Microsoft Windows [Estimation Model]. 2000. Version 1.67. Washington (DC): U.S. Environmental Protection Agency, Office of Pollution

Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Technical Data Sheet. 2005. Technical Information data-sheet: Macrolex Yellow 6G Gran. Leverkusen (DE): Lanxess Deutschland GmbH. 2p. [cited 2008 April] Available from: http://techcenter.lanxess.com/fcc/emea/en/products/datasheet/MACROLEX+Yellow+6G+Gran+-+February_e.pdf?docId=78837&gid=1978&pid=765

Leadscope [Prediction module]. 2009. Leadscope Model Applier Version 1.2.0-3. Columbus, OH: Leadscope, Inc. [cited 2010 January 12]. Available from: http://www.leadscope.com/all_products.php [restricted access].

[LNHPD] Licensed Natural Health Products Database [database on the internet]. 2010. (Last date modified 2009 May 08). Ottawa (ON): Health Canada. Available from: http://205.193.93.55/lnhpd-bdpsnh/start-debuter.do

[MPBPWIN] Melting Point Boiling Point Program for Microsoft Windows [Estimation Model]. 2000. Version 1.41. Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

[MITI] Ministry of International Trade & Industry (Japan), Basic Industries Bureau, Chemical Products Safety Division. 1992. Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan. Tokyo (Japan): Japan Chemical Industry Ecology-Toxicology & Information Centre

[NCI] National Chemical Inventories [database on a CD-ROM]. 2007. Issue 1. Columbus (OH): American Chemical Society, Chemical Abstracts Service. [cited 2007 Oct]. Available from: http://www.cas.org/products/cd/nci/require.html

[NHPID] Natural Health Products Ingredients Database [database on the internet]. 2010. Ottawa (ON): Health Canada. Available from: http://webprod.hc-sc.gc.ca/nhpid-bdipsn/search-rechercheReq.do

[OECD] Organisation for Economic Co-operation and Development. 2004. Emission scenario document on plastics additives [Internet]. Paris (FR): OECD, Environment Directorate. (Series on Emission Scenario Documents No. 3). Report No.: ENV/JM/MONO(2004)8, JT00166678. Available from: http://www.olis.oecd.org/olis/2004doc.nsf/LinkTo/env-jm-mono(2004)8

[PCKOCWIN] Organic Carbon Partition Coefficient Program for Windows [Estimation Model]. 2000. Version 1.66. Washington (DC): U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Sakuratani Y, Noguchi Y, Kobayashi K, Yamada J, Nishihara T. 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J Environ Biol 29(1):89–92.

[SPIN] Substances in Preparations in Nordic Countries [database on the Internet]. 2006. Copenhagen (DK): Nordic Council of Ministers. [cited 2006 Mar] Available from: http://195.215.251.229/Dotnetnuke/Home/tabid/58/Default.aspx

Study Submission. 2008a. Unpublished confidential study submitted to Environment Canada, Existing Substances Division under the Chemicals Management Plan Challenge initiative. Available as Robust Study Summary, Identification No.: 20281Challenge003.

Study Submission. 2008b. Unpublished confidential study submitted to Environment Canada, Existing Substances Division under the Chemicals Management Plan Challenge initiative. Identification No.: 20281Challenge004.

Study Submission. 2008c. Unpublished confidential study submitted to Environment Canada, Existing Substances Division under the Chemicals Management Plan Challenge initiative. Available as Robust Study Summary, Identification No.: 20281Challenge001.

Study Submission. 2008d. Unpublished confidential study submitted to Environment Canada, Existing Substances Division under the Chemicals Management Plan Challenge initiative. Available as Robust Study Summary, Identification No.: 20281Challenge002.

Study Submission. 2009. Unpublished confidential study submitted to Environment Canada, Ecological Assessment Division under the Chemicals Management Plan Challenge initiative. Identification No.: 20281Challenge005.

