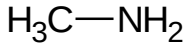
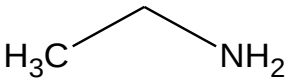
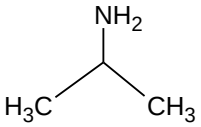
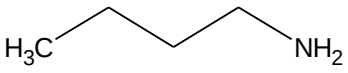
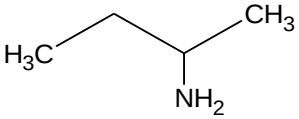
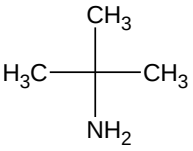
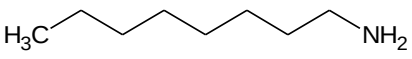
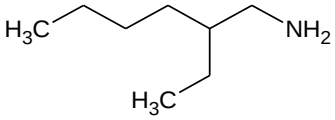
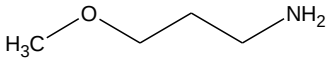
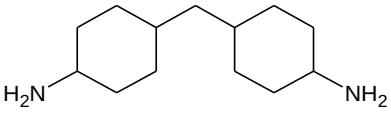
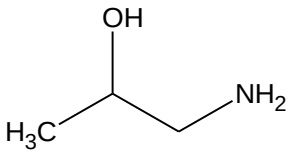
SIDS INITIAL ASSESSMENT PROFILE

Chemical Category	C1 -13 Primary Amines
Category Members: **CAS Registry Numbers, Chemical Names**	74-89-5 Methylamine 75-04-7 Ethylamine 75-31-0 Isopropylamine 109-73-9 Butylamine 13952-84-6 sec-Butylamine 75-64-9 tert-Butylamine 111-86-4 Octylamine 104-75-6 Hexylamine, 2-ethyl 5332-73-0 Propylamine, 3-methoxy- 1761-71-3 Cyclohexylamine, 4,4'-methylenebis 78-96-6 2-Propanol, 1-amino-
Structural Formula	

Methylamine	
Ethylamine	
Isopropylamine	
Butylamine	
sec-Butylamine	
tert-Butylamine	
Octylamine	

Hexylamine, 2-ethyl	
Propylamine, 3-methoxy-	
Cyclohexylamine, 4,4'-methylenebis	
2-Propanol, 1-amino-	

SUMMARY CONCLUSIONS OF THE SIAR

Category rationale

The C10-C13 primary amines category is limited to the eleven sponsored substances as mentioned above. It excludes C12-C16 primary fat amines.

The C10-C13 Primary Amines category is represented by the structure with a single and primary amino-group R-NH2, where R is an alkyl group that may be linear, branched or alicyclic; the alkyl group may include an atom or group that will not react with or substantially affect the properties of the amine function. The tendency to share the nonbonded electron pair on the nitrogen underlies the chemical behavior of amines as a group.

The C10-C13 Primary Amines category members are structurally similar showing trend in physical-chemical properties and ecotoxicity and similar toxicological properties. This category is defined as below:

• A structure that contains only aliphatic organic substituents that are linear, branched or cyclic;

• Molecular weights from approxiamtely 30 to 250 Dalton, classifying these primary amines as low molecular weight aliphatic amines.

• Incremental structural change across the group consisting of an increasing number of atoms in the molecular backbone; moderate branching is acceptable. The change is restricted to adding elements that do not greatly change the physicochemical properties of the amino moiety, as evidenced by the consistency of pKa values within the narrow range of 9.86 to 10.87.

Observed corrosive properties overwhelm the systemic toxicity of the primary amines in most cases, including acute toxicity; the known acute oral and dermal effects are generally related to the alkaline properties and are expected to be a general feature of the category. Structure-activity similarities for mammalian toxicity and structure-activity relationships (SAR) shown for aquatic toxicity endpoints lend support to the category.

In general, members of the C10-C13 primary amines can be considered to be comparable in metabolism. However,

there are known outliers for which own data are available to cover the endpoints (due to structural differences, methylamine, tert-butlylamine may be metabolized by different pathways than the rest of the category). Read-across approach has been used for addressing the mammalian toxicity endpoints where no data were available on individual substances (as indicated in the table below).

In the case of ecotoxicity read-across approach was not used as sufficient data for the individual chemicals are available.

