World-wide Limits for Toxic and Hazardous Chemicals in Air, Water and Soil

Marshall Sittig

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PREFACE

This book summarizes allowable limits for over 1,100 chemicals (domestic and international) in workplace air, in ambient air, in water of various types, and in soils. It includes data from all pertinent states and 25 foreign countries and organizations.

It is unique in that, for the first time in any publication, a variety of data on a specific chemical is assembled in one place. Thus, one does not have to go to a variety of reference sources for such data, but can get a panoramic view of the possible hazards associated with exposure to a single chemical, under various conditions, in one place.

The data in this book are new. They have not been presented in this manner before. They represent the latest in numerical values (and cancer assessments), most of them more recent than the third and latest edition of the writer's "Handbook of Toxic and Hazardous Chemicals and Carcinogens" (3).

The data in many cases are unique, hard to obtain, not previously published, and have been assembled in a single reference source for easy use by the reader. They include recent international data, checked by a visit to the United Nations information centers in Geneva, Switzerland in the months immediately before publication. They include very recent data from a variety of State agencies in the U.S.A., standards which have been established to safeguard the public health by many different agencies within the various states.

It is hoped that this book will be of wide utility to:

1. Lawmakers engaged in standards setting who can compare precedents, and then research those precedents to aid in their own work.
2. Manufacturers, distributors and users of chemical products who can now see at a single glance what restrictions do, or may, apply to the products they handle.
3. Enforcement agencies concerned with standards setting, who can see quickly what their own government, or neighboring governments have done in the past and then analyze data gaps and unusual differences in standards between governing bodies.
4. Attorneys defending accused violators of regulatory standards, who can analyze precedents differing from those which their client is accused of violating.
5. Public interest groups concerned with both standard setting and enforcement, who can observe both gaps in existing data and widely differing values for various chemicals to help to set their own agendas.
6. Labor unions and their environmental safety specialists who are concerned with worker protection and who can now compare standards in their own and neighboring governmental divisions for coverage and possible inequity.
7. Health agencies at various levels of government who can now see what precedents exist and what needs to be done to fill data gaps and insure the proper protection of all citizens.
8. Testing laboratories and those governmental bodies concerned with analytical standard setting, who can identify chemicals of concern and the need for further work.

9. Educational institutions with environmental research and teaching programs who can now, in this single volume, observe the panorama of what has been done and what should receive attention in the future.
10. Emergency personnel such as first aid and fire fighting groups, who can quickly get a profile of possible hazards associated with various chemicals to enable them to prepare emergency response methods.
11. Contracting firms and equipment manufacturers involved in toxic chemical cleanup operations.
12. Lending institutions concerned with the acceptability of properties for financing based on the present status of soils, for example, and the possible costs of remedial steps to prevent future litigation regarding the consequences of past uses.
13. Consulting firms having clients with present or possible future environmental problems.

While many of the values for allowable limits in air and water are better known, the values for soil are relatively new and unique. It is the author's hope that they will be useful and, indeed, may assist in standard setting for toxics in soil in other jurisdictions where such standards have not been heretofore been considered.

INTRODUCTION

Each entry in the 1,100 listed in this volume starts with alternative names for the chemical in question, and these names are cross-indexed within the volume.

Following the names are numerical identifiers from Chemical Abstracts Service (CAS numbers). They are followed by RTECS (Registry of Toxic Effects of Chemical Substances) identification numbers published by the U.S. National Institute of Occupational Safety and Health (NIOSH). The third identifying number, when available, is from the joint efforts of the United Nations and the U.S. Department of Transportation.

Then the chemical formula and a very brief statement of the utility of the particular chemical are given.

Finally, in this introductory section of each entry, there is a statement as to carcinogenicity. This is from the most recent summary publications available (13,39) and categorizes about 400 chemicals as

- confirmed or
- suspected or
- questionable carcinogens.

In those cases where substances have been given a clean bill of health, a citation from a British industrial publication is given (18,19). Many chemicals have unknown carcinogenic status and "No Data" is simply indicated in those cases.

Particular attention has been given to pesticides in this volume with the help of a valuable British source book (7) which assisted in correlation of generic names and trade names.

Then for each chemical, the data available are presented under four different categories. These are:

1. **Limits in Workplace Air.** The values are given in milligrams per cubic meter (mg/m^3). These are values for allowable limits within factory buildings or, in some cases, within factory fences, depending on equipment configuration.
2. **Limits in Ambient Air.** The values are given in micrograms per cubic meter (ug/m^3). These are values for allowable limits outside the factory boundaries or in adjacent neighborhoods downwind from the source of the chemical in question.
3. **Limits in Water.** The values are given in micrograms per liter (ug/l). These are generally for domestic or drinking water, but may also be given for fishery waters (where a multiplier effect can occur for humans through the chain of marine organisms) or for agricultural water (used for irrigation or for cattle watering).
4. **Limits in Soil.** The values are given in milligrams per kilogram (mg/kg) which is the same as parts per million (ppm). They are generally given for residential soils and sometimes for industrial soils. Occasionally, values are set for agricultural soils as well.