[TOPKAT] TOxicity Prediction by Komputer Assisted Technology [Internet]. 2004. Version 6.2. San Diego (CA): Accelrys Software Inc. [cited 2010 March 30] Available from: http://accelrys.com/

[Toxtree] Toxic hazard estimation by decision tree approach. 2009. Version 1.60. Ideaconsult Ltd., Sofia, Bulgaria [cited 2010 March 30]. Available from: http://toxtree.sourceforge.net/

[US EPA] United States Environmental Protection Agency. 2007. Inventory Update Reporting, Past IUR Data, Non-confidential Production Volume Information submitted by companies under the 1986,1990,1994,1998, and 2002 Inventory Update Reporting Regulation, Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]-, CAS RN 54079-53-7 [Internet]. Washington (DC): U.S. EPA. [cited 2007]. Available from: http://www.epa.gov/oppt/iur/index.html

[WSKOWWIN] Water Solubility for Organic Compounds Program for Microsoft Windows [Estimation Model]. 2000. Version 1.41 Washington (DC): US Environmental Protection Agency, Office of Pollution Prevention and Toxics; Syracuse (NY): Syracuse Research Corporation. Available from: www.epa.gov/oppt/exposure/pubs/episuite.htm

Appendix I - Robust Study Summaries

Description of the reliability evaluation

To evaluate the reliability of studies for key ecological endpoints (i.e., inherent toxicity to aquatic organisms, bioaccumulation potential, persistence), an approach analogous to that of Klimisch et al. (1997) has been developed. It involves the use of a standardized Robust Study Summary form, including a scoring system to quantitatively evaluate the studies. The Robust Study Summary (RSS) is an adaptation of the OECD Robust Study Summary templates (OECD 2009). It consists of a checklist of items or criteria (column 2 of the RSS) relating to identity of the substance, experimental protocol or method, test organism, specific test design/conditions, ecological relevance, and results. Most items are weighted according to their criticality to the quality and reliability of the study (column 3). The most important or critical items (which describe parameters/factors that have the most direct influence on the quality of the study) have been given a higher weight (3 points), while the less critical items have been given a lower score (1 or 2 points). For each item, the evaluator must indicate whether the item has been addressed appropriately in the study by answering "yes", "no" or "non-applicable (n/a)" (column 4). Specific information relating to the items is provided in column 5 of the RSS.

Once answers to all the items have been provided in column 4, an overall Robust Study Summary score for the study is calculated as:

$$\text{Overall Study Score (\%)} = \frac{\sum W_{Yes}}{\sum W_{Yes+No}} \times 100\%$$

Where:
W_{Yes} = weight of applicable "Yes" answers;
W_{Yes+No} = weight of applicable "Yes" and "No" answers.

The overall score's corresponding reliability code and category is determined using the four categories adapted from the Klimisch approach and based on the score ranges as described in Table A.

Table A: Scoring Grid for Overall Study Reliability

Reliability Code	Reliability Category	Overall Study Score Range
1	High confidence	≥ 80%
2	Satisfactory confidence	60 – 79%
3	Low confidence	40 – 59%
4	Not acceptable	< 40%

References

Klimisch HJ, Andreae M, Tillmann U. 1997. A systematic approach for evaluating the quality of experimental toxicological and ecotoxicological data. Regulatory Toxicology and Pharmacology 25:1-5

[OECD] Organisation for Economic Co-operation and Development. 2009. Manual for the Assessment of Chemicals. Annex 1: Guidance for Completing a SIDS Dossier. [Internet]. Paris (FR): OECD, Environment Directorate. [cited July, 2011]. Available from: http://www.oecd.org/dataoecd/13/17/36045066.pdf

Robust Study Summary Form: Aquatic B				
No	**Item**	**Weight**	**Yes/No**	**Specify**
1	Reference: 20281Challenge005 - Bioaccumulation: Fish Dietary Study with CHPD (Study Submission 2009)			
2	Substance identity: CAS RN	n/a	Y	54079-53-7
3	Substance identity: chemical name(s)	n/a	Y	Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]- (CHPD)
4	Chemical composition of the substance	2	Y	
5	Chemical purity	1	N	
6	Persistence/stability of test substance in aquatic solution reported?	1	n/a	Not Applicable
7	If test material is radiolabelled, were precise position(s) of the labelled atom(s) and the percentage of radioactivity associated with impurities reported?	2	n/a	Not Applicable
Method				
8	Reference	1	Y	
9	OECD, EU, national, or other standard method?	3	Y	The study was conducted according to the "Fish Dietary Bioaccumulation Study - Basic Protocol" and "Background document to the Fish Dietary Study-Protocol". General test conditions were those of OECD TG 305 – Bioconcentration: Flow-through Fish Test (June 1996) which equals to the EU Council Regulation 440/2008 method C.13, Biokonzentration: Durchfluss-Fischtest (2008). The followed study protocol (OECD 305e) is at the draft stage (given half-points for this item).
10	Justification of the method/protocol if not a standard method was used	2	n/a	Not Applicable
11	GLP (Good Laboratory Practice)	3	Y	Yes, GLP certificate supplied
Test organism				
12	Organism identity: name	n/a	Y	*Danio rerio* (previous scientific name *Brachydanio rerio) Common name: Zebra fish*
13	Latin or both Latin & common names reported?	1	Y	both
14	Life cycle age / stage of test organism	1	Y	3-5 months old (from reception to end of tests)

