

ASTER User Guide

ASsessment Tools for the Evaluation of Risk

Version 2.0

U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
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CONTRACT GS-35F-4381G, BPA 0775
TASK ORDER: 1521 – SAVCS3

November 2012

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INTRODUCTION

Ecological risk assessments are utilized by the U.S. Environmental Protection Agency (EPA) and other governmental agencies to determine the probability and magnitude of deleterious effects of hazardous chemicals on plants and animals. These assessments are important steps in formulating regulatory decisions. **ASTER (ASsessment Tools for the Evaluation of Risk)** was developed at the U.S. EPA, National Health and Environmental Effects Research Laboratory (NHEERL), Mid-Continent Ecology Division (MED), with funding from the U.S. EPA Office of Solid Waste and Emergency Response, and Office of Research and Development's, National Center for Computational Toxicology. The objective was to develop an intranet application that could assist regulators in hazard ranking and the development of comprehensive risk assessments. ASTER is designed to provide high quality data for discrete chemicals, when available in the associated databases (i.e., ECOTOX and EcoChem) and QSAR-based estimates when data are lacking. The EcoChem database includes measured physicochemical properties such as melting point, boiling point, vapor pressure, and water solubility as well as more than 50,000 molecular structures stored as SMILES (Simplified Molecular Input Line Entry System) strings for specific chemicals. ECOTOX (www.epa.gov/ecotox) is a comprehensive database, which provides information on adverse effects of single chemical stressors to ecologically relevant aquatic and terrestrial species.

You may initiate an ASTER query by entering a Chemical Abstract Services (CAS) Registry number, a chemical name, or the chemical's structure as represented by a SMILES string. Prior to generating a report, the software allows you to see details on how parameters were calculated or change critical information such as physical/chemical property data or the acute mode of toxic action. Reports are available in either an HTML or Microsoft Office Excel format. The HTML Profile Report provides chemical identification information, a summary of physical/chemical property and exposure information, ecotoxicity data either reported in the ECOTOX database or estimated using QSAR models, information on the chemical's mode of toxic action, and all references associated with the report. The Microsoft Office Excel format Profile Report provides the same data presented in the HTML Profile Report. Also available in the Excel format are the Supplemental Data Report, which provides the filtered data from ECOTOX used to calculate the median values presented in the Profile Report that were not presented in the Profile Report, and the Other Data Report, which presents all other ecotoxicity data from ECOTOX that did not meet the filter requirements available for the chemical searched.

ASTER was designed to be flexible, allowing for additions of new software modules and models as they become available. ASTER also includes supporting modules from Syracuse Research Corporation (KowWin (http://www.syrres.com/eSc/est_kowdemo.htm) and BioWin (<http://www.syrres.com/eSc/biowin.htm>)), the Prof. Assen, Zlatarov University in Bourgas Bulgaria (Structure depiction software (<http://www.oasis-lmc.org/>)), and

BioByte (ClogP (<http://www.biobyte.com/index.html>)).

For more information on the ASTER system contact:

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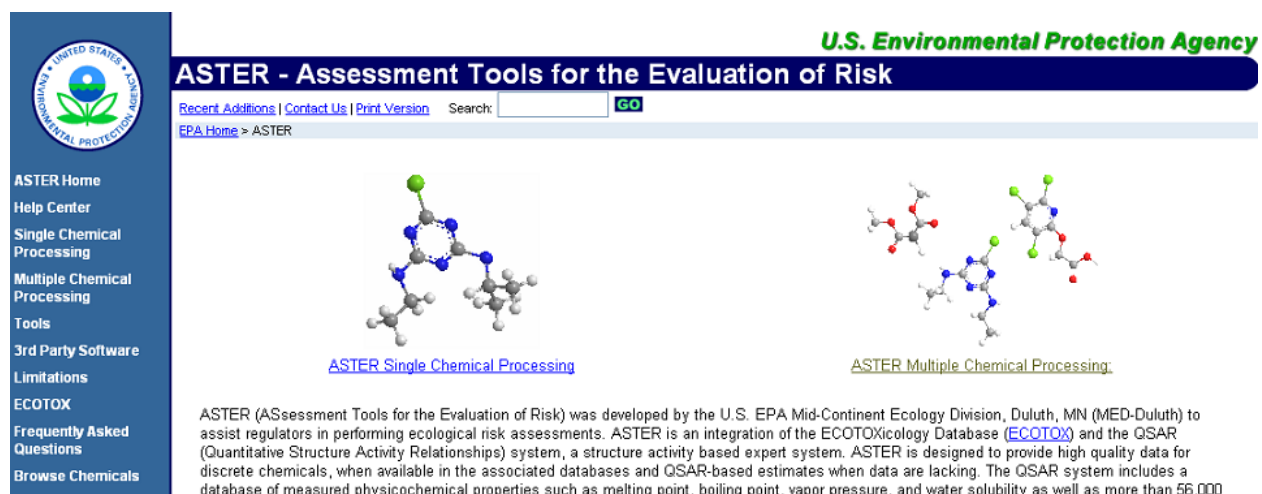
ACCESS

This user guide provides an overview of the ASTER system. ASTER is available to EPA employees and their contractors via EPA's intranet server (<http://q2626xmnay001.aa.ad.epa.gov/aster/>). Employees of other government (tribal, local, state, national, international) agencies that require a search of the ASTER system must request a search through the MED Scientific Outreach staff (E-mail: ecotox.support@epa.gov T: 218-529-5225). Searches are chemical specific, and clients should provide either a SMILES string(s) or CAS Registry Number(s) for the chemical(s) of interest. The ASTER report will be E-mailed to the client. Persons affiliated with government contracts or other extramural agreements must submit their search requests through the funding governmental agency's Project Officer.

ASTER HOME PAGE

This page provides an overview of the ASTER system. It also is the gateway to singles or multiple chemical searches. Select the type of search that you would like to perform by clicking the appropriate link.

Figure 1: ASTER Home Page



ENTERING CHEMICALS

After accessing the single chemical processing page, the Chemical Entry Screen will appear.

Figure 2: Chemical Search Screen

CAS Number:	<input type="text"/>	<input type="button" value="Browse Chemicals"/>	<input type="button" value="Search"/>
Chemical Name:	<input type="text"/>		<input type="button" value="View Structure"/>
Smiles String:	<input type="text"/>		<input type="button" value="Clear Form"/>
			<input type="button" value="Help"/>

Chemical Entry

ASTER is designed to present information on discrete chemicals. In order to retrieve and generate data, the compound must be identified. ASTER provides you with three chemical selection methods, CAS Registry Number, Chemical Name or SMILES string.

ASTER requires that information for one of the above choices be entered.

CAS Registry Number

A CAS Registry number is a chemical identification code assigned by the Chemical Abstract Service. CAS Registry numbers are available for mixtures of chemicals as well as for discrete compounds. The ASTER system has more than 70,000 CAS Registry numbers and more than 50,000 structures stored in its database. The CAS Registry number is a more efficient way than the chemical name to retrieve information about chemicals in the ASTER system, but for full functionality and modeling a structure is required. If no structure is available, no modeled data is presented but empirical data is still displayed. Please note that not all CAS Registry numbers stored in EcoChem include a chemical structure.

CAS Registry numbers appear with hyphens (e.g., aniline 62-53-3) and sometimes with leading zeros (e.g. 00062533). To obtain information on a chemical by using the CAS Registry number search, at the CAS Registry Number prompt enter the CAS Registry number with or without hyphens and leading zeros.