Substance	Skin irritation	Eye Irritation	Skin sensitization	Repeated dose toxicity	Effects on Fertility	Developmental toxicity	Genetic toxicity (Chrom. Aberration)
Methylamine	X	READ-ACROSS	READ-ACROSS	X	X	X	X
Ethylamine	X	X	READ-ACROSS	X	X	READ-ACROSS	READ-ACROSS
Isopropylamine	X	X	X	X	X	X	READ-ACROSS
Butylamine	X	X	X	X	READ-ACROSS	X	X
sec-Butylamine	X	READ-ACROSS	READ-ACROSS	READ-ACROSS	READ-ACROSS	READ-ACROSS	READ-ACROSS
tert-Butylamine	X	X	READ-ACROSS	X	X	READ-ACROSS	READ-ACROSS
Octylamine	X	X	X	X	X	X	X
Hexylamine, 2-ethyl	X	X	READ-ACROSS	READ-ACROSS	READ-ACROSS	READ-ACROSS	READ-ACROSS
Propylamine, 3-methoxy-	X	READ-ACROSS	X	X	X	X	X
Cyclohexylamine, 4,4'-methylenebis	READ-ACROSS	X	READ-ACROSS	X	X	X	X
2-Propanol, 1-amino-	X	X	X	X	X	X	X

X = data available

Using the category approach, read across has been performed from the tested members to those without available data. For those substances where data exist for developmental toxicity, the results indicate a lack of effect with the exception of butylamine, which was negative by inhalation but positive when administered as the hydrolchoride salt by the oral route (gavage). Taking a precautionary approach, all those category members without developmental toxicity data are regarded as potential developmental toxicants when administered by the oral (gavage) route.

In some cases, the tested substance was the salts of amines to avoid damage to the gastrointestinal tract following gavage administration due to the caustic mode of action. Testing the salt also provides the ability to distinguish between symptoms caused by local effects such as irritation or corrosion and symptoms that are due to systemic toxicity as follows:

Substance	**Repeated dose toxicity**	**Effects on Fertility**	**Developmental toxicity**
Methylamine	Tested as the hydrochloride	Tested as the	Tested as the hydrochloride (CAS

	(CAS no 593-57-1)	hydrochloride (CAS no 593-57-1)	no 593-57-1)
Octylamine	Tested as the hydrochloride (CAS no 142-95-0)	Tested as the hydrochloride (CAS no 142-95-0)	Tested as the hydrochloride (CAS no 142-95-0)
Propylamine, 3-methoxy-	Tested as the hydrochloride (CAS no 18600-41-4)	Tested as the hydrochloride (CAS no 18600-41-4)	Tested as the hydrochloride (CAS no 18600-41-4)
2-Propanol, 1-amino-	Tested as the hydrochloride (CAS no 7780-04-3)	Tested as the hydrochloride (CAS no 7780-04-3)	Tested as the hydrochloride (CAS no 7780-04-3)

Physical-chemical properties

The substances are gases (methylamine and ethylamine only) or liquids, with measured melting points that range from -104 °C (sec-butylamine) to 1 °C (2-propanol, 1-amino-). The measured boiling points range from -6.5 °C at 1013 hPa (methylamine) to 159°C (1013 hPa; 2-propanol, 1-amino). Measured and estimated vapor pressures range from 0.63 hPa at 25 °C (2-propanol, 1-amino-) to 3140 hPa at 20 °C (methylamine). Water solubility correlates well with structure; longer chain or cyclic functionalities result in lower water solubility values. Water solubility values range from miscible (1000 g/l) for methylamine, ethylamine and 2-propanol, 1-amino- to 0.2 g/L for octylamine. Measured data on the log K_{ow} are available for all members except hexylamine, 2-ethyl and propylamine, 3-methoxy-; modeling was used to fill this endpoint. The log K_{ow} are <3 for the category members and when indicated, generally were not pH adjusted. The pKa values are similar for the primary amines with measured and estimated values between 9.87 and 10.8.