15	Length and/or weight	1	Y	3.2 cm (S.D. = 0.17 cm) 325.2 mg (S.D. = 56.4 mg)
16	Sex	1	n/a	Not Applicable (not mature)
17	Number of organisms per replicate	1	Y	6
18	Organism loading rate	1	Y	0.19 to 0.62 g/L
19	Food type and feeding periods during the acclimation period	1	Y	Tetra Min® Mini Granules, Tetra GmbH, Charge No. 280353 (44.0% raw protein, 11.0% raw lipid, 2.0% raw fibre, 9.0% raw ash, 8.0% water). 3 % of wet weight per day, supplied in 2 portions daily (about 10:00 a.m. and 02:00 p.m. with an automatic feeding device).
Test design / conditions				
20	Experiment type (laboratory or field)	n/a	Y	Laboratory
21	Exposure pathways (food, water, both)	n/a	Y	Food
22	Exposure duration	n/a	Y	20 days (uptake) 28 days (depuration)
23	Number of replicates (including controls)	1	y	Yes. Replicates of number of fish sampled per sampling period = 3 for control fish and 3 for exposed fish
24	Concentrations	1	Y	100 ug/g and 1000 ug/g (in food)
25	Food type/composition and feeding periods during the test	1	Y	Same food and rate as above but food is contaminated with test substance and hexachlorobenzene (HCB) (positive control)
26	If BCF/BAF derived as a ratio of chemical concentration in the organism and in water, was experiment duration equal to or longer than the time required for the chemical concentrations to reach steady state?	3	n/a	Not Applicable. This is a dietary test. BMF was derived with sufficient time to reach steady state. Kinetic curves supplied
27	If BCF/BAF derived as a ratio of chemical concentration in the organism and in water, were measured concentrations in both water and organism reported?	3	n/a	Not Applicable. This is a dietary test. Concentrations in organism and food were reported during uptake an elimination phases.
28	Were concentrations in the test water measured periodically?	1	Y	Concentration measured in test dilution water (prior to tests), but this is not relevant to the outcome of the test.
29	Were the exposure media conditions relevant to the particular chemical reported? (e.g., for the metal toxicity - pH, DOC/TOC, water hardness, temperature)	3	Y	reported: Dissolved oxygen range: > 60%; pH range: 7.6 to 8.0; Temperature range: 20 to 25ºC; total hardness 249.9 mg/L
30	Photoperiod and light intensity	1	Y	16 h light: 8 h dark; intensity not mentioned
31	Stock and test solution preparation	1	Y	
32	Analytical monitoring intervals	1	Y	
33	Statistical methods used	1	Y	e.g .Regressions
34	Was solubilizer/emulsifier used, if the chemical was unstable or poorly soluble?	n/a	Y	Test substance and positive control substance were dissolved in a mixture of solubilisers (45% 1,4-Dioxan, 45% Tetrahydrofuran, 10% Acetone) prior to mixing with food.
Information relevant to the data quality				
35	Was the test organism relevant to the Canadian environment?	3	Y	This is a standard test species that is used for ecotixicity testing.
36	Were the test conditions (pH, temperature, DO, etc.) typical for the test organism?	1	Y	

