PRÉLIMINAIRE

CHEMIOTOX:

a toxic waste indicator

Methodology Document

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March 1992

TABLE OF CONTENTS

The Chemiotox model: a toxic waste indicator

INTRODUCTION

Pollution assessment is a complex exercise, in which the results of extensive sampling must often be considered. These results, analysed one by one, provide only a fragmented picture of the environmental problem to be confronted, and clearly indicate how difficult it is to obtain an overall picture of toxic waste.

Chemiotox is a toxic waste indicator model which allows such an overall picture to be obtained. It uses the results of a characterization campaign to calculate a new unit which takes into account the relative toxicity of each pollutant, and provides a new tool for evaluation, comparison and integration of results.

The model was initially developed as part of the St Lawrence Action Plan (SLAP) to evaluate the reduction of toxic substances and obtain an indication of the extent to which the objective of 90% reduction was being met. However, for those working in the environmental field, the model also presents additional possibilities for the management of toxic substances.

The basic model was developed jointly by the St Lawrence Action Team and SNC. SLAP and BPC Environment refined the model and operate it in SLAP's fifty priority industries.

This document describes the Chemiotox model as used under the St Lawrence Action Plan.

PROBLEM

The main objective of the St Lawrence Action Plan is to reduce the toxic liquid waste from 50 industries along the St Lawrence and the Saguenay by 90% by 1993.[1]

In theory this objective would appear quite easy to evaluate, since the presence and quantity of each toxic pollutant in industrial effluent can be precisely measured. In practice, however, it has proven relatively difficult to obtain an overall picture which includes all priority toxics released into watercourses by the 50 industries.

The 50 industries will be characterized in 1992, and more than 100 contaminants will be sampled and measured for each industry. Some contaminants are present in effluent in large amounts; others are found only as trace elements, at or below the limits of detection.

Fifty industries and hundreds of parameters, each with different physical, chemical and toxic characteristics . . . how can they be used to obtain syntheses and overall pictures which would enable us to:

- integrate and compare sampling results;
- evaluate conditions by sector, group of industries, type of contaminant, or overall;
- pinpoint toxic substance clean-up priorities;
- assess pollution reduction?

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[1] Appendix D contains a list of the 50 priority industries targeted by the St Lawrence Action Plan.

In addition, a toxic waste indicator must be able to process information on changes in waste over a given period of time. Under the SLAP, this period is from 1988 to 1993. Four types of information are used in this process:

- First, the results of the SLAP characterization campaign, that is, the results of contaminant sampling expressed in terms of concentrations and load for each industry.
- Second, characterizations prior to the SLAP, the results of which refer to a limited number of parameters, particularly with regard to toxic substances.
- Third, clean-up forecasts, that is, the anticipated effectiveness of measures to reduce toxic substances which will, in time, be implemented by each industry.
- Fourth and finally, changes in the industries which could affect the discharge of waste, for example, an increase in production.

The tool which has been developed, the Chemiotox model, proposes an alternative solution to this problem and a complementary approach to the management of toxic substances which makes it possible to assess the amount of polluting waste more accurately.

METHODOLOGY

Chemiotox is a mathematical model which makes it possible to evaluate an index of toxic waste based on the sampling of toxic substances. To do this, the model uses the concept of toxic weighting.[2]

Toxic weighting uses the relative toxic potential of contaminants to compare pollutants in terms of a common denominator of potential toxicity and danger for the receiving environment. From there, the Chemiotox unit can be calculated and a synthesis of the sampling results of industrial effluent made.

In addition, the model is combined with a procedure for assessing past and future waste, which allows waste for the reference year (1988) to be estimated and toxic waste reduction for 1993 to be forecast. It then becomes possible to estimate the extent to which the toxic substance reduction objectives of SLAP will be met.

The Chemiotox model uses only the results of industrial effluent characterizations for toxic substances. Overall conventional parameters (such as SS and AOX) and parameters which do not refer to priority toxic substances (such as magnesium and chlorides) are not included in the calculations for the Chemiotox index.

In the context of the SLAP, the priority toxic substances used for the characterization of effluent and, consequently, for calculation of the Chemiotox index, are those on the pre-established list of priority pollutants.[3] The SLAP characterization campaign for the fifty

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[2] The Chemiotox model also uses the concept of chemical equivalence to compare toxic substances and conventional parameters. Since this component is independent of the calculations for the Chemiotox index, the basics of chemical equivalence are presented in the appendix.

[3] The list of the St Lawrence Action Plan's priority toxic substances was drawn up mainly from the USEPA, Canadian Environmental Protection Act and MISA (Government of Ontario) lists of priority pollutants. Appendix B contains the SLAP list of priority toxic substances.

industries was based on this list. This allows priority toxic substance discharges to be compared with Chemiotox results for various industries.

This section presents the concept of toxic weighting and the procedure for evaluating projections.

Toxic weighting

One of the basic steps in preparing the Chemiotox model was to take into account the relative toxicity of the various pollutants. This was done using co-efficients to represent the danger and the toxic potential of contaminants.

The concept of "toxicity co-efficients" is not new. The procedure, which consists of assigning a relative toxicity co-efficient to various pollutants, is already used internationally in the case of dioxins and furans.[4]

To weight toxicity, all that is required is a database which distinguishes clearly between the toxic characteristics of each substance considered. The Chemiotox model uses the Quebec Department of the Environment's *Cahier des Critères de qualité de l'eau* (MENVIQ, 1990).

These criteria are environmental objectives expressed as acceptable concentration limits for each pollutant in the aquatic environment in terms of toxicity and the danger it poses to the river's threatened uses.

The *Cahier des Critères* brings together six data banks, representing four uses of the aquatic environment: *raw water*, for the protection of human health; *contamination of aquatic organisms*, for the protection of organisms against pollutant bioconcentration;

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[4] Based on the list of International Toxicity Equivalence Factors (TEF) for dioxins and furans, NATO/CCMS, 1988.

chronic and acute toxicity, for the protection of wildlife associated with the aquatic milieu; and *primary and aesthetic contact*, for the protection of recreational activities. All these criteria are determined according to precise methods and are supported by a large number of bibliographic references and data banks, including those of the USEPA, OMS, etc.[5]

In addition, since the main objective of clean-up programs and activities is to protect and recover the full use of the aquatic environment, a toxic weight based on three uses of the aquatic environment was chosen for the Chemiotox model:

- protection of human health;
- protection of aquatic organisms against contamination (bioaccumulation).
- protection of wildlife associated with the aquatic environment;

These three uses are represented by four databanks in the *Cahier des Critères de qualité de l'eau* respectively, as follows:

- *raw water;*
- *contamination of aquatic organisms;*
- *aquatic life: chronic toxicity;*
- *aquatic life: acute toxicity.*

The most stringent criterion (MSC) from the four databanks is used to prepare a toxicity factor (F_{tox}) for each priority toxic substance. The F_{tox}'s for the Chemiotox model are multi-dimensional co-efficients which take into account the harmful nature, toxic potential or the most pressing danger of each substance for the most sensitive use.

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[5] For a complete bibliography and a full definition of the *criteria*, see: MENVIQ, *Critères de qualité de l'eau*, 1990a, and MENVIQ, *Méthodologie de calcul des critères de qualité de l'eau pour les substances toxiques*, 1990b.

The toxicity factor of each pollutant is determined according to the follow equation:

$$F_{toxi} = \frac{1000\mu g/L}{MSC_i(\mu g/L)}$$

Where $F_{tox\,i}$ is the toxicity factor of pollutant i, 1000µg/L is an arbitrary reference and MSC_i is the most stringent water quality criterion for pollutant i.