The final digit in a CAS Registry number is a check digit. ASTER will check this digit, and if the CAS Registry number is in error, a window will appear alerting you of the invalid CAS Registry number. The ASTER prompt will return to the CAS entry section of the Chemical Entry Screen, and you should either edit or reenter the CAS Registry number.

Chemical Name

ASTER allows you to search for a chemical by name. You can directly enter a chemical name or synonym, or select the Browse Chemical button to search for chemical and synonym information in the ASTER system. Within the Browse Chemicals area, enter the chemical name (partial or exact) or CAS Registry number. Any matches within the ASTER chemical file will be retrieved. You may then select the chemical from the list of matches. Upon selection a window will appear confirming the selection. Select OK and the CAS Registry number data field will be populated for the single chemical search.

SMILES String

In order for all aspects of the ASTER system to function, the chemical structure in the form of a SMILES strings must be available. Approximately 57,000 SMILES strings are stored in ASTER, but not all chemicals with CAS Registry numbers in the chemical database include SMILES strings. You may verify whether your chemical has a SMILES string by using the Browse Chemicals feature. If a SMILES string is not

available in the database or you only have the chemical structure, you may enter the SMILES string in the SMILES data entry window.

The five basic rules used for composing SMILES strings are located in Appendix A and at http://www.epa.gov/med/Prods_Pubs/smiles.htm. For more information on SMILES, refer to Anderson et al., 1987, Hunter et al., 1987, Weininger 1988, Weininger et al., 1989.

If the SMILES string you enter has a syntax error the system will respond with one of the following messages at the bottom of the screen:

- SMILES error
- SMILES ERROR: SHOULD BE AN ATOMIC SYMBOL HERE
- IMPOSSIBLE AROMATIC RING

Recheck the SMILES composition and rules, then either reenter or edit the string.

Once the SMILES string has been accepted, ASTER will create a unique version of the string. Unique SMILES strings are stored in the ASTER database. If you have not entered a CAS Registry number or name, but only the SMILES string, ASTER will search its database for the unique SMILES string. If a SMILES string is found, any database information including CAS Registry number and chemical name will be retrieved.

After the SMILES string has been processed, ASTER will return all records associated with the entered SMILES string and an additional record, User Defined SMILES string. SMILES strings stored in ASTER do not contain geometric information. Therefore, if you enter a SMILES string for a compound such as 3-hexen-1-ol (CCC=CCCO), ASTER may not initially retrieve the desired isomeric form.

For example, there are three CAS registry numbers stored with the SMILES string (CCC=CCCO):

928-97-2	(E)-3-Hexene-1-ol
928-96-1	(Z)-3-Hexen-1-ol
544-12-7	Mixture of E and Z 3-Hexene-1-ol

ASTER will return the following screen:

Figure 3: Chemical Search Results

CAS Number:

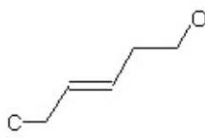
Chemical Name:

Smiles String:

[View/Print Larger Image](#)

3 CAS number(s) exist for CCC=CCCO.
Click on the correct chemical from the list below or enter new chemical information and search again.
Selecting the "User defined SMILES string" row will use only QSAR modeled data.

CAS Number	Chemical Name	Smiles String	Formula
928961	(Z)-3-Hexen-1-ol	OCCC=CCC	C ₆ H ₁₂ O
928972	(E)-3-Hexen-1-ol	OCCC=CCC	C ₆ H ₁₂ O
544127	3-Hexen-1-ol	OCCC=CCC	C ₆ H ₁₂ O
NA	User defined SMILES string	CCC=CCCO	



Select the chemical from the list of chemicals retrieved from the matching SMILES string. If your chemical is not in the list, select the User Defined SMILES string. It is important to select the correct CAS Registry number since some measured data may be stored for each isomer.

If the chemical you entered is not stored in the ASTER database, estimations will be made using the SMILES string entered, and geometric differences will not be incorporated.

After the user selects the correct SMILES string, the CAS Registry number data field will be populated with the CAS Registry number for the single chemical search, unless the user has selected the User Defined SMILES string. If this has been selected, the SMILES string data field will be populated with the user entered SMILES string.

Undefined SMILES Strings

If a SMILES string is not found for the CAS Registry number or chemical name, a Window alerts the user that there is no associated SMILES string with the following text:

CAS Registry number XXXXXXXXXX does not have an associated SMILES string. Structures are required for models to work. The report will not contain modeled data. Do you want to continue?

ASTER will retrieve aquatic toxicity database information for both organic and inorganic chemicals. However, if the CAS Registry number is stored in the ASTER database without information on the structure (SMILES string), all QSAR models will be disabled, since they require structural information to perform. QSAR models are disabled for

inorganic compounds because only organic models are available in the ASTER system.

Completing Chemical Entry

After you have entered your chemical search criteria, click the Search button and the following screen will appear. At this time, the user may change the name of the chemical by selecting the Change button next to the name and entering the User's Preferred Name. This name will be used on the reports.

Figure 4: Chemical Properties Screen

CAS Number:

Chemical Name:

Smiles String: CCC=CCCO

Chemical Formula:

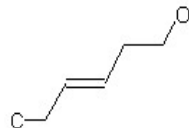
[View/Print Larger Image](#)

View Properties

View Calculations

Reports

Property	Value	Units	Source	Method/Error
Molecular Weight	100.16	g/mole	Calculated	
Parachor	276.20		Calculated	????
Molar Refraction	30.97		Calculated	Av. % Error = 5
Molecular Volume	140.00	cm ³ /g	Calculated	????
<input type="radio"/> LogP (CLogP)	1.40		CLogP	
<input checked="" type="radio"/> LogP (KowWin)	1.61		KowWin	
Melting Point		C	Calculated	
Boiling Point	145.11	C @ 760 mmHg	Calculated	Av. % Error = 7.4 K
Vapor Pressure	4.81	mmHg	Calculated	Av. % Error = 39.0
Heat of Vaporization	1.08E04	cal/mole	Calculated	Av. % Error = 1.85
Solubility in Water	0.06	moles/L	Calculated	????
pKa			Calculated	
FH TMOA	34		Calculated	



CHEMICAL PROPERTIES

The Chemical Properties screen allows you to modify information that may be used in QSAR estimations and/or to obtain details on how a certain property was obtained. For instance, if the octanol/water partition coefficient (log P) cannot be estimated for the selected chemical, various models that require log P as an input variable would not operate.

The screen is divided into four sections: Property, Value and Units, Source, and Method Error. The properties are explained in greater detail in the Environmental Exposure section of this document. The method used to select the acute mode of action is explained in greater detail in the Ecological Risk Characterization section of this document. The source column will have 'Calculated.' if the property is estimated using a QSAR or other method, or 'EcoChem' if the reported value is from the literature and has been stored in the EcoChem database.