37	Does system type and design (static, semi-static, flow-through; sealed or open; etc.) correspond to the substance's properties and organism's nature/habits?	2	Y	Flow-through
38	Was pH of the test water within the range typical for the Canadian environment (6 to 9)?	1	Y	7.6 to 8.0
39	Was temperature of the test water within the range typical for the Canadian environment (5 to 27°C)?	1	Y	20 to 25ºC
40	Was lipid content (or lipid-normalized BAF/BCF) reported?	2	Y	A lipid normalized Biomagnification Factor (BMF) could be calculated
41	Were measured concentrations of a chemical in the test water below the chemical's water solubility?	3	n/a	Not Applicable: test substance is in food source
42	If radiolabelled test substance was used, was BCF determination based on the parent compound (i.e. not on total radiolabelled residues)?	3	n/a	Not Applicable
Results				
43	Endpoints (BAF, BCF) and values	n/a	n/a	Biomagnification Factor (BMF)= 0.0026
44	BAF or BCF determined as: 1) the ratio of chemical concentration in the organism and in water, or 2) the ratio of the chemical uptake and elimination rate constants	n/a	n/a	Not Applicable. BMF is determine based on feeding rate, dietary assimilation efficiency and depuration rate kinetics, thus not a steady-state test
45	Whether BAF/BCF was derived from a 1) tissue sample or 2) whole organism?	n/a	n/a	BMF derived from (2) whole organism
46	Whether 1) average or 2) maximum BAF/BCF was used?	n/a	n/a	Not Applicable. BMF represents kinetic study
47	***Score*: ... %**			***97.3%***
48	***EC Reliability code*:**			***1***
49	***Reliability category (high, satisfactory, low)*:**			***High Confidence***
50	***Comments***	***The study was found to be reliable with a high confidence. It followed the draft OECD 305e dietary protocol and used HCB as a reference compound (positive control) in the test which showed good performance (i.e., dietary assimilation efficiency is very good and in agreement with values reported for HCB in other dietary tests). The HCB results also suggest that there are no test interferences restricting uptake efficiency and that the reported assimilation efficiency for CHPD is valid.***		

Robust Study Summary Form: Aquatic iT				
No	**Item**	**Weight**	**Yes/No**	**Specify**
1	Reference: 20281Challenge003 - Algae Inhibition Test with CHPD (Study Submission 2008a)			
2	Substance identity: CAS RN	n/a	Y	54079-53-7
3	Substance identity: chemical name(s)	n/a	Y	Propanedinitrile, [[4-[[2-(4-cyclohexylphenoxy)ethyl]ethylamino]-2-methylphenyl]methylene]- (CHPD)
4	Chemical composition of the substance	2	Y	
5	Chemical purity	1	Y	99.20%
6	Persistence/stability of test substance in aquatic solution reported?	1	N	
Method				
7	Reference	1	Y	
8	OECD, EU, national, or other standard method?	3	Y	OECD No. 201 Algae, Growth Inhibition Test (2006)
9	Justification of the method/protocol if a standard method was not used	2	n/a	Not applicable
10	GLP (good laboratory practice)	3	Y	
Test organism				
11	Organism identity: name	n/a	Y	*Desmodesmus subspicatus* (former name: *Scenedesmus subspicatus)*
12	Latin or both Latin and common names reported?	1	Y	
13	Life cycle age / stage of test organism	1	Y	
14	Length and/or weight	1	n/a	Not applicable

No	Item	Weight	Yes/No	Specify
15	Sex	1	n/a	Not applicable
16	Number of organisms per replicate	1	Y	Initial cell density
17	Organism loading rate	1	Y	Initial cell density
18	Food type and feeding periods during the acclimation period	1	n/a	Not applicable
Test design/conditions				
19	Test type (acute or chronic)	n/a	n/a	Chronic
20	Experiment type (laboratory or field)	n/a	Y	Laboratory
21	Exposure pathways (food, water, both)	n/a	Y	Water
22	Exposure duration	n/a	Y	72 hours
23	Negative or positive controls (specify)	1	Y	Negative
24	Number of replicates (including controls)	1	Y	6
25	Nominal concentrations reported?	1	Y	1 mg/L
26	Measured concentrations reported?	3	Y	Control: < 0.002; exposed, range: 0.004–0.041 mg/L
27	Food type and feeding periods during the long-term tests	1	n/a	Not applicable
28	Were concentrations measured periodically (especially in the chronic test)?	1	Y	Start and end of test
29	Were the exposure media conditions relevant to the particular chemical reported? (e.g., for the metal toxicity - pH, DOC/TOC, water hardness, temperature)	3	Y	Dissolved oxygen: not reported pH range: 7.5–8.2 Temperature range: 21–25ºC (chamber) Total hardness 22.5 mg/L
30	Photoperiod and light intensity	1	N	60–120 µE/m^2/s - equivalent of 4000 to 8000 lux; photoperiod not specified
31	Stock and test solution preparation	1	Y	
32	Was solubilizer/emulsifier used if the chemical was poorly soluble or unstable?	1	N	
33	If solubilizer/emulsifier was used, was its concentration reported?	1	n/a	Not applicable
34	If solubilizer/emulsifier was used, was its ecotoxicity reported?	1	n/a	Not applicable
35	Analytical monitoring intervals	1	Y	
36	Statistical methods used	1	n/a	Not applicable