The reference chosen to determine the F_{tox} is 1000µg/L, or one part per million. This reference was chosen for the simple reason that many toxicologists consider a substance with a water quality criterion of less than 1 ppm to have an obvious toxic nature.

To illustrate F_{tox} calculation, let us take an example.[6] Cadmium has the following *water quality criteria*:

5.0 µg/L for the *raw water* bank;
2.7 µg/L for the *contamination of aquatic organisms* bank;
1.1 µg/L for the *chronic toxicity* bank;
3.9 µg/L for the *acute toxicity* bank.

The most stringent criterion for cadmium is thus the 1.1 µg/L from the *chronic toxicity* bank. Consequently, the F_{tox} for cadmium will be the quotient of 1000 µg/L divided by 1.1 µg/L, or about 909.

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[6] A detailed list of the toxicity factors for all SLAP's priority toxic parameters appears in Appendix B.

In the Chemiotox model, F_{tox}s are used to calculate the Chemiotox unit (CU) for each pollutant. CUs are defined according to the following equation:

$$CU_i\ (kg/d) = Load_i\ (kg/d) \times F_{toxi}$$

CU_i is the Chemiotox unit of pollutant i in the effluent. $Load_i$ is the amount of pollutant i discharged during the course of a day by the effluent (ie, $concentration_i$ (g/L) X effluent flow (m^3/d), and $F_{tox\,i}$ is the toxicity factor of pollutant i.

This new unit is the quotient of the load of a given contaminant divided by a co-efficient based on its toxic potential. It thus represents the potential harmful contribution of a particular pollutant to the environment. By extension, it may be considered that the Chemiotox unit reflects the potential "toxic mass" of a given toxic substance discharged by an industrial effluent on a daily basis.

Moreover, since the Chemiotox unit is expressed over a common denominator of potential danger to the environment, the results obtained can be compared and integrated. It then becomes possible to compare the relative significance of various toxic substances and bring them together to obtain syntheses and overall pictures. The results may be integrated by industry, group of contaminants, industrial sector, or overall, according to the following equation:

$$\Sigma CU = CU_i + CU_j + \ldots + CU_n$$

In this equation, ΣCU is a Chemiotox index (for an industry, family of pollutants, etc) and $CU_{i,j,...,n}$ are the Chemiotox units for pollutants i, j, ... and n.

The Chemiotox index is the compilation of a great number of sampling results expressed in Chemiotox units, and has the advantage of enabling us to compare one situation to another. The Chemiotox index, however, has no real significance in terms of toxicity for the receiving environment, as will be discussed in the section entitled "Advantages and limitations of the method". It is merely an index of the discharge of the an effluent's toxic substances into a receiving environment.

All results obtained (loads, Chemiotox units and the Chemiotox index) are compiled to produce a Chemiotox file for each industry. An example of a Chemiotox file is given in Appendix A.

Toxic weighting, as used in the Chemiotox model, is a multi-purpose tool which enables us to :

- compare characterization results;
- directly identify one or more predominant toxic substances in industrial effluent in order to verify the real problem;
- combine the results in a single data base;
- obtain syntheses and overall pictures of toxic waste;

Projections

Because evaluation of a reduction index has been used since the inception of the SLAP in order to measure the extent to which the 90% objective has been attained, a procedure for evaluating waste has been combined with the Chemiotox model.

To evaluate the reduction of toxic substances in the fifty industries, we must be able to estimate the amount of toxic substances discharged in 1988, SLAP's "zero" year. In addition, future quantities of waste must be estimated in order to obtain a reduction index.

The general procedure for evaluating waste is detailed below. However, it should be mentioned that, in the case of past waste, information is often based on old characterization campaigns or monthly data provided by industry. In the absence of such data, past waste is estimated according to the procedure.

When specific clean-up measures are planned or already in place, forecasts are made using simulations which take these technologies into consideration. Otherwise, simulations are based on clean-up hypotheses made for this purpose. These hypotheses are established in accordance with the best available technologies (taking into account economic and logistical factors), based on intervention priorities and the sector to which the industry belongs. Nevertheless, they are only clean-up hypotheses, and other hypotheses may also be taken into consideration.

The projections are carried out by identifying clean-up measures for each industry. The hypotheses are established as follows:

1. meetings with St Lawrence Action Team staff in charge of the project;
2. analysis of:
   - ° water purification programs
   - ° certificates of authorization
   - ° current and anticipated regulations;
3. evaluation of industry infrastructure;
4. study of industrial waste (characterization results, Chemiotox units, bio-assay results, environmental studies, etc);
5. clean-up hypotheses.

Once clean-up measures have been selected, actual modelling for the reduction of toxic substances is carried out by:[7]

- considering the type of wastewater treatment selected;
- considering the industrial sector of the firm;
- proceeding effluent by effluent (for an industry which has more than one);
- proceeding parameter by parameter;
- considering the concentration of parameters in effluent;
- considering modifications made by the industry (production, facilities, etc).

It should be noted that the reduction percentages attributed to toxic substances are from the *Treatability Database* (USEPA, 1991). These percentages were determined from analyses of water purification plants or pilot plants carried out by the USEPA. Projections for the SLAP industries have, for the most part, been underestimated in comparison to these reduction percentages. That is, since pollutant reduction could not be measured precisely, it was under-evaluated.

ADVANTAGES AND LIMITATIONS OF THE METHOD

The Chemiotox model is a tool which enables environmental players an opportunity to understand the environmental problems posed by industrial effluent more clearly and detect them more effectively. It should not be used as the sole means of evaluating industrial waste. The results of complementary ecotoxicological evaluations (bio-assays) and environmental studies should also be taken into consideration.[8] In addition, persons

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7 The main reference used to evaluate the effectiveness of clean-up measures and to estimate the reduction of toxic substances with regard to the items mentioned is the USEPA *Risk Reduction Engineering Laboratory (RREL) Treatability Database, Rev No 3.0, 1991.*

8 The USEPA also recommends, in its "Triad" approach, using the results of chemical analyses, bio-assays and environmental studies in all water clean-up activities.

in charge of projects and SLAP staff have access to these results in order to evaluate waste in the fifty priority industries more effectively.

Chemiotox is a toxic waste indicator. Chemiotox units and the Chemiotox index should not be interpreted as a measurement of the actual toxicity of waste. In developing a model, possible chemical interactions between the various parameters (synergy, antagonism and potentiation), dilution of pollutants in the receiving environment, bio-availability, specific modes of action of toxic substances and determining factors in the observation of toxic effects, such as Ph, were not taken into account. Moreover, such considerations are not part of the objectives of Chemiotox.

The Chemiotox index is based simply on the theoretical and relative danger, damaging impact and toxic potential of certain priority toxic substances, and makes no distinction for specific receiving environments. It evaluates an effluent index, for the sole purpose of comparing and integrating sampling results.

The overall toxicity of an industrial effluent can be measured only through direct bio-assays of waste. However, the bio-assay approach provides no information on the causes of toxicity. Conversely, the Chemiotox model is able to target many contaminants which could be responsible for the toxic effect. This is one of the other specific objectives of the model: selection of predominant toxic parameters.

Characterization data are, undeniably, a limiting factor. Under the SLAP, effluents are to be sampled over a three-day period for the vast majority of the 50 industries. The variability of waste cannot be accurately recorded within this timeframe. The accuracy of laboratory analysis results also limits the calculation of the Chemiotox index. Nevertheless, the SLAP's characterization campaign gives a good picture of current conditions and rigorous quality control keeps errors to a minimum.