Changing Property Values

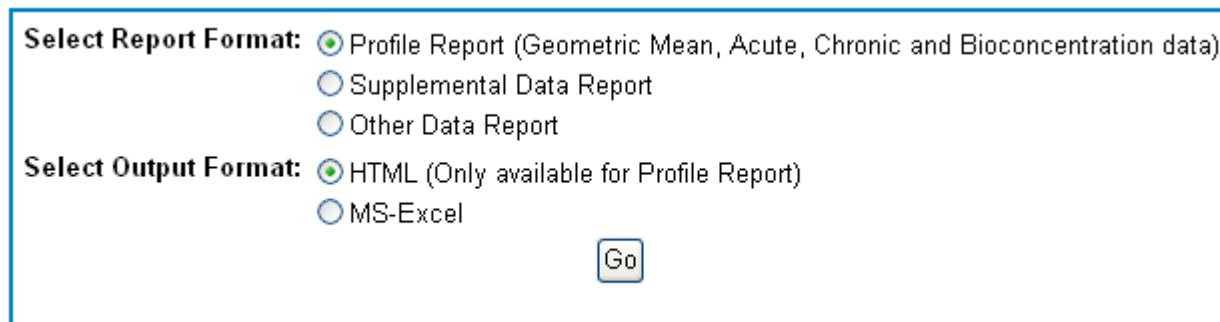
To change the property values, type over the value in the Chemical Properties screen. This modification is temporarily stored in ASTER, and any models using the changed parameter value will be stored in computer memory until you return to the Chemical Entry Screen and select another chemical. When a property value is changed, 'User' will appear in the source column for the changed property value. Any other properties that were recalculated using the revised value will have 'Recalculated.' in the Source column.

Details of Property Values

To view the details of the chemical properties, click on the Property hyperlink or View Calculations button. The detail option allows you to see details of how a property was calculated or a mode of action was determined. The "Environmental Exposure Assessment" section of Appendix B provides general information and sources of algorithms for each parameter. The "Ecological Risk Characterization" section of Appendix B describes the procedure used to determine the acute mode of action.

REPORT GENERATION

After you have identified a chemical by a CAS Registry number, name, and /or SMILES entry and/or previewed/edited the chemical properties, the next step is to create the report. To start the process, select the Report button. When completed the following menu will appear:

Figure 5: Report Selection Screen

The screenshot shows a form with two sections. The first section is labeled "Select Report Format:" and contains three radio button options: "Profile Report (Geometric Mean, Acute, Chronic and Bioconcentration data)" (selected), "Supplemental Data Report", and "Other Data Report". The second section is labeled "Select Output Format:" and contains two radio button options: "HTML (Only available for Profile Report)" (selected) and "MS-Excel". Below these options is a "Go" button.

Profile Report

The Profile report in html format is the default output format. This report is also available in a Microsoft Office Excel format, which is identical to the HTML report and contains the chemical information, physical/chemical property and exposure assessment information, and ecotoxicity data. The ECOTOX data undergoes a filter process where data meeting minimum test requirements that are the mean values for each species/effect combination, derived from standard test methodologies are presented along with any data used in the development of Agency benchmarks (e.g., Water Quality Criteria, Ecological Soil Screening Levels) and high quality datasets such as EPA's Fathead Minnow database and the USGS' Aquatic Toxicity database (see Aquatic Hazard Identification in Appendix B for filter details).

Supplemental Report

The Supplemental Report is only available in a Microsoft Office Excel format. If more than one test result meets the filter requirements for a particular species/effect pairing, the median value is reported in the Profile report and the other values appear in the Supplemental Report.

Other Data Report

Any data or species that do not meet the ASTER filter's minimum test requirements are presented in the Other Data Report. The Other Data Report is only available in a Microsoft Office Excel format. The data in this report includes all species and tests that

were not reported in the ASTER Profile Report or the Appendix.

Citations Included for All References

Citations are included in all report formats. Citations are numbered in the text and printed in order of the citation number.


Details

Within the HTML Profile Report, you may request a detail of a specific effect data record. Detailed information on the test record is available via the hyperlinks under the SOURCE column. The ECOTOX hyperlink provides the entire data entry record for any paper abstracted for ECOTOX, as well as the entire data record provided in the EPA's fathead minnow (MED) and the United States Geological Service (USGS) database. The detail for QSAR estimates include the mode of action, QSAR equation used to estimate the effect and any related statistical information. To view this information, click the hyperlink in the Source data field. For instance, if the data presented in Figure 6 was on your screen, by clicking 'ECOTOX' in the Source column displays the spreadsheet of information stored in ECOTOX for that particular test result.

Figure 6: Interactive Detail Example

T	Mammal	Saimiri sciureus	NOEL	BEH	ACTP	NR	109	OR	0.01 mg/kg	ECOTOX	35448
A	Fish	Pimephales promelas	MATC	GRO	GGRO	FW	4	S	42.06 ug/L	QSAR	9003

Figure 7: Interactive Detail Calculation



Early Life Stage chronic toxicity -- Log10 (Moles / Liter)

Structurally predicted Mode of Action: Nonpolar necrosis

LogP = 5.450

ELS = -2.21 - 0.871 * LOGP

$R^2 = 0.939$ $s = +/- 0.96902012363$ $n = 14$

The "NO-EFFECT" (32 Day Chronic Level) is expected to be -6.957 Log10(Mol/L)

ELS =	-6.957	Log10(Mol/L)	95% C.I.=(-11.276, -2.638)
ELS =	0.000	(Mol/L)	
ELS =	0.000	(Gm/L)	
ELS =	0.042	(mg/L)	
ELS =	42.061	(ug/L)	

MULTIPLE CHEMICAL PROCESSING

ENTERING CHEMICAL LISTS

After accessing the ASTER system multiple chemical processing page, the Chemical Entry Screen ASTER Main Menu will appear:

Figure 8: Multiple Chemical Processing Screen

Browse for the CSV file you want to upload. ***The file must be in Comma Delimited format.**
To convert an MS Excel File to CSV, open up the file in Excel. Choose "Save As" and select "CSV (Comma Delimited) *.csv" in the "save as type" box.

Chemical Entry

The Multiple Chemical Search in ASTER is designed to present information on discrete chemicals. In order to retrieve and generate data, the compound must be identified by either CAS Registry Number or SMILES string. Enter either the CAS Registry number or SMILES string in a comma separated value (*.CSV) file, one entry per line. Spreadsheet and database applications allow you to create or save in the CSV format. Check the help section within your software application for instructions on exporting your data to this file format.

To upload the file, either type the file path in the entry box or use the browse button to locate the file. If you use the Browse feature, once you have located your file, select open, and then select the Upload File button.

Chemical Pre-Processing

During the upload process, ASTER will check the file entries for errors or processing warnings. Errors include incorrect CAS Registry numbers or errant SMILES strings. If you are only loading CAS Registry numbers without concurrent SMILES strings, ASTER will alert you if a SMILES string is not stored in the ASTER chemical database. If a structure is not provided by the user and one is not in the ASTER chemical database, models will not function within ASTER. Also, it is important to remember that modeled information will not be available for inorganic compounds, so including the structures for these will not affect the final report.

You have the opportunity to correct your file and re-upload it, or continue to process your file. To update your file, return to your original file and update your information based on the error messages in this pre-processing screen. Once you have updated your file, select the 'Back to ASTER Batch Upload' and reload your file for processing. Select 'Process Batch Report' to continue processing your file without corrections.

REPORT GENERATION

Multiple chemical reports are as Microsoft Office Excel files. Follow the screen prompts to open or save your file.

The report format is a single line per CAS Registry number or SMILES string. The following data is included in the Multiple Chemical Report. Report field headers are noted in parenthesis.