Some comments on these categories and the sources of data for them follow. Preceding these comments is a list of codes for various countries (Table 1) and for various states in the U.S.A. which have been used in this volume (Table 2) as well as for some agencies which have been quoted (Table 3).

Limits in Workplace Air

The values given in this category are for TWA (time-weighted average), the average concentration "for normal 8-hour work day and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect" (25).

A second value quoted in many cases is for the STEL (short-term exposure limit). This is the "concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TWA is not exceeded" (25). STEL is thus defined as a 15 minute exposure limit which should not be exceeded at any time during a work day even if the 8-hour TWA is within acceptable limits. Further, the STEL value should not occur more than four times per day and there should be at least 60 minutes between successive such exposures.

Under "Notes" in the tabulation for each chemical, notations used are given in Table 4. Also the notation MAX following any value indicates a maximum or ceiling value.

The principal collective literature source for limits in workplace air is a publication of the International Labour Office in Geneva (1). Values have been published separately for Germany (12) and the U.K. (34).

There are also data published by the Peoples' Republic of China (38) and by the UNEP/IRPTC based on standards approved in the USSR (10). Further, more recent Russian data have been included (37). Data for Israel and for California (representative of standard setting by individual states for workplace air) are also cited from a recent compendium (35). The reader is also referred to an interesting broad-gauge compendium of occupational exposure limits worldwide by W.A. Cook (40). The last publication is referred here but not quoted extensively because it is somewhat older and also in the interest of brevity in the present volume.

In the U.S.A. there are two major sources of this category of data:

- U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (24,41,42).
- American Conference of Governmental Industrial Hygienists (25).

It should be noted that, in connection with NIOSH and OSHA values, NIOSH does research and recommends standards, but OSHA is a standards-setting and enforcement agency which acts on NIOSH recommendations.

The two U.S. sources cited above and the ILO compendium are supplemented by the IRPTC Legal File (21).

Limits in Ambient Air

The values given are for various exposure periods to ambient air. They range from a very short period:

- commonly 0.5 hours but occasionally 15 minutes or one hour with occasional designations such as "momentary," the last used extensively in USSR/UNEP publications (10,37)

to longer periods, commonly

- 8 hours
- 24 hours
- annual.

The principal collective literature source for limits in ambient air is a state-by-state summary published by the U.S. Environmental Protection Agency (9), known as NATICH which stands for "National Air Toxics Information Clearinghouse." Some states, notably New York (27) and Texas (20) have produced their own lists of allowable levels of toxic chemicals in ambient air.

Secondary sources covering international standards are available from the U.N. in Geneva and include

- the IRPTC Legal File (21)
- a compendium of USSR/UNEP values for "Maximum Allowable Concentrations and Tentative Safe Exposure Levels of Harmful Substances in the Environmental Media" (10) and subsequent Russian data (37).

Particularly in the case of ambient air values, one finds rather wide deviations — by many factors of ten — between values given for the same pollutant for the same exposure time.

Limits in Water

The values given are for various types of water use with major emphasis placed on domestic or drinking water.

A second set of values may be set for fishery waters, with separate values sometimes given for fresh water and for salt water. Here the practical problem is that toxic chemicals may multiply to many times their concentration in water in the seafood that is ultimately consumed at the top of the food chain.

A third set of values may be given for agricultural water where the end use may be irrigation of crops or livestock watering.

Finally, in addition to the values for the various categories of water use, some agencies give the detection limit for the particular toxic chemical in water. This is often described as the practical quantitation limit or PQL. The principal collective literature source for allowable limits in water is a publication of the U.S. Environmental Protection Agency known as FSTRAC (6) which stands for Federal/State Toxicology and Regulatory Alliance Committee. It should be noted that both guidelines and standards are sometimes given in FSTRAC and that no differentiation has been made in this volume between those values for a particular chemical in water.

Values for water have also been set forth by the U.S.E.P.A. for those chemical substances designated as "priority toxic pollutants" (2,32). Other allowable values in water have also been set forth by U.S.E.P.A. at various times (4,14,23).

Additional data on allowable limits in water are provided by the United Nations Environment Programme in the form of:

- the IRPTC Legal File (21)
- the USSR/UNEP publications cited above (10,37).

Limits in Soil

The newest and probably the most complex set of limits are those that are even now being set for toxic and hazardous chemicals in soil.

This is complex for one reason, due to the inhomogeneity of soils compared to water or air where mixing tends to be more rapid. Further, some agencies have specified limits for surface and for subsurface soil.