Toxicological criteria have not been established for all priority parameters. In certain cases, generic water quality criteria for families of contaminants may be used. Some criteria should then be updated. However, the current list, which is based on dozens of major works and databanks, is a reliable departure point for preparation of F_{tox}'s.

In addition, it is important to note that the *raw water* data bank contains some organoleptic and aesthetic criteria. In terms of priority toxic substances and the Chemiotox model F_{tox}'s, it is acceptable to eliminate these criteria as much as possible. However, in a few, rare cases, F_{tox}'s have been prepared on the major organoleptic characteristics of some substances. This is not, in itself, a disadvantage, since a clean-up and protection program to ensure full use of the environment also uses this type of criteria. Damage to the environment is an increasingly important concern.

CONCLUSION

Chemiotox, when used properly and within its limitations, serves as a base for compiling and comparing large amounts of information, as well as an instrument for singling out priority toxic substances which could have a negative effect on the environment.

Future development of the Chemiotox model could provide players with new applications in areas such as atmospheric emissions, contaminated soil and hazardous waste.

The model is therefore an important resource for those working in environmental fields. It is a complementary model in terms of toxic substance management. It is also a scientific communication and popularization tool which can make the problem of toxic substances and the progress made under the St Lawrence Action Plan easier to understand.

COMPLEMENTARY ASSESSMENTS

As part of the development of the Chemiotox model, research was conducted and thought given to the notion of chemical equivalence, in order to provide a tool to express toxic substances in terms of conventional parameters such as SS and COD. This tool is independent of the toxicity index, but provides additional information on the physical significance of toxic substances present in industrial effluent.

In calculating chemical equivalence, each pollutant is converted into a conventional parameter in order to gain information on the significance of various contaminants in waste. In addition, this tool attempts to reconcile priority contaminants with conventional parameters, which are used in regulations and in designing clean-up technologies.

Under the SLAP, chemical equivalents were determined as follows. Toxic substances were divided into two categories:

- inorganic
- organic

An overall conventional parameter was then selected for each category:

- total solids (TS)
- chemical oxygen demand (COD)

In addition, the theoretical chemical equivalent was calculated for each toxic substance. That is, the loads per unit of mass (kg/d of substance) were converted into:[9]

- TS equivalents (kg/d of TS) for inorganic contaminants;
- COD equivalents (kg/d of COD) for organic contaminants.

This provided a basis for comparing the physical space which a contaminant occupies with the space taken by other pollutants and, especially, its proportion in total waste. In actual fact, the value of the conventional parameter sampled is representative of the vast majority of substances (toxic or non-toxic) in the final effluent. Thus, by comparing this value with the calculated value of a given pollutant, we obtain the polluting substance/total waste ratio.

The results can then be expressed over a common denominator of chemical equivalence, and may added to obtain the sum of equivalent loads (Σ TS_{equiv} and Σ COD_{equiv}). These sums give the portion of toxic TS and toxic CODs in the effluent. By dividing these results by the value of the analytical measure of the conventional parameter, we obtain the modelling co-efficient (MC).

$$MC_{inorg} = \frac{\Sigma TS_{equivalent}}{TS_{measured}} \quad but \quad MC_{org} = \frac{\Sigma COD_{equivalent}}{COD_{measured}}$$

9 Conversion of inorganic parameters into TS equivalents is direct, since it is obvious that a gram of iron, for example, corresponds to a gram of total solids. However, in the case of organic parameters, oxidation-reduction equations must be established for each pollutant in the presence of bichromate of potassium and in an acid environment in order to obtain the conversion factor for each load per unit of mass in COD equivalent. Appendix C gives an example of how COD equivalents are calculated and lists chemical equivalence factors.

The modelling co-efficient thus indicates the proportion which the total priority toxic substances take up in comparison to total industrial waste.

Like toxic weighting, this tool pinpoints certain properties of an industrial effluent. That is, to some extent, additional information for evaluating the problem of industrial waste can be obtained.

The main limitation of chemical equivalence is in terms of laboratory analysis of TS and COD. When TSs are analysed using the standard method, substantially all inorganic toxic substances are accounted for in the experimental result.

However, the method used to analyse CODs results in 95% to 100% recovery of organic products present in the sample, as discussed in *Standard Methods*.[10] Use of silver sulphate as a catalyst and new methods 5220C and D of *Standard Methods* improve the accuracy of COD analysis measurements. It can thus be considered, with an accuracy rate of 95 to 100%, that most organic toxic substances are oxidized and that the results are included in the overall COD of the water sample analysed. This level of analytical inaccuracy is acceptable to most scientists.

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10 *Standard Methods for the Examination of Water and Wastewater*, 17th Edition, 1989.

APPENDICES

The CHEMIOTOX file
an example

The next page contains an example of a Chemiotox file, showing a year-long Chemiotox evaluation of a given industry.

At the top is the name and address of the industry, the year covered by this file, and information on whether this is an evaluation of the SLAP characterization year or a projection: past or projected waste, as the case may be.

The rest of the file is divided into four blocks. The first contains details on conventional parameters and effluent outflow. The next two blocks provide information on two categories of toxic substances sampled and detected in the effluent -- inorganic and organic. Each of these blocks contains a list of contaminants, classified by family, load per unit of mass, load expressed as a chemical equivalent, toxicity factor and, finally, the calculated Chemiotox unit. The last block gives the total Chemiotox units: the Chemiotox index for the industry.

In analysing the file, we can see that:

- arsenic is the dominant factor, owing to its Chemiotox unit results (21785.5 CU), which represent 67% of the total index;
- iron, even if it is not dominant, with its 19.4 CUs nevertheless represents 30% of total TS equivalents;
- mineral oils are the most significant organic substances, in terms of both COD equivalent and Chemiotox units;
- the modelling co-efficients are: $CM_{inorg} = 0.149$ and $CM_{org} = 0.163$. This means that toxic TS represent 14.9% of total waste and toxic COD represents 16.3%.

SAMPLE OF A CHIMIOTOX FILE

ABC REFINERIES INC (industry #00)

SECTOR: ORGANIC; oil refineries
LOCATION: MONTRÉAL

1991 CHARACTERIZATION

CONVENTIONAL PARAMETERS	LOAD (kg/d)		
Suspended solids (SS)	92	Flow (mc/d)=	8967
Measured total solids (TS)	132	CMinor =	0.149
TOC	129	CMorg =	0.029
COD	414		

INORGANIC TOXIC PARAMETERS	LOAD (kg/d)	LOAD TS equiv	Ftox	CU
--HEAVY METALS--				
Arsenic	0.05	0.05	454545	21785.5
Nickel	0.49	0.49	75	36.7
Zinc	0.65	0.65	9.4	6.1
Total	***1.18***	***1.18***		***21828.2***
--OTHER METALS--				
Iron	5.83	5.83	3.3	19.4
Total	***5.83***	***5.83***		***19.4***
--ANIONS AND OTHERS--				
Ammonia (nitrogen)	5.56	5.56	2.0	11.1
Total phosphorus	4.88	4.88	50	244.1
Sulphurs	2.26	2.26	500	1128.3
Total	***12.69***	***12.69***		***1383.5***
- TOTAL inorganic	***19.7***	***19.7***		***23 231***