Input (Input) – data that was input as search term
Message (Message) – error message if data not returned
Chemical Name (Chemical Name)
CAS Registry number (CAS)
SMILES string (SMILES)
Molecular Weight (g/mole) (Molecular Weight (g/mole))
Molecular Weight Source (MW Source)
Melting Point (C) (Melting Point (C))
Melting Point Source (MP Source)
Boiling Point (C) (Boiling Point (C))
Boiling Point Source (BP Source)
Vapor Pressure (mm of Hg) (Vapor Pressure (mm of Hg))
Vapor Pressure Source (VP Source)
Heat of Vaporization (cal/mole) (Ht Vaporization cal/mol)
Heat of Vaporization Source (HoV Source)
Solubility in Water (mg/L) (Solubility in Water (mg/L))
Solubility in Water Source (WS Source)
pKa (pKa)
pKa Source (pKa Source)
Adsorption Coefficient (log Koc) (Adsorption Coef (log Koc))
Adsorption Coefficient (log Koc) Source (AC Source)
Log10(Henry's Constant) (atm-m³/mole) (Log10(Henry's Constant) (atm--
m³/mole))
Log10(Henry's Constant) Source (Henry Source)
Hydrolysis Half-life (days) (Hydrolysis Half-life (days))
Biodegradation (Biodegradation)
Fugacity (Fugacity)
LogP (LogP)
Log P Source (LogP Source)
Acute Toxic Mode of Action (MOA)
Acute Toxic Mode of Action Source (MOA Source)
Measured Median LC50 or Chronic Values and Reference (from ECOTOX) or
Estimated LC50, if available, for the following species
 Minnow Species (Acute) [Included data fields are; Minnow Species
 Acute (species name), MSA Measured LC50 (ug/l), MSA Endpoint,
 MSA Measurement, MSA Reference, and Fathead Estimated Acute

LC50 (ug/l)]

Minnow Species (Chronic) [Included data fields are; Minnow Species Chronic (species), MSC Measured MATC (ug/l), MSC Endpoint, MSC Measurement, MSC Reference, and Fathead Estimated Chronic MATC (ug/l)]

Catfish Species (Acute) [Included data fields are; Catfish Species Acute (species), CSA Measured LC50 (ug/l), CSA Endpoint, CSA Measurement, CSA Reference, and Catfish Estimated LC50 (ug/l)]

Sunfish Species (Acute) [Included data fields are; Sunfish Species Acute, (species) SSA Measured LC50 (ug/l), SSA Endpoint, SSA Measurement, SSA Reference, and Bluegill Estimated Acute LC50 (ug/l)]

Trout Species (Acute) [Included data fields are; Trout Species Acute (species), TSA Measured LC50 (ug/l), TSA Endpoint, TSA Measurement, TSA Reference, and Rainbow Trout Estimated Acute LC50 (ug/l),]

Daphnia Species (Acute) [Included data fields are; Daphnia Species Acute (species), DSA Measured LC50 (ug/l), DSA Endpoint, DSA Measurement, DSA Reference, and Daphnia Estimated LC50 (ug/l)]

EXIT FROM ASTER

To exit the ASTER system, close your browser.

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APPENDIX A: SMILES TUTORIAL

What is SMILES?

SMILES (**S**implified **M**olecular **I**nput **L**ine **E**ntry **S**ystem) is a chemical notation that allows a user to represent a chemical structure in a way that can be used by the computer. SMILES is an easily learned and flexible notation. The SMILES notation requires that you learn a handful of rules. You do not need to worry about ambiguous representations because the software will automatically reorder your entry into a unique SMILES string when necessary.

SMILES was developed through funding from the U.S. EPA, National Health and Environmental Research Laboratory (NHEERL), Mid-continent Ecology Division (MED), the Medicinal Chemistry Project at Pomona College, Claremont, CA, and the Computer Sciences Corporation, Duluth, MN. Several publications discuss SMILES in more detail, including Anderson et al. 1987, Weininger 1988, Weininger et al. 1989, and Hunter et al., 1987.

SMILES has five basic syntax rules which must be observed. If basic rules of chemistry are not followed in SMILES entry, the system will warn the user and ask that the structure be edited or reentered. For example, if the user places too many bonds on an atom, a SMILES warning will appear that the structure is impossible. The rules are described below and some examples are provided. The rules below allow for the representation of a two-dimensional structure of a chemical. For the ASTER and QSAR systems, a two-dimensional depiction is adequate. Other rules are available for chemicals that are structural isomers, but will not be discussed in this basic tutorial.

Rule One: Atoms and Bonds

SMILES supports all elements in the periodic table. An atom is represented using its respective atomic symbol. Upper case letters refer to non-aromatic atoms; lower case letters refer to aromatic atoms. If the atomic symbol has more than one letter the second letter must be lower case. Bonds are denoted as:

- Single bond
- = Double bond
- # Triple bond
- * Aromatic bond
- . Disconnected structures

Single bonds are the default and therefore need not be entered. For example, 'CC' would mean that there is a non-aromatic carbon attached to another non-aromatic carbon by a single bond, and the computer would identify the structure as the chemical

ethane. It is also assumed that the bond between two lower case atom symbols is aromatic. A blank terminates the SMILES string.

Rule Two: Simple Chains

By combining atomic symbols and bond symbols simple chain structures can be represented. The structures that are entered using SMILES are hydrogen-suppressed, that is to say that the molecules are represented without hydrogens. The SMILES software understands the number of possible connections that an atom can have. If enough bonds are not identified by the user through SMILES notation, the system will automatically assume that the other connections are satisfied by hydrogen bonds. Some examples:

CC	CH ₃ CH ₃	Ethane
C=C	CH ₂ CH ₂	Ethene
CBr	CH ₃ Br	Bromomethane
C#N	C≡N	Hydrocyanic acid
Na.Cl	NaCl	Sodium chloride

The user can explicitly identify the hydrogen bonds, but if one hydrogen bond is identified in the string, the SMILES interpreter will assume that the user has identified **all** hydrogens for that molecule.

HC(H)=C(H)(H)	Ethene
---------------	--------

Because SMILES allows entry of all elements in the periodic table, and also utilizes hydrogen suppression, the user should be aware of chemicals with two letters that could be misinterpreted by the computer. For example, 'Sc' could be interpreted as a sulfur atom connected to an aromatic carbon by a single bond, or it could be the symbol for scandium. The SMILES interpreter gives priority to the interpretation of a single bond connecting a sulfur atom and an aromatic carbon. To identify scandium the user should enter [Sc].

Rule Three: Branches

A branch from a chain is specified by placing the SMILES symbol(s) for the branch between a parenthesis. The string in parentheses is placed directly after the symbol for the atom to which it is connected. If it is connected by a double or triple bond, the bond symbol immediately follows the left parenthesis. Some examples:

CC(O)C	2-Propanol
CC(=O)C	2-Propanone
CC(CC)C	2-Methylbutane
CC(C)CC(=O)	2-Methylbutanal
c1c(N(=O)=O)cccc1	Nitrobenzene

CC(C)(C)CC

2,2-Dimethylbutane

Rule Four: Rings

SMILES allows a user to identify ring structures by using numbers to identify the opening and closing ring atom. For example, in C1CCCCC1, the first carbon has a number '1' which connects by a single bond with the last carbon which also has a number '1'. The resulting structure is cyclohexane. Chemicals that have multiple rings may be identified by using different numbers for each ring. If a double, single, or aromatic bond is used for the ring closure, the bond symbol is placed before the ring closure number. Some examples:

<chem>C=1CCCCC1</chem>	Cyclohexene
<chem>C*1*C*C*C*C*C1</chem> or <chem>c1ccccc1</chem>	Benzene
<chem>C1OC1CC</chem>	Ethyloxirane
<chem>c1cc2ccccc2cc1</chem>	Naphthalene

Rule Five: Charged Atoms

Charges on an atom can be used to override the knowledge regarding a valence that is built into SMILES software. The format for identifying a charged atom consists of the atom followed by brackets which enclose the charge on the atom. The number of charges may be explicitly stated ({-1}) or not ({-}). For example:

<chem>CCC(=O)O{-1}</chem>	Ionized form of propanoic acid
or <chem>CCC(=O)O{-}</chem>	
<chem>c1ccccn{+1}1CC(=O)O</chem>	1-Carboxymethyl pyridinium

References:

Anderson, E., G.D. Veith, and D. Weininger. 1987. *SMILES: A line notation and computerized interpreter for chemical structures*. Report No. EPA/600/M-87/021. U.S. Environmental Protection Agency, Environmental Research Laboratory-Duluth, Duluth, MN 55804

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APPENDIX B: ECOTOXICITY PROFILE REPORTS

The ASTER Ecotoxicity Profile report contains five sections:

- 1) Chemical Identification
- 2) Environmental Exposure Assessment
- 3) Ecotoxicological Hazard Assessment
- 4) Risk Characterization
- 5) Citations

CHEMICAL IDENTIFICATION

Chemical Identification briefly presents information which is stored in ASTER or has been supplied by the user for the name, CAS Registry number, SMILES string, and formula of the compound. An example screen is given below.

I. CHEMICAL IDENTIFICATION

Parameter	Value
Name	1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]
CAS Number	50293
SMILES	Cl-c(ccc1C(-c(ccc2Cl)cc2)C(Cl)(Cl)Cl)cc1
Formula	C ₁₄ H ₉ Cl ₅

ENVIRONMENTAL EXPOSURE ASSESSMENT

The Environmental Exposure Assessment section of the ASTER Report describes the potential hazard of exposure from the chemical due to the distribution of the compound within the environment. When empirical data are not available, predictive models in ASTER are used to estimate physicochemical properties, biodegradation, hydrolysis half-life and environmental partitioning. An example of an Environmental Exposure Assessment output is given below.

Source Definitions for Physical/Chemical Properties

EcoChem	From the EcoChem database of literature values
Calculated	Estimated value using method described below
ClogP/KowWin	The octanol/water partitioning coefficient source obtained from the ClogP (BioByte) or KowWin (Syracuse Research Corporation) software
Recalculated	Value that was recalculated after user entry under Property Preview

Display

User Value entered by user under Property Preview Display

Citations are provided where available.

II. ENVIRONMENTAL EXPOSURE ASSESSMENT

Parameter	Value	Source	Reference
Molecular Weight (g/mole)	354.49	Calculated	
Melting Point (C)	108.00	EcoChem	
Boiling Point (C)	260.00	EcoChem	
Vapor Pressure (mm of Hg)	2.48E-03	Calculated	
Ht Vaporization (cal/mole)	1.21E04	Calculated	
Solubility in Water (mg/L)	4.60E-03	Calculated	
CLogP	6.76	CLogP	83337
KowWin	6.79	KowWin	83336
pKa	Not available for this chemical		
Adsorption Coef (log Koc)	5.02	Calculated	
Henry's Constant (atm-m ³ /mole)	Not available for this chemical		
Log10 (Henry's Constant)(atm-m ³ /mole)	Not available for this chemical		
Hydrolysis Half-life (days)	Hydrolysis unlikely		
BOD Half-life	Not available for this chemical		
Mackay Level 1 Environmental Partitioning @ 25C	Fugacity = 3.75E-05 Pa 90.84 % into air 4.73 % into soil 0.01 % into water 0.01 % into suspended solids 0.00 % into aquatic biota 4.42 % into sediment		

** Denotes the LogP value used in calculations

Physicochemical Parameters

Molecular Weight

Molecular weight is calculated from the sum of the atomic weights of the atoms in a molecule. Molecular weight is a factor in estimating partitioning (Oliver and Nilmi, 1985).

Melting Point

Melting point is the temperature at which crystals are in equilibrium with the liquid phase at atmospheric pressure. The terms melting point and freezing point are used interchangeably, depending on whether the substance is being heated or cooled (Hawley, 1981). No model is

stored in ASTER for estimating melting point. The EcoChem database includes measured melting point values for more than 6,000 chemicals.

Boiling Point

Boiling point is the temperature at which the vapor pressure of a liquid is equal to the pressure of the atmosphere (Rechsteiner, 1982a). The model used for estimating the boiling point of chemicals is the Meissner method (Rechsteiner 1982a). The EcoChem database includes measured boiling point values for approximately 3,000 compounds.

Vapor Pressure

Vapor pressure is the pressure in mm of mercury at which a solid is in equilibrium with its own vapor. The method used for calculating vapor pressure in ASTER is a modified Watson correlation (Grain 1982). The EcoChem database includes measured vapor pressures for over 800 compounds.

Heat of Vaporization

Heat of vaporization is the amount of heat required to convert a unit mass of liquid into a vapor without a rise in temperature, which implies a constant pressure process. The method for calculating heat of vaporization is a modified Kleig method (Rechsteiner 1982b).

Solubility in Water

Solubility reflects the maximum amount of chemical that will dissolve in pure water at a given temperature (Lyman, 1982a). Water solubility is calculated using various QSAR models developed at MED (Veith, personal communication). The EcoChem database includes measured water solubility values for approximately 200 compounds.

Log P

Log P (the logarithm of the octanol-water partition coefficient) is the equilibrium concentration of solute in a non-polar solvent (octanol) divided by the concentration of the same species in a polar solvent (water) (Leo and Weininger, 1984). ASTER provides two estimations of the octanol water partition coefficient; ClogP developed and provided by BioByte, and KowWin developed and provided by the EPA and Syracuse Research Corporation (BioByte Corporation, 2005; Syracuse Research Corporation 2000b.)

pKa

pKa is an expression of the strength of an organic acid or base (Perrin et al., 1981). pKa is estimated using an algorithm by Hunter (1988) based on Perrin et al. (1981).

Adsorption Coefficient

The adsorption coefficient (Log Koc) is the ratio of soluble fugacity coefficients in the aqueous and organic matter phase (Lyman, 1982b). The ASTER adsorption coefficient estimation model is from Lyman et al. (1982b).

Henry's Constant

Henry's Constant is the ratio of chemical concentration in air to concentration in water, when those two phases are in contact and are at equilibrium (Thomas 1982). The method

described by Thomas (1982) is used to estimate Henry's Constant.

Log10 Henry's Constant

Is the log in base ten of the Henry's Constant.

Hydrolysis Half-Life

The hydrolysis half-life is the time it takes to reduce a chemical to one-half of its original quantity through hydrolysis. This provides a measure of the stability of organic chemicals in the aquatic environment and is important in environmental fate processes. The estimation is based on a method described in Harris, 1982.

Chemical Biodegradation

Biodegradation is the transformation of a chemical caused by the action of living organisms (Scow 1982). ASTER uses the BioWin estimation, which was provided and developed by the EPA and Syracuse Research Corporation (Syracuse Research Corporation 2000a).

Mackay Level 1 Environmental Partitioning

Environmental partitioning is the relative deposition of a chemical into various environmental compartments. The model used in ASTER is the Level I model provided by Mackay (1988). In Mackay's Level I model, the compartments are air, water, soil, bottom sediment, suspended aquatic matter, and biota. The sizes of the compartments are fixed.