Human Health

Toxicokinetics

The C10-C13 primary amines may be absorbed through the skin up to chain length of about six carbon atoms. The charged form will hinder absorption across biological membranes, and the corrosive properties of the substances may also affect absorption. Dermal exposures to dilute solutions, aerosols and vapors might not have sufficient base capacity to overwhelm the skin's natural acidity and only a few of these molecules exist as the uncharged free base. In situations where the majority of the molecules would exist as the free base on the skin, the individual would experience a chemical burn. At the pH of the GI tract, only limited, non-ionized compound would be absorbed. Following inhalation, the C10-C13 primary amines will be removed by dissolution in the upper respiratory tract and swallowed. Vapors or particulates that get to the deep lungs will be primarily in the charged form which is expected to slow absorption somewhat and contribute to the local metabolism of these C10-C13 primary amines by alveolar and bronchiolar tissues. The major routes of metabolism of C10-C13 primary amines involve various processes including oxidation, conjugation, and other enzyme-catalyzed reactions leading to detoxification and excretion. Additionally, N-acetylation may occur, but represents only a very minor pathway in the metabolism of aliphatic amines. Methylamine, which has the amino group is attached to a methyl group rather than a methylene group, is not a substrate for monoamine oxidase. Pharmacokinetic studies have indicated that a substantial amount of methylamine is oxidized to carbon dioxide, even though some is excreted unchanged in expired air and urine. Although metabolic pathways have not been identified for tert-butylamine, it is expected, based on its structure, to have a different metabolic pathway than the other members of the category.

Human health effects data are available for the C10-C13 primary amines. In some cases (repeated dose and reproductive toxicity), the tested substance was the salt of amines to avoid damage to the gastrointestinal tract following gavage administration due to the caustic mode of action. Testing the salt also provides the ability to distinguish between symptoms caused by local effects such as irritation or corrosion and symptoms that are due to systemic toxicity.

Acute toxicity

Acute inhalation toxicity studies are available for all members except sec-butylamine, propylamine, 3-methoxy-, and, cyclohexylamine, 4,4'-methylenebis. Four hour vapor LC_{50} values (rat) range from <1548 mg/m^3 (hexylamine, 2-ethyl-) to 9,800 mg/m^3 (males, ethylamine). Clinical signs and findings at gross necropsy were consistent with generally severe local effects of eye and respiratory irritation, respiratory distress and lung damage; similar effects of irritation were not seen following a 6-hour exposure to 2460 mg/m3 2-propanol, 1-amino-. The effects observed in most cases were quite severe due to the corrosive nature of the substances tested. Dermal LD_{50} values (rat or rabbit) are available for all members except methylamine, tert-butylamine, hexylamine, 2-ethyl- and 2-propanol, 1-amino-. Dermal LD_{50} values (for 24-hour covered contact) ranged from around 200 mg/kg bw (sec-butyl and octylamine) to 2000 mg/kg bw (propylamine, 3-methoxy-). Severe skin necrosis at the site of application was noted in most studies. Similar results including severe skin necrosis would be expected for all substances based on structural similarities. Acute oral LD_{50} values in rats range between 122 mg/kg bw (isopropylamine) and approximately 2813 mg/kg bw (2-propanol, 1-amino-). In the acute oral studies, most deaths occurred on day 1; clinical signs generally included salivation, breathing abnormalities, oral-nasal staining, decreased defecation, diarrhea, polyuria, piloerection, decreased activity, convulsions, ataxia, rough hair coat, urine stains and dehydration. Site of contact effects (irritation) were noted in the gastrointestinal tract at gross necropsy in some studies.

Irritation

Reliable skin irritation studies are available for all category memebrs except cyclohexylamine, 4,4'-methylenebis. All tested category members were corrosive to skin. Based on the available acute dermal toxicity study with cyclohexylamine, 4,4'-methylenebis and data from other category memebers, this substance is also considered to be corrosive to the skin. Based on the available data and known eye irritation potential of alkyl amines in general, it is expected that all the amines in the category are corrosive to the eye. The C10-C13 primary amines are known irritants of the human respiratory tract; supporting animal data confirm this finding.

Sensitization

There was no evidence of positive sensitization results at the concentrations tested in animal studies for isopropylamine, butylamine, octylamine, propylamine, 3-methoxy-, or 2-propanol, 1-amino-. There were no data located for methylamine, ethylamine, sec-butylamine, tert-butylamine, hexylamine, 2-ethyl, cyclohexylamine, 4,4'-methylenebis; a similar lack of skin sensitization potential is expected for these substances.