ORGANIC TOXIC PARAMETERS	LOAD (kg/d)	LOAD COD equiv	Ftox	CU
--NON-HALOGENATED VOCs--				
Benzene	2.14	6.47	1515	3245.5
Toluene	1.15	3.59	42	47.8
Total	***3.29***	***10.06***		***3293.2***
--HALOGENATED VOCs--				
Dichloromethane	0.11	0.04	5263	569.4
Tetrachloroethylene	0.02	0.01	1250	29.0
Total	***0.13***	***0.05***		***598.3***
--NON-CHLORINATED PHENOLS--				
Phenol	0.87	1.74	200	174.0
Total	***0.87***	***1.74***		***174.0***
--PHTALATES--				
Bis-(2-ethylhexyl) phtalate	0.02	0.06	1667	41.1
Di-n-butyl phtalate	0.04	0.08	250	9.3
Total	***0.06***	***0.14***		***50.4***
- TOTAL organic	***4.4***	***12.0***		***4 116***

CHIMIOTOX INDEX (inorganic + organic)	27 347

CHIMIOTOX

List of toxicity factors

Code	Parameters	MENVIQ criteria A: Eau brute [ppb]		Toxicité chronique [ppb]		Toxicité aiguë [ppb]		Contamination org. aquatiques [ppb]	Le plus sévère [ppb]	Ftox
	CONVENTIONAL PARAMETERS									
870	TOC								-	-
840	BDO5	3000		3000					-	-
820	COD								-	-
110	Suspended solids			10000					-	-
130	Dissolved solids	500000							-	-
135	Total solids (TS)	500000	B						-	-
800	Tannin and lignin								-	-
-	Total load of inorganics		T						-	-
	INORGANIC TOXIC PARAMETERS									
	--HEAVY METALS--									
380	Antimony	3		610	P	9000	P	45000	3	333
410	Silver	50		0.1		4.1	C		0.1	10000
500	Arsenic	0.0022		50		360	P	0.0175	0.0022	454545
400	Beryllium	0.0037		11		130	P	0.0641	0.0037	270270
320	Cadmium	5		1.1	C	3.9	C	2.7	1.1	909
451	Chromium	50		2		16			2	500
440	Copper	1000		0.49	C	17.7	C		0.49	2041
351	Mercury	0.144		0.006		2.4		0.146	0.006	166667
430	Nickel	13.4		158	C	1418	C	100	13.4	75
301	Lead	50		3.18	C	81.6	C		3.18	314
310	Selenium	10		5		20			5	200
571	Thallium	13		8		20		48	8	125
390	Vanadium			14		190			14	71
330	Zinc	5000		106	C	117	C		106	9.4
	--OTHER METALS--									
470	Aluminium	200		87		750			87	11
460	Iron	300		300		300			300	3.3
370	Manganese	50						100	50	20
570	Molybdenum	250		1000		2000			250	4
	--ANIONS AND OTHERS--									
710	Ammonia (nitrogen)	500		1250	D	6000	D		500	2.0
81	Total chlorine			2		19			2	500
631	Cyanides	200		5		22			5	200
680	Nitrites-nitrates	10000		200	E	600	E		200	5.0
677	Elementary phosphorus			0.1					0.1	10000
674	Total phosphorus			20	U				20	50
620	Sulfides	50	V	2	V	100	V		2	500
	ORGANIC TOXIC PARAMETERS									
	--FATTY ACIDS--									
3909	Linoleic acid			52	F				52	19
3912	Linolenic acid			52	F				52	19
3908	Oleic acid			52	F				52	19
3920	Palmitic acid			52	F				52	19
3913	Palmitoleic acid			52	F				52	19
3914	Dichlorostearic acid			52	F				52	19
3911	Stearic acid			52	F				52	19
	--RESINOUS ACIDS--									
3906	Abietic acid			52	G				52	19
3922	Chlorodehydroabietic acid			52	G				52	19
3905	Dehydroabietic acid			13	H				13	77
3923	Dichlorodehydroabietic acid			52	G				52	19
3902	Isopimaric acid			52	G				52	19
3904	Levopimaric acid			52	G				52	19
3907	Neoabietic acid			52	G				52	19
3903	Palustric acid			52	G				52	19
3910	Pimaric acid			52	G				52	19
3901	Sandaracopimaric acid			52	G				52	19

CHIMIOTOX

List of toxicity factors

Code	Parameters	MENVIQ criteria A										Ftox
		Eau brute [ppb]		Toxicité chronique [ppb]		Toxicité aiguë [ppb]		Contamination org. aquatiques [ppb]	Le plus sévère [ppb]			
	--PCBs--											
3160	Total PCBs	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3161	PCB-1016	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3170	PCB-1221	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3180	PCB-1232	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3190	PCB-1242	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3200	PCB-1248	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3210	PCB-1254	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
3220	PCB-1260	7.9E-05		0.001		2	P	7.9E-05	7.9E-05			12658228
	--NON-HALOGENATED VOCs											
2235	Acetone			500					500			2.0
5010	Acrolein	320		3		68	P	780	3			333
5020	Acrylonitrile	0.058		2600	P	7550	P	0.65	0.058			17241
2010	Benzene	0.66		60		5300	P	40	0.66			1515
2471	Butylcyclooctane	50	I						50			20
16040	2,4-Dinitrotoluene	0.11		70				9.1	0.11			9091
2115	Ethylic ether	50	I						50			20
2200	Ethylbenzene	2.4		30		32000	P	3280	2.4			417
2472	Ethylmethylcyclohexane	50	I						50			20
2480	Isopropanol	50	I						50			20
2246	Mesitylene	50	I						50			20
2470	Methylcyclohexane	50	I						50			20
16110	Nitrobenzene	30		2		27000	P		2			500
2245	Styrene	10		50				19	10			100
2240	Toluene	24		100		17500	P	424000	24			42
2243	Xylenes (o,m and p)	300	P	40					40			25
2247	Xylene-m	300	P	40					40			25
2242	Xylene-o	300	P	40					40			25
2241	Xylene-p	300	P	40					40			25
	--HALOGENATED VOCs--											
2110	Bis-(chlorométhyl) ether	3.8E-06		122	SP	360	SP	0.00184	3.8E-06			263157895
2020	Bromodichloromethane	0.19		6400	QP	11000	QP	15.7	0.19			5263
2030	Bromoform	0.19		6400	QP	11000	QP	15.7	0.19			5263
2040	Bromomethane	0.19		6400	QP	11000	QP	15.7	0.19			5263
2060	Chlorobenzene	3		71					3			333
2120	Chlorodibromomethane	50	I	6400	QP	11000	QP		50			20
2070	Chloroethane	50	I						50			20
2290	Chloroethylene	2						525	2			500
2080	2-Chloroethyl vinyl ether			122	SP	360	SP		122			8
2090	Chloroform	0.19		1240	P	28900	P	15.7	0.19			5263
2100	Chloromethane	0.19		6400	QP	11000	QP	15.7	0.19			5263
2400	1,2-cis-Dichloroethylene	70	P						70			14
2450	1,3-cis-Dichloropropene	87		244	P	6060	P	14100	87			11
12010	1,2-Dichlorobenzene	0.3		7					0.3			3333
12020	1,3-Dichlorobenzene	20		2.5				20	2.5			400
12030	1,4-Dichlorobenzene	0.1		4				15	0.1			10000
2130	Dichlorodifluoromethane	0.19		6400	QP	11000	QP	15.7	0.19			5263
2140	1,1-Dichloroethane	50	I						50			20
2150	1,2-Dichloroethane	0.94		500		118000	P	243	0.94			1064
2160	1,1-Dichloroethylene	0.033		100		11600	P	1.85	0.033			30303
2300	Dichloromethane	0.19		59		11000	QP	15.7	0.19			5263
2180	1,2-Dichloropropane	0.6		160					0.6			1667
2190	1,2-Dichloropropene	87		244	P	6060	P	14100	87			11
12050	Hexachlorobenzene	0.00072		0.0065				0.00074	0.00072			1388889
16090	Hexachloroethane	1.9		540	P	980	P	8.74	1.9			526
2212	Tetrachloroacetaldehyde	50	I						50			20
2220	1,1,2,2-Tetrachloroethane	0.17		2400	P	9320	P	10.7	0.17			5882
2161	Tetrachloroethylene	0.8		260	P	5280	P	8.85	0.8			1250
2050	Tetrachloromethane	0.4				35200	P	6.94	0.4			2500
2170	1,2-trans-Dichloroethylene	100	P						100			10
2460	1,3-trans-Dichloropropene	87		244	P	6060	P	14100	87			11
12040	1,2,4-Trichlorobenzene	10		0.5				22	0.5			2000
2250	1,1,1-Trichloroethane	200		117		18000	P	1030000	117			8.5
2260	1,1,2-Trichloroethane	0.6		156		18000	P	41.8	0.6			1667
2270	Trichloroethylene	2.7		94		45000	P	80.7	2.7			370
2280	Trichlorofluoromethane	0.19		6400	QP	11000	QP	15.7	0.19			5263