ECOTOXICOLOGICAL HAZARD ASSESSMENT

ASTER is designed to provide well documented data (applying filter rules based on standard test methodologies) for discrete chemicals, when available in the associated databases, and mechanistically-based QSAR estimates when data are lacking.

Aquatic Hazard Identification

Data that appears in the Profile Report have met minimum requirements as defined by the ASTER filter. ECOTOX Filtered Data reported is the median effect value for the identified species at the specified exposure duration. As mentioned in the Report Generation section of this document, ASTER uses a filter to remove effect data that is not associated with a standard method. Also, by presenting the median value for each species/effect/test duration you will not be overwhelmed with data, but will get a representative data point to work with. The other data are available in ECOTOX database (www.epa.gov/ecotox) or by selecting the Supplemental and Other Data reports under the Report menu.

ASTER screens ECOTOX, and presents data which pass the following restrictions:

- Data must be from an Evaluated Data Set (MED Fathead Minnow data, Agency Benchmark Studies or the USGS Database)
- Test must be conducted in a laboratory or artificial setting

- A Control is used
- No solvents are used (aquatic studies only)
- Follow a standard test methodology defining standard effects, endpoints and test durations (ASTM or OPPTS guidelines)

Data that do not pass this filter are placed in the “Other Data” report (see Viewing Reports).

Data and Source Definitions included in this report are:

- EPA Water Quality Criteria Documents and Ecological Soil Screening Level documents
- EPA MED Fathead Minnow database and the USGS Acute Toxicity Database
- ECOTOX data that has passed screening rules derived from Standard Methods documents
- QSAR estimates of effects

Source Definitions

ECOTOX	Data obtained from the ECOTOX database
ECOTOX - EDS	ECOTOX Evaluated Data Sets – Data encoded into the ECOTOX database from references associated with one or more of the following EPA projects; EPA Water Quality Criteria Documents (see http://www.epa.gov/waterscience/criteria/aqlife.html), EPA Ecological Soil Screening Levels documents (see www.epa.gov/ecotox/ecossl) and risk assessments performed for the EPA Office of Pesticide Programs (see http://www.epa.gov/pesticides/).
MED	Fathead minnow toxicity studies performed at EPA/ORD/NHEERL/MED
QSAR	Data estimated using structure-activity models
USGS	Data from the United States Geological Service - Acute Toxicity Database

An abbreviated example of the Ecological Hazard Assessment appears below. For a complete example, see Appendix C.

III. ECOTOXICOLOGICAL HAZARD ASSESSMENT

Table 1. Geometric Means of all data passing the ASTER filter by Species Group

Habitat	Species	Effect	Count	Geo Mean	Min	Max
A	Amphibian - Acute	MOR	5	282.52 ug/L	30 ug/L	1000 ug/L
A	Arthropod - Acute	MOR	28	2.7 ug/L	0.18 ug/L	1000 ug/L
A	Arthropod - Acute	PHY	4	1.86 ug/L	0.36 ug/L	4.7 ug/L
A	Fish - Acute	MOR	54	6.96 ug/L	1.5 ug/L	48 ug/L
A	Mollusc - Acute	GRO	2	7.94 ug/L	7 ug/L	9 ug/L
T	Bird - Acute	MOR	6	685.47 mg/L	311 mg/L	1869 mg/L

Table 2. Median Acute Data values

Habitat	Taxon	Group	Name	Endpoint	Effect	Measure	Media	Dur (d)	Exposure	Median Conc	Source	Ref No
A	Amphibian		<i>Bufo woodhousei fowleri</i>	LC50	MOR	MORT	FW	4	S	1000.00 ug/L	USGS	6797
A	Amphibian		<i>Pseudacris triseriata</i>	LC50	MOR	MORT	FW	4	S	800.00 ug/L	USGS	6797
A	Arthropod		<i>Aedes cantans</i>	LC50	MOR	MORT	FW	2	S	4.20 ug/L	ECOTOX	5162
A	Arthropod		<i>Asellus brevicaudus</i>	LC50	MOR	MORT	FW	4	S	4.00 ug/L	USGS	6797
A	Arthropod		<i>Atherix variegata</i>	LC50	MOR	MORT	FW	4	S	17.00 ug/L	USGS	6797
A	Arthropod		<i>Cancer magister</i>	LC50	MOR	MORT	SW	4	S	1.10 ug/L	ECOTOX	3752
A	Arthropod		<i>Chaoborus sp.</i>	LC50	MOR	MORT	FW	4	S	7.40 ug/L	USGS	6797
A	Arthropod		<i>Claassenia sabulosa</i>	LC50	MOR	MORT	FW	4	S	3.50 ug/L	USGS	6797
A	Arthropod		<i>Crangon septemspinosa</i>	LC50	MOR	MORT	SW	4	R	0.40 ug/L	ECOTOX	5409
A	Arthropod		<i>Daphnia magna</i>	EC50	ITX	IMBL	FW	2	S	4.70 ug/L	USGS	6797
A	Arthropod		<i>Daphnia pulex</i>	EC50	ITX	IMBL	FW	2	S	0.36 ug/L	USGS	6797
A	Arthropod		<i>Ephemera sp.</i>	LC50	MOR	MORT	FW	4	S	1.20 ug/L	USGS	6797
A	Arthropod		<i>Gammarus fasciatus</i>	LC50	MOR	MORT	FW	4	S	1.80 ug/L	USGS	6797

The ASTER Aquatic Hazard Identification Report includes the following data parameters, report field headers are noted in parenthesis below :

- Habitat (Habitat)
- Taxonomic Group (Taxon Group)
- Scientific name (Name)
- Endpoint (Endpoint)
- Effect (Effect)_
- Effect Measurement (Measure)
- Media Type (Media)
- Duration in days (Dur (d))
- Exposure Type (Exposure)
- Response Site (SITE)(Residue tables only)
- Median Concentration / Unit in ug/L, or original unit if it cannot be recalculated (Median conc)
- BCF (BCF) (Residue tables only)
- Source of the data being used (Source)
- Reference Number in ECOTOX (Ref #)

ASTER uses ECOTOX code abbreviations. For information on the code abbreviations and definitions of codes used within the ASTER outputs please see the ECOTOX help webpage located at <http://cfpub.epa.gov/ecotox/help.cfm>

Quantitative Structure Activity Relationships (QSAR)

QSARs are statistically-based relationships between physicochemical properties and biological activity. If the high quality data filter or associated high quality data sets do not include an empirical value for species and endpoints with associated ASTER QSAR models, the QSAR models will be invoked, and an estimated value will be provided.

If acute LC50 values were not available from any of the high quality data sets or the ECOTOX database for goldfish, catfish, rainbow trout, and *Daphnia magna*, ASTER will use QSARs to estimate these effects based on the fathead minnow acute LC50 selected under the Aquatic Hazard Identification section of the ASTER Report. ASTER will also estimate a bioconcentration factor using a QSAR described by Veith and Kosian (1983).

If the effect data are based on QSAR estimates, 'QSAR' appears in the source column, and 'Calculated' will appear under the 'Conc' column of the ASTER report below the estimated value to warn you that a QSAR estimate was used.