Human consumption of pollutants present in soils may arise from various routes:

- Inhalation of airborne soil particles from a contaminated site.
- Ingestion of contaminated soil particles, particularly by young children at a playground, for example.
- Transmission of toxics from the soil by percolation through soils of widely varying nature (clay vs. sand vs. loam) into the water table which, in turn, may directly affect drinking water sources.

Apart from point location (surface vs. subsurface) and mode of transmission of contaminants to air, to water, or directly to humans, allowable values are set for the use categories of

- residential soils
- agricultural soils
- industrial soils.

In addition to setting allowable values for various soil locations and end uses, some agencies specify the detection limit for the particular toxic chemical in soil.

The U.S. Government has tended to try to set site-specific values rather than generic values for chemicals in soil. One cynic has commented that this means that value setting for a specific situation involves work of the magnitude of a Ph.D. thesis—a wonderful product but a type of solution that could take years to cure the world's ills.

Thus, the U.S. emphasis, in the absence of guidance from the central government, has been on standards setting by individual states for water and soil, such as:

- Arizona (8)
- Florida (26,36)
- Massachusetts (30)
- Michigan (11)
- New Jersey (5)
- New York (27)
- Oregon (22)
- Tennessee (28,44)
- Texas (29)
- Washington (16,45)

The "view from Geneva" of the international situation on limit setting for pollutants in water and soils is that a few specific countries have set forth standards including

- Canada (15)
- Denmark (31)
- Germany (31)
- Great Britain (31,43)
- Malaysia (33)
- Netherlands (31)
- New Zealand (31)
- Russia (10,37)

The question of allowable limits in soils is an immensely important practical one because it concerns legal problems in property transfers at many levels. Since pollutants are less mobile in soils than in air or water, previous use as a manufacturing site or a dump may impact the use of the site many years hence.

Thus the levels in soil not only relate to the allowability of depositing toxic chemicals onto or into soils from current operations related to manufacturing or waste disposal, but also relate to acceptable cleanup levels for sites which have been previously (even many years before) exposed to environmental abuse and which are now subject to cleanup under the U.S. Superfund program or other programs elsewhere in the world.

TABLE 1

Country Codes (from the United Nations)

ARG	Argentina
AUS	Australia
BEL	Belgium
BRA	Brazil
CAN	Canada
CHE	Switzerland
CIS (SUN)	Commonwealth of Independent States (formerly the Soviet Union)
CSK	Czechoslovakia
DEU	Germany
DNK	Denmark
EEC	European Economic Community
FIN	Finland
FRA	France
GBR	United Kingdom
HUN	Hungary
ISR	Israel
JPN	Japan
MEX	Mexico
MYS	Malaysia
NLD	Netherlands
NZL	New Zealand
POL	Poland
PRC	Peoples' Republic of China
SWE	Sweden
USA	United States of America
WHO	World Health Organization

TABLE 2

U.S. State Codes based on U.S. Post Office designations.

AK	Alaska	MT	Montana
AL	Alabama	NC	North Carolina
AR	Arkansas	ND	North Dakota
AZ	Arizona	NE	Nebraska
CA	California	NH	New Hampshire
CO	Colorado	NJ	New Jersey
CT	Connecticut	NM	New Mexico
DE	Delaware	NV	Nevada
FL	Florida	NY	New York
GA	Georgia	OH	Ohio
HI	Hawaii	OK	Oklahoma
IA	Iowa	OR	Oregon
ID	Idaho	PA	Pennsylvania
IL	Illinois	RI	Rhode Island
IN	Indiana	SC	South Carolina
KS	Kansas	SD	South Dakota
KY	Kentucky	TN	Tennessee
LA	Louisiana	TX	Texas
MA	Massachusetts	UT	Utah
MD	Maryland	VA	Virginia
ME	Maine	VT	Vermont
MI	Michigan	WA	Washington
MN	Minnesota	WI	Wisconsin
MO	Missouri	WV	West Virginia
MS	Mississippi	WY	Wyoming

TABLE 3

Agency Codes

		Location
ACGIH	American Conference of Governmental Industrial Hygienists	Cincinnati, Ohio
DFG	Deutsche Forschungsgemeinschaft	Weinheim, Germany
HSE	Health and Safety Executive	London, England
ILO	International Labour Office	Geneva
IRPTC	International Register of Potentially Toxic Chemicals	Geneva
NIOSH	National Institute for Occupational Safety and Health	Cincinnati, Ohio
OSHA	Occupational Safety and Health Administration	Washington, DC
UNEP	United Nations Environment Programme	Nairobi & Geneva
USA (EPA)	United States Environmental Protection Agency	Washington, DC
USA (NIOSH/OSHA)	See Above	
WHO	World Health Organization	Geneva

TABLE 4

Code for Notes Under Workplace Air (from ILO) (1)

ALL	Allergen	IR	Irritant
ASP	Asphyxiant	SEN	Sensitizer
CR	Corrosive	SK	Skin absorption significant
C	Carcinogen		

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