CHIMIOTOX

List of toxicity factors

Code	Parameters	MENVIQ criteria A										Ftox
		Eau brute [ppb]		Toxicité chronique [ppb]		Toxicité aiguë [ppb]		Contamination org. aquatiques [ppb]		Le plus sévère [ppb]		
	--DIOXINS and FURANS--											
3054	2,3,7,8-T4CDD equivalent	1.3E-08	O	0.001	OP	1	OP	1.4E-08	O	1.3E-08		76923076923
	--PAHs--											
11010	Acenaphtene	20		3		67	P			3		333
11020	Acenaphthylene	50	I			300	X			50		20
11030	Anthracene	50	I			300	X			50		20
11040	Benzo(a)anthracene	0.0028	J			300	X	0.0311	J	0.0028		357143
11050	Benzo(b)fluoranthene	0.0028	J			300	X	0.0311	J	0.0028		357143
11060	Benzo(k)fluoranthene	0.0028	J			300	X	0.0311	J	0.0028		357143
11070	Benzo(ghi)perylene	50	I			300	X			50		20
11080	Benzo(a)pyrene	0.0028	J	0.01		300	X	0.0311	J	0.0028		357143
16020	2-Chloronaphtalene	10	P			1600	P			10		100
11090	Chrysene	50	I			300	X			50		20
11031	Dibenzo(ah)anthracene	0.0028	J			300	X	0.0311	J	0.0028		357143
11110	Fluoranthene	42		16	P	3980	P	54		16		63
11120	Fluorene	50	I			300	X			50		20
11130	Indeno(1,2,3-cd)pyrene	0.0028	J			300	X	0.0311	J	0.0028		357143
11190	2-Methylnaphtalene	50	I			300	X			50		20
11140	Naphtalene	10		29		2300	P			10		100
11150	Phenanthrene	50	I			300	X			50		20
11160	Pyrene	50	I			300	X			50		20
	--OIL AND GREASE--											
181	Total oil and grease	50	I							50		20
182	Mineral oil and grease	50	I	10	W					10		100
	--NON-CHLORINATED PHEN											
4013	Catechol	2	K	5	L					2		500
4016	Cresols (o,m and p)	2	K	5	L					2		500
4011	m-Cresol	2	K	5	L					2		500
4012	o-Cresol	2	K	5	L					2		500
4015	p-Cresol	2	K	5	L					2		500
4040	2,4-Dimethylphenol	400		5	L	2120	P			5		200
4050	4,6-Dinitro-o-cresol	13.4		5	L			765		5		200
4060	2,4-Dinitrophenol	70		9.8				14300		9.8		102
4105	Eugenol	2	K	5	L					2		500
4014	Guaiacol	2	K	5	L					2		500
4111	Hydroxyphenol	2	K	5	L					2		500
4106	Isoeugenol	2	K	5	L					2		500
4108	3-methyl- 4,6-Dinitrophenol	50	I							50		20
4070	2-Nitrophenol	2	K	150		230	P			2		500
4080	4-Nitrophenol	2	K	150		230	P			2		500
4100	Phenol	300		5	L			230		5		200
810	Total phenols	2	K	5	L					2		500
	--CHLORINATED PHENOLS--											
4010	p-Chloro-m-cresol	50	I	1	M					1		1000
4020	2-Chlorophenol	0.1		1	M	4380	P			0.1		10000
4107	4-Chloro 3-méthylphenol	3000		4.4		30	P			4.4		227
4149	6-Chlorovanilla	50	I	1	M					1		1000
4144	4,5-Dichlorocatechol	50	I	1	M					1		1000
4148	4,5-Dichloroguaiacol	50	I	1	M					1		1000
4030	2,4-Dichlorophenol	0.3		0.2		2020	P			0.2		5000
4150	5,6-Dichlorovanilla	50	I	1	M					1		1000
4021	Monochlorophenols	50	I	7						7		143
4090	Pentachlorophenol	30		15.6	D	24.8	D			15.6		64
4142	Tetrachlorocatechol	50	I	1	M					1		1000
4145	Tetrachloroguaiacol	50	I	1	M					1		1000
4125	2,3,4,6-Tetrachlorophenol	1		1						1		1000
4143	3,4,5-Trichlorocatecol	50	I	1	M					1		1000
4146	3,4,5-Trichloroguaiacol	50	I	1	M					1		1000
4147	4,5,6-Trichloroguaiacol	50	I	1	M					1		1000
4110	2,4,6-Trichlorophenol	1.2		18				1.5		1.2		833
4112	Trichlorophenols	50	I	18						18		56
4151	Trichlorosyringol	50	I	1	M					1		1000

CHIMIOTOX

List of toxicity factors

Code	Parameters	MENVIQ criteria A								Ftox
		Eau brute [ppb]		Toxicité chronique [ppb]		Toxicité aiguë [ppb]		Contamination org. aquatiques [ppb]	Le plus sévère [ppb]	
	--PHTALATES--									
14010	Butyl benzyl phtalate	50	I	0.2	R	940	RP		0.2	5000
14060	Bis-(2-éthylhexyl) phtalate	15000		0.6				50000	0.6	1667
14020	Di-n-butyl phtalate	34000		4				154000	4	250
14030	Diethyl phtalate	350000		0.2	R	940	RP	1800000	0.2	5000
14040	Dimethyl phtalate	313000		0.2	R	940	RP	2900000	0.2	5000
14050	Di-n-octyl phtalate	50	I	0.2	R	940	RP		0.2	5000
14000	Total phtalates	50	I	0.2	R	940	RP		0.2	5000
	--SVOCs-									
16140	Aniline	1							1	1000
16120	Anthraquinone	50	I						50	20
16010	Benzidine	0.00012		0.1		2500	P	0.00053	0.00012	8333333
15020	Bis-(2-chloroethoxy) methane			4.6					4.6	217
15030	Bis-(2-chloroethyl) ether	0.03		122	SP	360	SP	1.36	0.03	33333
15040	Bis-(2-chloroisopropyl) ether	34.7		122	SP	360	SP	4360	34.7	29
15010	4-Bromophenyl phenyl ether			122	SP	360	SP		122	8
15050	4-Chlorophenyl phenyl ether			122	SP	360	SP		122	8
16030	3,3-Dichlorobenzidine	0.0103						0.0204	0.0103	97087
16060	1,2-Diphenylhydrazine	0.042							0.042	23810
16130	2-Ethylhexanol	50	I						50	20
16070	Hexachlorobutadiene	0.45		0.1		90	P	50	0.1	10000
16080	Hexachlorocyclopentadiene	1		0.45		4.5			0.45	2222
16100	Isophorone	5200		260		117000	P	520000	260	3.8
16145	3-Nitroaniline	50	I						50	20
13010	Nitroso-n-dimethylamine	0.0014				5850	P	16	0.0014	714286
13020	Nitroso-n-diphenylamine	4.9				5850	P	16.1	4.9	204
13030	Nitroso-n-di-n-propylamine	0.005	P			5850	P		0.005	200000