All QSAR estimates in this section, with the exception of BCF, are calculated based on the acute mode of toxic action of the compound. The Risk Characterization section of this document describes in greater detail how mode of action is determined. QSARs were developed using the MED fathead minnow acute and chronic databases. QSARs for goldfish, catfish, rainbow trout, and *Daphnia magna* are based on comparisons of

High quality ECOTOX data for these species with the MED fathead minnow acute database. These interspecies estimates are only available for chemicals acting by nonpolar and polar narcosis modes of action. QSARs used to estimate chronic toxicity are selected based on the acute mode of action. Some compounds may become bioactivated during long exposures (chronic) and the acute mode of action may not be suitable. ASTER accounts for bioactivation for some classes of compounds. These issues are addressed in the Ecological Risk Characterization section of the ASTER Report.

Sources of the equations and information regarding the predominant chemical classes used to develop these QSARs are presented below.

Table 2. Acute LC50 QSARs for Fathead Minnows

Mode of action	Predominant Chemical Classes Used in QSAR	Reference
Nonpolar narcosis	Alcohols, Ketones, Ethers, Alkanes, Benzenes	Veith et al., 1983
Polar narcosis	Phenols, Anilines	Veith and Broderius, 1987
Uncouplers of Oxidative Phosphorylation	Phenols, Anilines	Russom, et al., 1997
Reactive carbonyl (equation 1)	Aldehydes: aromatics other than salicylaldehydes	Russom, personal communication
Reactive carbonyl (equation 2)	Aldehydes: salicylaldehydes	Russom, personal communication
Reactive carbonyl (equation 3)	Aldehydes: aliphatic	Russom, personal communication
Diesters	Diesters	Russom, personal communication
Ester narcosis	Esters excluding diesters	Russom, et al., 1997
Reactive: acrylates	Acrylates	Russom et al., 1988

Table 3. Chronic Value QSARs for Fathead Minnows

Mode of Action	Predominant Chemical Classes Used in QSAR	Reference
Nonpolar narcosis	Alkanes, Benzenes	Russom, personal communication
Polar narcosis	Phenols, Pyridines	Russom, personal communication
Uncouplers of oxidative phosphorylation	Phenols	Russom, personal communication

Table 4. Multiple Species LC50 Estimations for Nonpolar and Polar Narcosis Modes of Action

Species	Predominant Chemical Class Used in QSAR	Reference
Rainbow trout	Phenols, Benzenes, Alkanes, Alcohols	Russom, personal communication
Bluegill	Phenols, Benzenes, Alkanes, Alcohols	Russom, personal communication
Daphnia	Phenols, Alkanes, Benzenes, Alcohols	Russom, personal communication
Catfish	Alcohols, Phenols	Russom, personal communication

QSARs are not currently available in ASTER for some of the more specific modes of action because of a lack of reliable parameters to explain variation in toxicity. ASTER QSAR toxicity estimations use log P as the independent variable. QSARs for reactive toxicants and acetylcholinesterase inhibitors may require the use of electronic parameters which are not currently stored or estimated by the ASTER system.

ECOLOGICAL RISK CHARACTERIZATION

The fourth section of the ASTER Ecotoxicity Profile is Ecological Risk Characterization. This section discusses data from the previous sections.

The first component reviews the data from the Environmental Exposure Assessment section. A discussion of the potential volatility, persistence in water and partitioning behavior of the compound is given.

The second component is a discussion of the data from the Ecotoxicological Hazard Assessment section. The acute mode of action is determined by examining structural fragments present in the chemical, and is based on research conducted at the MED (Russom, et al., 1997). The acute toxicity modeling component of ASTER assesses the structural characteristics of chemicals and evaluates whether or not a compound contains specific functional moieties (or moieties capable of being bioactivated) that are associated with more specific modes of toxic action. When structural fragments associated with a mode of action are identified, ASTER calculates the toxicity based on that mode of action. If structural fragments for more than one mode of action are identified by ASTER, the mode of action that is determined to result in the greatest hazard to the organism (e.g. greatest toxicity) is selected. The nonpolar narcosis QSAR is invoked only if the structural characteristics of a chemical do not suggest that a more specific mode of action may be involved (e.g., the chemical has gone through all fragment checks in ASTER and no fragments were identified).

QSARs used to estimate chronic toxicity are selected based on the acute mode of action. Some compounds may become bioactivated during long exposures (chronic) and the acute mode of action may not be suitable. ASTER accounts for bioactivation for some classes of compounds. These issues are addressed in discussions regarding chronic toxicity which appear in the Ecological Risk Characterization section of the ASTER Report.

The third component of the Environmental Exposure Assessment section presents ancillary information that is stored in the ASTER database. You are advised when additional information on the compound is available from the U.S. EPA, IRIS (Integrated Risk Information System) database, and when the chemical appears on SARA (Superfund Amendments and Reauthorization Act) Title III's Toxic Emissions Inventory (also known as section 313 of the Emergency Planning and Community Right-to-Know Act of 1986). Information regarding the chemical's registered use is given for pesticides registered with the U.S. EPA, Office of Pesticide Programs.

REFERENCES

A list of references will appear at the end of the ASTER Reports.-The references are numbered and appear in numerical order. The numbers correspond to numbers appearing in reference columns in the Environmental Exposure Assessment and Ecotoxicological Hazard Assessment sections and numbers in square brackets [] in text

portions of the ASTER Report.

SUPPLEMENTAL REPORT

If you selected Supplemental when creating the report, this output is in a Microsoft Office Excel file format. As discussed previously, ASTER uses a filter when creating the ASTER report. Supplemental refers to other data that met the ASTER screening requirements, but were not median values for particular endpoints and species.

The Supplemental report consists of Chemical Identification, Aquatic Hazard Identification and Reference sections similar to those described in the ASTER Ecotoxicity Profile Report section of this document. All data presented in the Aquatic Hazard Identification Section are from the ECOTOX database; therefore the Source column is not included in the table.

OTHER DATA REPORT

If you selected Other Data when creating the report, this output is in a Microsoft Office Excel file format. As discussed previously, ASTER uses a filter when creating the ASTER report. The Other Data output contains ECOTOX data that did not meet the screening requirements of ASTER. In addition, the Other Data report may include species that did not have standard test methods, and therefore do not appear in the Report and Supplemental outputs.

The Other Data output will consist of Chemical Identification, Aquatic Hazard Identification and Reference (if option was selected) sections similar to those described in the ASTER Ecotoxicity Profile Report section of this document. All data presented in the Aquatic Hazard Identification Section are from the ECOTOX database, therefore the Source column is not included in the table.

APPENDIX C: PROFILE ASTER REPORT EXAMPLE

16-Jul-06

ASTER ECOTOXICITY PROFILE
U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
Mid-Continent Ecology Division
Contact: Scientific Outreach Program
218-529-5225 or FAX 218-529-5003
Internet: ecotox.support@epa.gov

The ASTER (ASsessment Tools for the Evaluation of Risk) database integrates aquatic and terrestrial toxicity database information and quantitative structure activity relationships (QSARs) to assess the environmental risk of discrete chemicals. ASTER is designed to provide high quality data for discrete chemicals, when available in the ECOTOX database, and mechanistically-based QSAR estimates when data are lacking.

You should consult the original scientific paper to ensure an understanding of the context of the data retrieved from the ECOTOX database.