Information relevant to the data quality				
No	**Item**	**Weight**	**Yes/No**	**Specify**
37	Was the endpoint directly caused by the chemical's toxicity and not by the organism's health (e.g., when mortality in the control > 10%) or physical effects (e.g., "shading effect")?	n/a	Y	24-hour LOECr,y ≤ 0.041 mg/L[1]
38	Was the test organism relevant to the Canadian environment?	3	Y	
39	Were the test conditions (pH, temperature, DO, etc.) typical for the test organism?	1	Y	
40	Do system type and design (static, semi-static, flow-through; sealed or open; etc.) correspond to the substance's properties and organism's nature/habits?	2	Y	Static
41	Was pH of the test water within the range typical for the Canadian environment (6–9)?	1	Y	
42	Was temperature of the test water within the range typical for the Canadian environment (5–27°C)?	1	Y	
43	Was toxicity value below the chemical's water solubility?	3	Y	24-hour LOECr,y ≤ 0.041 mg/L[1]
Results				
44	Toxicity values (specify endpoint and value)	n/a	n/a	EC_{10}r,y; EC_{50}r,y (0–48 h) > 1 mg/L[2]
45	Other endpoints reported - e.g., BCF/BAF, LOEC/NOEC (specify)?	n/a	Y	NOECr,y ≥ 1 mg/L[3]
46	Other adverse effects (e.g., carcinogenicity, mutagenicity) reported?	n/a	N	
47	**Score: ... %**			**92.5**
48	**Environment Canada reliability code:**			**1**
49	**Reliability category (high, satisfactory, low):**			**High Confidence**
50	**Comments**			**The study was found to be reliable with a high confidence. However, the test results reported (cells G51 and G52) could have included growth rate and yield results after 24 hours. These parameters are reduced and the effect is statistically significant (P < 0.05, Mann-Whitney U Test). Therefore, a value of 24-hour LOECry ≤ 0.041 mg/L could have been reported and is indicative of an inherent toxic effect of the substance. Algae seem to have recovered since there was no significant difference on these parameters after 48 hours (P > 0.05, Mann-Whitney U Test). However, data suggest that the recovery of algae is due to the decrease of the dissolved concentration of the substance in the test water that went from 0.041/0.040 to 0.006/0.004 mg/L from the beginning to the end of test. This decrease is likely due to adsorption of the substance on the Erlenmeyer flask walls since substance is persistent and has a very low volatility. Considering that the significant effect occurring after 24 hours is likely due to the substance, the LOEC result was deemed valid even if exposure duration was shorter than the usual total, more standard, test duration.** **Additional comments: (1) The raw data after 72 hours could have been reported in the report for completeness. (2) About filtration: OECD 2000 states that filter pore size of 0.22 to 0.45 µM may be suitable to achieve adequate separation and that filter matrix**

		should be made of inert materials (i.e., chemically and physically non-reactive with testing compounds). The type of filter matrix was not reported and pore size used was 7–12 µM in the study. However, it was judged that maximal exposure was achieved and larger pore sizes have not reduced effective concentrations.

[1] LOECr,y – The Low Observed Effect Concentration is the lowest concentration in a toxicity test that caused a statistically significant effect in comparison to the controls where r = growth rate and y = yield (biomass variation).

[2] EC_{10}r,y, EC_{50}r,y – The concentration of a substance that is estimated to cause a 10 or 50% reduction in the growth rate (r) or yield (biomass variation) (y) of the test organisms.

[3] NOECr,y – The No Observed Effect Concentration is the highest concentration in a toxicity test not causing a statistically significant effect in comparison to the controls where r = growth rate and y = yield (biomass variation).