A: Water quality criterias of the Ministère de l'Environnement du Québec
B: Criteria for total disolved solids.
C: Calculated criteria with an average concentration of 100 ppm of CaCO3
D: Calculated criteria with a pH=8.0 and a temperature=6 C
E: Criteria for nitrites calculated with a chloride concentration of more than 10 ppm
F: Criteria corresponding to resinous acids with a pH=8.0
G: Criteria with 52 ppb at pH=8.0 and 25 ppb at pH=7.0
H: Criteria with 13 ppb at pH=8.0 and 8 ppb at pH=7.0
I: Generic criteria for organic parameters in accordance with Appendix 1
J: Generic criteria for group 1 PAHs in accordance with Appendix 5
K: Generic criteria for non-clorinated phenolic compouds (eau brute)
K: Generic criteria for non-clorinated phenolic compouds (toxicité chronique)
M: Generic criteria for total chlorophenols
N: Criteria with 15.6 ppb at pH=8.0 and 5.7 ppb at pH=7.0
O: Equivalent criteria for for2,3,7,8- tétrachlorodibenzodioxin in accordance with Appendix 8
P: Provisional criteria (MENVIQ)
Q: Generic criteria for halomethanes
R: Generic criteria for phtalate esters
S: Generic criteria for halogenated ethers
T: Summary of all characterized inorganics (such as calcium, chlorides, magnesium, sulphates, zinc, etc)
U: Criteria expressed in terms of phosphorus (P)
V: Sulphuric hydrogen criteria
W: Operational criteria for total petroleum hydrocarbons
X: Generic acute toxicity criteria for PAHs

UPDATED: 05/12/91

CHEMICAL EQUIVALENCE FACTORS

The pages which follow provide an exhaustive list of all the chemical equivalence factors for the SLAP's priority toxic substances. Below is an example of how these factors are calculated.

1. Theoretical calculation of TS equivalents

Conversion of the loads per unit of mass of inorganic parameters into TS equivalent loads is obvious, since a gram of lead, for example, equals a gram of total solids. The conversion factor for TS for all inorganic parameters is thus: $F_{ST} = 1$.

2. Theoretical calculation of COD equivalent

In the Chemiotox model, each organic toxic substance is converted into an equivalent COD unit. In order to do this, oxidation-reduction equations for organic parameters are established so as to determine the conversion factor (F_{COD}).

Analysis measurement of the COD is conducted in the laboratory in the presence of an oxidizing agent (potassium dichromate) in an acidic environment (sulphuric acid). The organic components are oxidized by a sulphur and chromium mixture.

Let us take the example of a toxic organic compound to illustrate the process of calculating an F_{COD}: 2-chlorophenol. The reduction equation is:

$$C_6H_4Cl(OH) + 11H_2O \rightarrow 6CO_2 + Cl^- + 27H^+ + 26e$$

The oxidation equation using the sulphur and chromium mixture is:

$$Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_2O$$

The overall oxidation-reduction reaction will be:

$13Cr_2O_7^{2-} + 3C_6H_4Cl(OH) + 101H^+ \rightarrow 26Cr^{3+} + 18CO_2 + Cl^- + 58H_2O$

Since a mole of $Cr_2O_7^{2-}$ equals 6 equivalents and one equivalent equals, by convention, a chemical demand of 8 g of oxygen, we can establish that in this case each mole of 2-chlorophenol exerts a COD of:

[13 moles $Cr_2O_7^{2-}$ x 6 eq/mole $Cr_2O_7^{2-}$ x 8 g O_2/eq]/3 moles $C_6H_4Cl(OH)$ = **208 g/mole**

The COD factor of 2-chlorophenol will be (the molecular mass of 2-chlorophenol is 128.6 g/mole):

F_{COD} = [COD/mole]/[molecular mass] = 208 g/mole / 128.6 g/mole = **1.62**

CHIMIOTOX

List of chemical equivalence factors

Code	Parameters	Molecular mass (g/mole)	COD per mole (g of O/mole)	Chemical equivalence factor	
	INORGANIC TOXIC PARAMETERS				
	--HEAVY METALS--				
380	Antimony	121.8	-	1.00	
410	Silver	107.9	-	1.00	
500	Arsenic	74.9	-	1.00	
400	Beryllium	9.0	-	1.00	
320	Cadmium	112.4	-	1.00	
451	Chromium	52.0	-	1.00	
440	Copper	63.6	-	1.00	
351	Mercury	200.6	-	1.00	
430	Nickel	58.7	-	1.00	
301	Lead	207.2	-	1.00	
310	Selenium	79.0	-	1.00	
571	Thallium	204.4	-	1.00	
390	Vanadium	50.9	-	1.00	
330	Zinc	65.4	-	1.00	
	--OTHER METALS--				
470	Aluminium	27.0	-	1.00	
460	Iron	55.9	-	1.00	
370	Manganese	54.9	-	1.00	
570	Molybdenum	95.9	-	1.00	
	--ANIONS AND OTHERS--				
710	Ammonia (nitrogen)	>17.0	-	1.00	
81	Total chlorine	>35.4	-	1.00	
631	Cyanides	>26.0	-	1.00	
680	Nitrites-nitrates	>46.0	-	1.00	
677	Elementary phosphorus	31.0	-	1.00	
674	Total phosphorus	>31.0	-	1.00	
620	Sulfides	>33.1	-	1.00	
	ORGANIC TOXIC PARAMETERS				
	--FATTY ACIDS--				
3909	Linoleic acid	280.5	768.0	2.74	
3912	Linolenic acid	278.4	784.0	2.82	
3908	Oleic acid	282.5	816.0	2.89	
3920	Palmitic acid	256.4	736.0	2.87	
3913	Palmitoleic acid	282.0	816.0	2.89	
3914	Dichlorostearic acid	353.4	800.0	2.26	
3911	Stearic acid	284.5	832.0	2.92	
	--RESINOUS ACIDS--				
3906	Abietic acid	302.5	848.0	2.80	
3922	Chlorodehydroabietic acid	334.9	816.0	2.44	
3905	Dehydroabietic acid	300.4	864.0	2.88	
3923	Dichlorodehydroabietic acid	369.3	800.0	2.17	
3902	Isopimaric acid	302.5	848.0	2.80	
3904	Levopimaric acid	302.5	848.0	2.80	
3907	Neoabietic acid	302.5	848.0	2.80	
3903	Palustric acid	302.5	848.0	2.80	
3910	Pimaric acid	302.5	848.0	2.80	
3901	Sandaracopimaric acid	302.5	848.0	2.80	
	--PCBs--				
3160	Total PCB	-	-	1.53	A
3161	PCB-1016	257.2	416.2	1.62	B
3170	PCB-1221	200.7	442.4	2.20	B
3180	PCB-1232	228.6	429.4	1.88	B
3190	PCB-1242	262.9	408.2	1.55	B
3200	PCB-1248	299.6	396.5	1.32	B
3210	PCB-1254	327.3	378.2	1.16	B