Repeated dose toxicity

Local effects (irritation of the respiratory tract and mucous membranes) are the major effects following repeated inhalation exposure (methylamine, ethylamine, isopropylamine and tert-butylamine). This occurred in rats exposed to 96 mg/m^3 of methylamine for 10 days, or to 200 mg/m^3 of tert-butylamine for 13 weeks, and at higher concentrations of ethylamine and isopropylamine. Systemic effects (changes in clinical chemistry parameters) were also noted following repeated dose inhalation of tert-butylamine at 200 mg/m^3. The oral NOAELs in rats were 15 mg/kg bw/d for cyclohexylamine, 4,4'-methylenebis-, 500 mg/kg bw/day as methylamine hydrochloride; CAS No. 593-51-1; 100 mg/kg bw for octylamine (as the hydrochloride, CAS No 142-95-0), 300 mg/kg bw/ d for 2-propanol, 1-amino (as the hydrochloride; CAS No. 7780-04-3) and 1000 mg/kg bw/day (females) for propylamine, 3-methoxy- (as the hydrochloride; CAS No. 18600-41-4). The effects observed in these studies included reductions in body weight, body weight gain, and food consumption; and/or changes in blood, urine and clinical chemistry parameters, as well as histopathological findings in various organs with cyclohexylamine, 4,4'-methylenebis- . Similar effects following repeated exposure are expected for the remaining members (sec-butylamine, butylamine and hexylamine, 2-ethyl) are expected. For those category members for which read-across is applied, the lowest NOAEC/NOAEL level is used.

Genetic toxicity

All of the members of the category have been tested in the Ames test and no evidence of mutagenic potential was detected with the exception of 2-propanol, 1-amino-, which was positive in one bacterial mutagenicity assay with *Salmonella* TA1535 with activation; the second bacterial mutagenicity assay was negative. Of the five compounds evaluated in a mouse lymphoma assay, all but methylamine gave negative results. Four of these five, including methylamine, have been examined in micronucleus tests in rodents and none showed any evidence of clastogenic activity. 2-Propanol, 1-amino- was negative in a mammalian gene mutation assay and an *in vitro* chromosomal aberration assay. Cyclohexylamine, 4,4'-methylenebis- was negative in two *in vivo* micronucleus assays. A third micronucleus assay (with methodological limitations) was positive; data for clastogenicity are equivocal for this substance. The weight-of-evidence suggests the category members are not mutagenic.

Carcinogenicity

No data are available for the carcinogenicity of the C10-C13 Primary Amines.

Reproductive toxicity

Effects on fertility

Reproductive toxicity has been directly investigated following inhalation or oral (gavage) exposure on eight members of the category. Following oral (gavage) exposure, no reproductive toxicological potential was detected for octylamine, propylamine, 3-methoxy or 2-propanol, 1-amino- (each tested as the hydrochloride). Cyclohexylamine, 4,4'-methylenebis- reduced the number of implantation sites in an OECD 422 study in rats at an oral dose of 50 mg/kg bw/day that also produced other indications of parental systemic toxicity. No reproductive or systemic toxicity occurred at 15 mg/kg bw/day. Methylamine (as the hydrochloride), in an oral (gavage) OECD 422 study did produce adverse reproductive effects at 1000 mg/kg bw/day, a dose that also produced overt indications of parental toxicity. The NOAEL for systemic and reproductive toxicity was considered to be 500 mg/kg bw/day. Following inhalation exposure, no reproductive toxicological potential was detected for isopropylamine in a one generation study with rats. Reproductive toxicity has also been investigated as part of repeated dose inhalation studies. In a 24-week repeated dose inhalation toxicity study, ethylamine did not adversely effect male and female gonads up to 922 mg/m^3. In a 13-week repeated dose inhalation toxicity test, tert-butylamine produced no adverse effects on the testes up to 2000 mg/m^3. Substances that have not been tested for reproductive toxicity (butylamine, sec-butylamine, and hexylamine, 2-ethylhexyl) are not expected to be reproductive toxicants based on read across to other category members.