I. CHEMICAL IDENTIFICATION

Parameter	Value
Name	Benzenamine
CAS Number	62533
SMILES	<chem>c(ccc1N)cc1</chem>

Formula	C ₆ H ₇ N
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II. ENVIRONMENTAL EXPOSURE ASSESSMENT

Parameter	Value	Source	Reference
Molecular Weight (g/mole)	93.13	Calculated	
Melting Point (C)	-6.00	EcoChem	
Boiling Point (C)	184.00	EcoChem	
Vapor Pressure (mm of Hg)	0.67	EcoChem	
Ht Vaporization (cal/mole)	1.04E04	Calculated	
Solubility in Water (mg/L)	2.64E04	Calculated	
CLogP	0.92	CLogP	83337
KowWin	1.08**	KowWin	83336
pKa	Not available for this chemical		
Adsorption Coef (log Koc)	1.92	Calculated	
Henry's Constant (atm-m ³ /mole)	3.12E-06	Calculated	
Log10 (Henry's Constant)(atm-m ³ /mole)	-5.51	Calculated	
Hydrolysis Half-life (days)	Hydrolysis unlikely		
Biodegradation			
Mackay Level 1 Environmental Partitioning @ 25C	Fugacity = 4.06E-06 Pa 9.83 % into air 0.09 % into soil 90.01 % into water 0.00 % into suspended solids 0.00 % into aquatic biota 0.08 % into sediment		

** Denotes the LogP value used in calculations

III. ECOTOXICOLOGICAL HAZARD ASSESSMENT

Table 1. Geometric Means of all data passing the ASTER filter by Species Group

Habitat	Species	Effect	Count	Geo Mean	Min	Max
A	Arthropod - Acute	MOR	3	103.34 ug/L	44 ug/L	190 ug/L
A	Arthropod - Acute	PHY	1	160 ug/L	160 ug/L	160 ug/L
A	Fish - Acute	MOR	10	35365 ug/L	30 ug/L	134000 ug/L
A	Fish - Chronic	GRO	13	1521 ug/L	422 ug/L	7800 ug/L
A	Fish - Chronic	MOR	4	4979 ug/L	2100 ug/L	15900 ug/L

Table 2. Median Acute Data values

Habitat	Taxon Group	Name	Endpoint	Effect	Measure	Media	Dur (d)	Exposure	Median Conc	Source	Ref No
A	Arthropod	Ceriodaphnia dubia	LC50	MOR	MORT	FW	2	S	132.00 ug/L	ECOTOX	58703
A	Arthropod	Ceriodaphnia dubia	LC50	MOR	MORT	FW	4	F	190.00 ug/L	ECOTOX	4343
A	Arthropod	Daphnia magna	EC50	ITX	IMBL	FW	2	R	160.00 ug/L	ECOTOX	55961
A	Fish	Oncorhynchus mykiss	LC50	MOR	MORT	FW	4	F	30000.00 ug/L	ECOTOX	58703
A	Fish	Oryzias latipes	LC50	MOR	MORT	FW	4	F	93500.00 ug/L	ECOTOX	14908
A	Fish	Pimephales promelas	LC50	MOR	MORT	FW	4	F	114000.00 ug/L	MED	3217
A	Fish	Pimephales promelas	LC50	MOR	MORT	FW	4	F	134000.00 ug/L	MED	12448
A	Fish	Pimephales promelas	LC50	MOR	MORT	FW	4	F	75500.00 ug/L	MED	3217

A	Fish	Pimephales promelas	LC50	MOR	SURV	FW	4	F	134000.00 ug/L	ECOTOX	3910
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Table 3. Median Chronic Data values

Habitat	Taxon Group	Name	Endpoint	Effect	Measure	Media	Dur (d)	Exposure	Median Conc	Source	Ref No
A	Fish	Oncorhynchus mykiss	LOEC	GRO	WGHT	FW	56	F	4000.00 ug/L	ECOTOX	58703
A	Fish	Oncorhynchus mykiss	NOEC	GRO	WGHT	FW	56	F	2000.00 ug/L	ECOTOX	58703
A	Fish	Oncorhynchus mykiss	MATC	GRO	WGHT	FW	90	F	5600.00 ug/L	ECOTOX	58703
A	Fish	Oncorhynchus mykiss	LOEC	MOR	SURV	FW	90	F	15900.00 ug/L	ECOTOX	58703
A	Fish	Oncorhynchus mykiss	NOEC	MOR	SURV	FW	90	F	7800.00 ug/L	ECOTOX	58703
A	Fish	Pimephales promelas	MATC	GRO	LGTH	FW	32	F	557.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	NOEC	GRO	WWGT	FW	32	F	422.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	MATC	GRO	WWGT	FW	32	F	557.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	NOEC	GRO	LGTH	FW	32	F	422.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	LOEC	GRO	LGTH	FW	33	F	2360.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	LOEC	GRO	WWGT	FW	33	F	2360.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	NOEC	MOR	SURV	FW	32	F	2100.00 ug/L	ECOTOX	57532
A	Fish	Pimephales promelas	LOEC	MOR	SURV	FW	33	F	2360.00 ug/L	ECOTOX	57532

Table 4. Median Bioconcentration Data values

Habitat	Taxon Group	Name	Endpoint	Effect	Measure	Media	Dur (d)	Exposure	Site	Median Conc	BCF Value	Source	Ref No
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No Records Found

IV. ECOLOGICAL RISK CHARACTERIZATION

A. Environmental Exposure Assessment

Henry's Constant = $3.12\text{E-}06$ atm-m³/mole

Log₁₀ (Henry's Constant) = -5.51 atm-m³/mole

Lyman et al. 1982. would conclude that a chemical with these properties will volatilize slowly from open water. See page 15-15.

Hydrolysis is not likely to be an important transformation mechanism for this chemical.

B. Ecotoxicological Hazard Assessment

POLAR NARCOSIS The acute mode of toxic action for these types of compounds is generally attributed to narcosis (the toxicologically induced and reversible stages of neural disruption). The narcosis syndrome elicited by these chemicals is distinct from the syndrome elicited by compounds thought to act via nonpolar narcosis. Polar narcotics are typically more toxic than what would be predicted from the nonpolar narcotic QSAR [3536].

When sufficient data is available from fathead minnow early life stage (ELS) tests (32-d exposures) completed at MED-Duluth, QSAR models have been developed to predict chronic values for either survival or growth, whichever is the most sensitive endpoint. A chronic value is defined as the geometric mean of the LOEC (lowest observable effect concentration) and the NOEC (no observable effect concentration). These models have been developed for groups of xenobiotics that have been classified based on their acute modes of toxic action. Empirical observations suggest that when a statistically robust ELS QSAR can be established and when 96-h LC₅₀/32-d ELS chronic value ratios are within a factor of 20 it is reasonable to assume that adverse effects are elicited through the same mode of toxic action in both 4-d and 32-d exposures. If during a chronic exposure a different mode of action is involved, or if metabolic activation is significant, the ratios between acute and chronic endpoint values for a group of xenobiotics are generally quite variable and typically exceed two orders of magnitude. In addition, the statistical strength of ELS QSARs in these instances are poor.

Based on toxicity tests using fathead minnows performed at MED-Duluth, 96-h LC50/32-d ELS Chronic value ratios range from 184 to 382 for aniline derivatives. This suggests that aniline compounds which act as polar narcotics in an acute exposure are acting through a different mode of action during chronic exposures.

C. Other Information

V. Citation Information

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Memo to C. Stephan, U.S. EPA, June 24, 1987. Criteria Document Data
U.S.EPA, Duluth, MN (Memo to C.Stephan, U.S.EPA, Duluth, MN) :24 p.