CHIMIOTOX

List of chemical equivalence factors

Code	Parameters	Molecular mass (g/mole)	COD per mole (g of O/mole)	Chemical equivalence factor	
3220	PCB-1260	377.4	360.3	0.95	B
	--NON-HALOGENATED VOCs--				
2235	Acetone	58.1	128.0	2.20	
5010	Acrolein	56.1	112.0	2.00	
5020	Acrylonitrile	53.1	160.0	3.01	
2010	Benzene	78.1	240.0	3.07	
2471	Butylcyclooctane	170.0	1776.0	10.45	
16040	2,4-Dinitrotoluene	182.1	288.0	1.58	
2115	Ethylic ether	74.0	192.0	2.59	
2200	Ethylbenzene	106.2	2688.0	25.31	
2472	Ethylmethylcyclohexane	126.0	432.0	3.43	
2480	Isopropanol	60.0	144.0	2.40	
2246	Mesitylene	120.2	384.0	3.19	
2470	Methylcyclohexane	98.0	336.0	3.43	
16110	Nitrobenzene	123.1	240.0	1.95	
2245	Styrene	104.2	320.0	3.07	
2240	Toluene	92.1	288.0	3.13	
2243	Xylenes (o,m and p)	106.2	336.0	3.16	
2247	Xylene-m	106.2	336.0	3.16	
2242	Xylene-o	106.2	336.0	3.16	
2241	Xylene-p	106.2	336.0	3.16	
	--HALOGENATED VOCs--				
2110	Bis-(chlorométhyl) ether	115.0	64.0	0.56	
2020	Bromodichloromethane	163.8	40.0	0.24	
2030	Bromoform	252.7	40.0	0.16	
2040	Bromomethane	94.9	48.0	0.51	
2060	Chlorobenzene	112.6	224.0	1.99	
2120	Chlorodibromomethane	208.3	40.0	0.19	
2070	Chloroethane	64.5	96.0	1.49	
2290	Chloroethylene	62.5	80.0	1.28	
2080	2-Chloroethyl vinyl ether	107.6	168.0	1.56	
2090	Chloroform	119.4	40.0	0.34	
2100	Chloromethane	50.5	56.0	1.11	
2400	1,2-cis-Dichloroethylene	96.9	64.0	0.66	
2450	1,3-cis-Dichloropropene	99.0	112.0	1.13	
12010	1,2-Dichlorobenzene	147.0	208.0	1.41	
12020	1,3-Dichlorobenzene	147.0	208.0	1.41	
12030	1,4-Dichlorobenzene	147.0	208.0	1.41	
2130	Dichlorodifluoromethane	120.9	32.0	0.26	
2140	1,1-Dichloroethane	99.0	80.0	0.81	
2150	1,2-Dichloroethane	99.0	80.0	0.81	
2160	1,1-Dichloroethylene	96.9	64.0	0.66	
2300	Dichloromethane	84.9	48.0	0.57	
2180	1,2-Dichloropropane	113.0	128.0	1.13	
2190	1,2-Dichloropropene	111.0	112.0	1.01	
12050	Hexachlorobenzene	224.7	192.0	0.85	
16090	Hexachloroethane	236.7	64.0	0.27	
2212	Tetrachloroacetaldehyde	181.8	48.0	0.26	
2220	1,1,2,2-Tetrachloroethane	167.9	80.0	0.48	
2161	Tetrachloroethylene	165.8	64.0	0.39	
2050	Tetrachloromethane	153.8	32.0	0.21	
2170	1,2-trans-Dichloroethylene	96.9	64.0	0.66	
2460	1,3-trans-Dichloropropene	99.0	112.0	1.13	
12040	1,2,4-Trichlorobenzene	181.4	192.0	1.06	
2250	1,1,1-Trichloroethane	133.4	112.0	0.84	
2260	1,1,2-Trichloroethane	133.4	112.0	0.84	
2270	Trichloroethylene	131.4	80.0	0.61	
2280	Trichlorofluoromethane	137.4	32.0	0.23	
	--DIOXINS and FURANS--				
3054	2,3,7,8-T4CDD equivalent	459.8	288.0	0.63	
	--PAHs--				

CHIMIOTOX

List of chemical equivalence factors.

Code	Parameters	Molecular mass (g/mole)	COD per mole (g of O/mole)	Chemical equivalence factor	
11010	Acenaphtene	154.2	464.0	3.01	
11020	Acenaphthylene	152.2	448.0	2.94	
11030	Anthracene	178.2	528.0	2.96	
11040	Benzo(a)anthracene	228.3	672.0	2.94	
11050	Benzo(b)fluoranthene	252.3	736.0	2.92	
11060	Benzo(k)fluoranthene	252.3	736.0	2.92	
11070	Benzo(ghi)perylene	276.3	800.0	2.90	
11080	Benzo(a)pyrene	252.3	736.0	2.92	
16020	2-Chloronaphtalene	162.5	368.0	2.26	
11090	Chrysene	228.3	672.0	2.94	
11031	Dibenzo(ah)anthracene	278.4	336.0	1.21	
11110	Fluoranthene	202.3	592.0	2.93	
11120	Fluorene	166.2	496.0	2.98	
11130	Indeno(1,2,3-cd)pyrene	276.3	800.0	2.90	
11190	2-Methylnaphtalene	142.0	272.0	1.92	
11140	Naphtalene	128.2	384.0	3.00	
11150	Phenanthrene	178.2	528.0	2.96	
11160	Pyrene	202.3	592.0	2.93	
	--OIL AND GREASE--				
181	Total oil and grease	-	-	3.00	B
182	Mineral oil and grease	-	-	3.45	B
	--NON-CHLORINATED PHENOL				
4013	Catechol	110.1	208.0	1.89	
4016	Cresols (o,m and p)	108.1	272.0	2.52	
4011	m-Cresol	108.1	272.0	2.52	
4012	o-Cresol	108.1	272.0	2.52	
4015	p-Cresol	108.1	272.0	2.52	
4040	2,4-Dimethylphenol	122.2	320.0	2.62	
4050	4,6-Dinitro-o-cresol	198.1	272.0	1.37	
4060	2,4-Dinitrophenol	184.1	224.0	1.22	
4105	Eugenol	164.2	384.0	2.34	
4014	Guaiacol	124.1	256.0	2.06	
4111	Hydroxyphenol	110.1	208.0	1.89	
4106	Isoeugenol	164.2	384.0	2.34	
4108	3-methyl- 4,6-Dinitrophenol	314.9	272.0	0.86	
4070	2-Nitrophenol	139.1	224.0	1.61	
4080	4-Nitrophenol	139.1	224.0	1.61	
4100	Phenol	94.1	224.0	2.38	
810	Total phenols	-	-	2.02	A
	--CHLORINATED PHENOLS--				
4010	p-Chloro-m-cresol	142.6	256.0	1.80	
4020	2-Chlorophenol	128.6	208.0	1.62	
4107	4-Chloro 3-méthylphenol	142.6	256.0	1.80	
4149	6-Chlorovanilla	186.6	256.0	1.37	
4144	4,5-Dichlorocatechol	179.0	176.0	0.98	
4148	4,5-Dichloroguaiacol	193.0	240.0	1.24	
4030	2,4-Dichlorophenol	163.0	192.0	1.18	
4150	5,6-Dichlorovanilla	221.0	240.0	1.09	
4021	Monochlorophenols	128.6	208.0	1.62	
4090	Pentachlorophenol	266.3	144.0	0.54	
4142	Tetrachlorocatechol	247.9	176.0	0.71	
4145	Tetrachloroguaiacol	261.9	208.0	0.79	
4125	2,3,4,6-Tetrachlorophenol	231.9	160.0	0.69	
4143	3,4,5-Trichlorocatecol	229.5	160.0	0.70	
4146	3,4,5-Trichloroguaiacol	227.5	224.0	0.98	
4147	4,5,6-Trichloroguaiacol	192.0	224.0	1.17	
4110	2,4,6-Trichlorophenol	197.5	176.0	0.89	
4112	Trichlorophenols	197.5	176.0	0.89	
4151	Trichlorosyringol	475.7	544.0	1.14	
	--PHTALATES--				
14010	Butyl benzyl phtalate	312.4	704.0	2.25	