Developmental toxicity

Developmental toxicity has been investigated following inhalation and oral (gavage) exposures in rats. An inhalation study found isopropylamine not to be fetotoxic in rats at test concentrations that also produced maternal toxicity; administration of butylamine by the inhalation route was associated with significant respiratory tract (portal of entry) irritation of the dams at even the lowest tested concentration of 50 mg/m3, while fetal effects were not observed at the highest test concentration of 450 mg/m3. Rat studies involving repeated oral exposures to methylamine, octylamine, propylamine, 3-methoxy and 2-propanol, 1-amino- (each tested as the hydrochloride) or cyclohexylamine, 4,4'-methylenebis during pregnancy identified no evidence of developmental toxicity potential. Butylamine (tested as the hydrochloride, CAS 3858-78-4) produced fetal malformations in rats at an oral gavage dose of 400 mg/kg bw/day that was not overtly toxic to the dams. Rat studies involving repeated inhalation exposures to isopropylamine, or butylamine during pregnancy identified no evidence of developmental toxic potential. The reported developmental effects of butylamine (as the hydrochloride salt) are therefore expected to be route specific occurring only after oral exposure. For those substances where data exist for developmental toxicity, the results indicate a lack of effect with the exception of butylamine, which was negative by inhalation but positive when administered as the hydrolchoride salt by oral (gavage). Taking a precautionary approach, ethylamine, sec-butylamine, tert-butylamine and hexylamine, 2-ethyl, are regarded as potential developmental toxicants when administered by the oral (gavage) route.

The C10-C13 Primary Amines possess properties indicating a hazard for human health (acute toxicity,

irritating/corrosive properties). Cyclohexylamine, 4,4'-methylenebis (oral gavage) and tert-butylamine (inhalation) may exhibit additional potential hazardous properties for human health (repeated dose toxicity). Butylamine may exhibit additional potential hazardous properties for human health (developmental effects when tested as the salt by the oral route); based on read-across, ethylamine, sec-butylamine, tert-butylamine and hexylamine, 2-ethyl may also cause similar developmental effects by the oral route. Adequate screening-level data are available to characterize the hazard to human health for the purposes of the OECD HPV Chemicals Programme.

Environment

Most aliphatic amines are considered stable to hydrolysis, as the molecules do not contain any functional group sensitive to hydrolysis. Tert-butylamine was resistant to hydrolysis at pH 4, 7, or 9 at 50C up to 125 hours (OECD TG 111). In water solution, all of the simple alkyl amines share the property of forming ammonium ions. This is due to the ability of the free electron pair on the amine nitrogen to pick up a proton from water and form a hydroxide ion raising the solution pH. Estimated pKa values of >9.5 indicate that the C10-C13 primary amines will exist primarily as cations in the environment (relevant pH 5.0 – 9.0). However, the EPIWIN modeling program predicts environmental fate endpoints for C10-C13 primary amines in their uncharged form.

In the atmosphere, indirect photo-oxidation by reaction with hydroxyl radicals is predicted to occur with a half-life of <1 day. For the C10-C13 primary amines, EPIWIN Level III fugacity modeling predicts that, when distributed equally to air, water and soil, for most of the amines, the substances will partition more towards the soil compartment relative to the water compartment; the favored distribution towards soil increases proportionally with molecular weight of the C10-C13 primary amines. Most of the C10-C13 primary amines are readily biodegradable (methylamine, ethylamine, isopropylamine, butylamine, sec-butylamine, octylamine, hexylamine, 2-ethyl, and 2-propanol, 1-amino-). Tert-butylamine, propylamine, 3-methoxy- are not readily biodegradable; however, they are inherently biodegradable. Cyclohexylamine, 4,4'-methylenebis- showed <10% biodegradation in 28 days, and is considered to be not readily biodegradable. Predicted BCF values, from BCFBAF Program v3.00 in EPIWIN v4.0, range from 3.162 to 38.06 indicating that they have low bioconcentration potential and are not expected to be bioaccumulative. The measured BCF was 2.7-3.6 for 2-propanol, 1-amino (OECD TG 305C) indicating it is not expected to be bioaccumulative.

The following acute aquatic toxicity test results using buffered/unbuffered conditions have been determined for the C10-C13 primary amines (key and supporting studies are presented; the supporting studies are used to illustrate pH effects). "Estimated" values are from the ECOSAR Program (v1.00).