CHIMIOTOX

List of chemical equivalence factors

Code	Parameters	Molecular mass (g/mole)	COD per mole (g of O/mole)	Chemical equivalence factor	
14060	Bis-(2-éthylhexyl) phtalate	390.6	1008.0	2.58	
14020	Di-n-butyl phtalate	278.4	624.0	2.24	
14030	Diethyl phtalate	222.2	432.0	1.94	
14040	Dimethyl phtalate	194.2	336.0	1.73	
14050	Di-n-octyl phtalate	390.6	1008.0	2.58	
14000	Total phtalates	-	-	2.22	A
	--SVOCs--				
16140	Aniline	93.0	288.0	3.10	
16120	Anthraquinone	210.0	496.0	2.36	
16010	Benzidine	184.2	560.0	3.04	
15020	Bis-(2-chloroethoxy) methane	175.1	192.0	1.10	
15030	Bis-(2-chloroethyl) ether	143.0	160.0	1.12	
15040	Bis-(2-chloroisopropyl) ether	173.1	272.0	1.57	
15010	4-Bromophenyl phenyl ether	249.1	432.0	1.73	
15050	4-Chlorophenyl phenyl ether	204.7	432.0	2.11	
16030	3,3-Dichlorobenzidine	253.1	528.0	2.09	
16060	1,2-Diphenylhydrazine	184.2	560.0	3.04	
16130	2-Ethylhexanol	130.0	288.0	2.22	
16070	Hexachlorobutadiene	260.8	128.0	0.49	
16080	Hexachlorocyclopentadiene	272.8	160.0	0.59	
16100	Isophorone	138.2	384.0	2.78	
16145	3-Nitroaniline	138.0	288.0	2.09	
13010	Nitroso-n-dimethylamine	74.1	176.0	2.38	
13020	Nitroso-n-diphenylamine	198.2	528.0	2.66	
13030	Nitroso-n-di-n-propylamine	130.0	368.0	2.83	

A: This COD factor is obtained from the average of factors in the same family.
B: This COD factor is obtained from the weighted average of factors of components of the mixture.

UPDATED: 02/12/91

ST LAWRENCE ACTION PLAN

LIST OF 50 PRIORITY INDUSTRIES

Number	Name of plant	Location	Industrial sector
1	Dominion Textile inc.	St-Timothée	Inorganic: textiles
2	Minéraux Noranda inc. (CCR)	Montréal	Metallurgy: non-ferrous metals
3	Produits Shell Canada ltée	Montréal	Organic: refineries
4	Union Carbide du Canada ltée	Montréal	Organic: primary petrochemicals
5	Société Pétrochimique Kemtec inc.	Montréal	Organic: primary petrochemicals
6	Produits Pétro-Canada inc.	Montréal	Organic: refineries
7	Produits Chimiques Expro inc.	St-Timothée	Inorganic: inorganic chemicals
8	Zinc Electrolytique du Canada ltée	Salaberry-de-Valleyfield	Metallurgy: non-ferrous metals
9	Société d'Electrolyse et de Chimie Alcan ltée	Melocheville	Metallurgy: aluminum smelter
10	Domtar inc. (Papiers Fins)	Beauharnois	Pulp and paper
11	Elkem Métal Canada inc.	Beauharnois	Metallurgy: ferrous metals
12	PPG Canada inc.	Beauharnois	Inorganic: inorganic chemicals
13	Locweld inc.	Candiac	Inorganic: surface treatment
14	Papiers Perkins ltée	Candiac	Pulp and paper
15	Monsanto Canada inc.	LaSalle	Organic: organic chemicals
16	Héroux inc.	Longueuil	Inorganic: surface treatment
17	Pratt & Whitney Canada inc.	Longueuil	Inorganic: surface treatment
18	Produits Nacan ltée	Boucherville	Organic: organic chemicals
19	Alcools de Commerce ltée	Varennes	Organic: organic chemicals
20	Albright & Wilson Amérique inc.	Varennes	Inorganic: inorganic chemicals
21	Hoechst Canada inc.	Varennes	Organic: organic chemicals
22	Kronos Canada inc.	Varennes	Inorganic: inorganic chemicals
23	Pétromont inc.	Varennes	Organic: primary petrochemicals
24	Sidbec-Dosco inc.	Contrecoeur	Metallurgy: ferrous metals
25	Aciers Inoxydables Atlas inc.	Tracy	Metallurgy: ferrous metals
26	Industries de Préservation du bois ltée	Tracy	Organic: organic chemicals
27	Tioxide Canada inc.	Tracy	Inorganic: inorganic chemicals
28	QIT-Fer et Titane inc.	St-Joseph-de-Sorel	Metallurgy: ferrous metals
29	I.C.I. inc.	Bécancour	Inorganic: inorganic chemicals
30	Produits Forestiers Canadien Pacifique ltée	Trois-Rivières	Pulp and paper
31	Stone-Consolidated inc. (Div. Wayagamak)	Trois-Rivières	Pulp and paper
32	Kruger inc.	Trois-Rivières	Pulp and paper
33	Aluminerie de Bécancour inc.	Bécancour	Metallurgy: aluminum smelter
34	Société Canadienne de Métaux Reynolds ltée	Cap-de-la-Madeleine	Metallurgy: aluminum smelter
35	Domtar inc. (Papeterie Donnacona)	Donnacona	Pulp and paper
36	Daishowa inc.	Québec	Pulp and paper
37	Ultramar Canada inc.	St-Romuald	Organic: refineries
38	Abitibi-Price inc. (Papeterie Beaupré)	Beaupré	Pulp and paper
39	Donohue inc.	Clermont	Pulp and paper
40	F.F. Soucy inc.	Rivière-du-Loup	Pulp and paper
41	Compagnie de Papier Québec et Ontario ltée	Baie-Comeau	Pulp and paper
42	Société Canadienne de Métaux Reynolds ltée	Baie-Comeau	Metallurgy: aluminum smelter
43	Cascades inc.	Jonquière	Pulp and paper
44	Stone-Consolidated inc. (Div. Port-Alfred)	La Baie	Pulp and paper
45	Abitibi-Price inc. (Papeterie Alma)	Alma	Pulp and paper
46	Abitibi-Price inc. (Papeterie Kénogami)	Jonquière	Pulp and paper
47	Société d'Electrolyse et de Chimie Alcan ltée	Alma	Metallurgy: aluminum smelter
48	Société d'Electrolyse et de Chimie Alcan ltée	Jonquière	Metallurgy: aluminum smelter
49	Société d'Electrolyse et de Chimie Alcan ltée	La Baie	Metallurgy: aluminum smelter
50	Services T.M.G. inc. (Mine Niobec)	St-Honoré	Inorganic: mines