Fish:

Substance	Species	LC50 (96 hr; mg/L)	Remark	Estimated values (ECOSAR 1.0) (96 hr, mg/L)[8]
Methylamine	*Brachydanio rerio*	711	pH 8.0; nominal/measured not specified[1]	210
	Leuciscus idus	16	48 hr; unbuffered, nominal	
		970	48 hr; buffered, nominal	
Ethylamine	*Pimephales promelas*	227	pH not specified; nominal/measured not specified	155
Isopropylamine	*Oncorhynchus mykiss*	40	maximum pH 10.2 at 100 mg/L[2]; nominal	114
Butylamine	*Pimephales promelas*	268	Buffered pH; measured	64.5
sec-Butylamine	*Leuciscus idus*	>46 - <68	Unbuffered pH; nominal	71.5

		>100	Buffered pH; nominal[3]	
tert-Butylamine	*Oncorhynchus mykiss*	28 (soft water); 270 (hard water)	pH not specified; nominal	75.3
Octylamine	*Pimephales promelas*	5.19	pH not specified; measured	7.5
Hexylamine, 2-ethyl-	*Leuciscus idus*	> 46.4 - < 68.1	Unbuffered; nominal	8.3
		> 100 - < 500	Buffered; nominal[4]	
Propylamine, 3-methoxy-	*Leuciscus idus*	148	Unbuffered; nominal	448
		>1000	Buffered; nominal[5]	
Cyclohexylamine, 4,4'-methylenebis-	*Leuciscus idus*	67.8	Unbuffered; nominal	6.41
		>100	Buffered; nominal[6]	
2-Propanol, 1-amino-	*Leuciscus idus*	>215-<464	Unbuffered; nominal	1102
		>1000	Buffered; nominal[7]	

[1] test method: development of zebrafish eggs was observed microscopically for 96 hr beginning with the 8 cell stage.
[2] The pH normalised during the test period and was in the range of the control values by the end of the test.
[3] no effects at 100 mg/L
[4] no effects at 100 mg/L (buffered, nonimal); 100% mortality at 500 mg/L (buffered, nominal)
[5] no effects at 1000 mg/L (buffered; nominal)
[6] at 100 mg/L (buffered, nominal): observed mortality: 10 % (1 of 10 fish)
[7] no effects at 1000 mg/L (buffered; nominal)
[8] ECOSAR Class used was Aliphatic Amines; all predicted values fall within the applicability domain

Aquatic invertebrates:

Substance	Species	EC50 (48 hr; mg/L)	Remark	Estimated values (ECOSAR 1.0) (48 hr, mg/L)[11]
Methylamine	*Daphnia magna*	163	Unbuffered; nominal	12.3
		702	Buffered; nominal	
Ethylamine	*Ceriodaphnia dubia*	7.9	pH 8.0-9.0; measured	10.0
Isopropylamine	*Daphnia magna*	47.4	Unbuffered: nominal[9]	8.0
Butylamine	*Ceriodaphnia dubia*	8.2	pH 7.8; measured	5.1
sec-Butylamine	*Daphnia magna*	40	Unbuffered; nominal[10]	5.5
tert-Butylamine	Daphnid	-	-	5.8
Octylamine	*Daphnia magna*	1.9	Not specified; measured	0.89
Hexylamine, 2-ethyl-	Daphnid	-	-	0.974
Propylamine, 3-methoxy-	Daphnid	-	-	27.2

Cyclohexylamine, 4,4'-methylenebis-	*Daphnia magna*	6.84	pH not specified; nominal	0.84
2-Propanol, 1-amino-	*Daphnia magna*	109	Unbuffered; nominal	57.47

[9] observed effects at higher test item concentrations may be due to high pH (up to 11.95)
[10] observed effects at higher test item concentrations may be due to high pH (up to 10.46)
[11] ECOSAR Class used was Aliphatic Amines; all predicted values fall within the applicability domain

Algae:

Substance	Species	EC50 (72 hr; mg/L)	Remark	Estimated values (ECOSAR 1.0) (96 hr, mg/L)[12]
Methylamine	*Pseudokirchnerella subcapitata*	21% ErC50 at 31 mg/L	pH not specified; duration not specified; measured	2.25
Ethylamine	*Green algae*	-	-	2.14
Isopropylamine	*Desmodesmus subspicatus*	18.9 ErC50; 4.13 yield	pH 8.0-9.7; nominal	1.97
Butylamine	*Green algae*	-	-	1.5
sec-Butylamine	*Desmodesmus subspicatus*	0.520 (EyC50); 2.03 (ErC50); 0.716 (EbC50)	pH 8.0 – 10.0; nominal	1.6
tert-Butylamine	*Pseudokirchnerella subcapitata*	16	96 hr; pH not specified; measured	1.65
Octylamine	*Desmodesmus subspicatus*	0.23 (ErC50); 0.12 (EbC50)	pH not specified; nominal	0.50
Hexylamine, 2-ethyl-	*Desmodesmus subspicatus*	10 (ErC50); 4.5 (EbC50)	pH 7.4 – 8.0; measured	0.53
Propylamine, 3-methoxy-	Green algae	-	-	5.36
Cyclohexylamine, 4,4'-methylenebis-	*Desmodesmus subspicatus*	141.42 - 200(ErC50 and EbC50)	pH not specified; nominal	0.54
2-Propanol, 1-amino-	*Desmodesmus subspicatus*	25.4 (EbC50); 32.7 (ErC50)	pH 8.68 – 10.24; nominal	8.74

[12] ECOSAR Class used was Aliphatic Amines; all predicted values fall within the applicability domain

Observed effects in acute toxicity tests for fish appear to be due to an increase in pH at higher test item concentrations, as demonstrated in the tests with fish, where unbuffered and buffered test solutions were tested in parallel.

The C10-C13 Primary Amines possess properties indicating a hazard for the environment (acute aquatic toxicity values < 1 and up to 100 mg/L). These C10-C13 Primary amines are readily or inherently

biodegradable except for cyclohexylamine, 4,4'-methylenebis- which is not readily biodegradable. The C10-C13 primary amines are not bioaccumulative. Adequate screening-level data are available to characterize the hazard for the environment for the purposes of the OECD HPV Chemicals Programme.

Exposure

The estimated production volumes (metric tons) of the primary amines from 2007 are provided for the United States and globally. Data from 2003 are provided when 2007 data was not available:

	United States; Global (2007)
Methylamine	52,000; 742,900
Ethylamine	16,000; 64,800
Isopropylamine	43,000; 95,800
Butylamine	2,100; 17,300
sec-Butylamine	1000- 2,000 (2003); 2,000 - 4,000 (2003)
tert-Butylamine	0; 10,600
Octylamine	500 - 1,500 (2003);1,000 - 3,000(2003)
Hexylamine, 2-ethyl-	500 - 1,500 (2003); 1,000 - 3,000 (2003)
Propylamine, 3-methoxy-	0 - 6,000 (2003); 3,000 - 10,000 (2003)
Cyclohexylamine, 4,4'-methylenebis	5,000 - 15,000 (2003); 15,000 - 30,000 (2003)
2-Propanol, 1-amino-	1,000 - 3,000 (2003); 3,000 - 6,000 (2003)

Primary amines can be synthesized in various ways including reaction of ammonia with alkyl halides or alcohols, reduction of nitriles or amides, or reductive amination of aldehydes. The reaction between ammonia and alcohol forms the basis for most of the present commercial processes for making primary amines. No monitoring data are available. The most likely route of human occupational exposure is either via dermal contact or inhalation; most of these materials are highly irritating or corrosive to the skin and adequate protective equipment is required if any splash hazard is present. In addition, employee health and safety training provides employees with an understanding of the potential for skin and eye damage from direct contact with these materials. There are no known direct consumer exposures with the exception of home-use herbicides containing glyphosate isopropylamine salt. This exposure would be primarily dermal as the salt form is non-volatile. In production, these materials are handled in closed systems. Transfer of these materials is in closed pipe systems rather than in open systems to minimize loss. There may be low level losses in process waters, which are discharged to a waste water treatment system. Limited potential exists for release of material to a publicly-owned treatment works (POTW) or a body of water after primary biological treatment on site. All of these materials are stored in closed tanks or pressurized cylinders and transported in tank cars and tank trucks, and smaller amounts are transported in drums, pressurized cylinders or Intermediate Bulk Containers (IBCs). The possibility of a release to air varies from material to material as a function of vapor pressure, ranging from certain for anhydrous methylamine to minimal for the higher molecular weight amines.

Intentional environmental release occurs for the glyphosate salt of isopropylamine that is used as an herbicide. During the approximate period 1972 to 1987, sec-butylamine was registered as a fungicide and was thus permitted to be released in the environment.