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EPA-450/ -89-

CANCER RISK FROM OUTDOOR EXPOSURE TO AIR TOXICS

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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TABLE 2-6 (concluded)

UNIT RISK FACTORS USED TO COMPARE CANCER RISK

POLLUTANT	EPA CLASSIFICATION[a]	UNIT RISK FACTORS $(\mu g/m3)^{-1}$	REFERENCE
76. 1,1,2,2-Tetrachloroethane	C	$5.8x10^{-5}$	3
77. Thiourea	B2	$5.5x10^{-4}$	3
78. Toxaphene	B2	$3.2x10^{-3}$	3
79. 1,1,2-Trichloroethane	C	$1.6x10^{-5}$	3
80. Trichloroethylene	B2	$1.7x10^{-6}$	2
81. 2,4,6-Trichlorophenol	B2	$5.7x10^{-6}$	3
82. Vinyl chloride	A	$4.1x10^{-6}$	2[c]
83. Vinylidene chloride	C	$5.0x10^{-5}$	1

[a] For a discussion of how EPA evaluates suspect carcinogens and more information on these classifications, refer to "Guidelines for Carcinogen Risk Assessment" (51 Federal Register 33992). The EPA classifications used in this report are:

A = proven human carcinogen

B = probable human carcinogen (B1 indicates limited evidence from human studies; B2 indicates sufficient evidence from animal studies but inadequate evidence from human studies)

C = possible human carcinogen

[b] Based on inhalation study. Oral study suggests a unit risk factor of $3.3x10^{-3}$.

[c] Oral studies suggest a unit risk factor of $4.2x10^{-5}$. U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment. Health Effects Assessment Summary Tables First Quarter FY89. January 1989.

References

1. Integrated Risk Information System.
2. Office of Health and Environmental Assessment.
3. U.S. Environmental Protection Agency. Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards, Volume II - Appendices. Preliminary Draft. March 1988. pp. E-8 through E-13.
4. Draft Supplemental Rule for Hazardous Waste Incinerators. Appendix B, Unit Risks for Carcinogenic Constituents.
5. IEMP-Philadelphia. Developed from EPA's Drinking Water Criteria Document. 3/2/84.
6. U.S. EPA, Office of Solid Waste.
7. Southeast Chicago Study.

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TABLE 3-27

COMPARISON OF UNIT RISK FACTORS

POLLUTANT	May 1985	June 1988	% Change
Acrylamide	1.7×10^{-5}	1.1×10^{-3}	+6400
Benzene	6.9×10^{-6}	8.3×10^{-6}	+20
BaP	3.3×10^{-3}	1.7×10^{-3}	-48
Beryllium	4.0×10^{-4}	2.4×10^{-3}	+500
1,3-Butadiene	4.6×10^{-7}	2.8×10^{-4}	+60770
Cadmium	2.3×10^{-3}	1.8×10^{-3}	-22
Chloroform	1.0×10^{-5}	2.3×10^{-5}	+130
[illegible]	[illegible]	[illegible]	+445
Ethylene dibromide	5.1x10[illegible]	2.2x10[illegible]	-57
Ethylene oxide	3.6×10^{-4}	1.0×10^{-4}	-72
Formaldehyde	6.1×10^{-6}	1.3×10^{-5}	+113
Gasoline vapors	7.5×10^{-7}	6.6×10^{-7}	-12
Methyl chloride	1.4×10^{-7}	3.6×10^{-6}	+2,470
Methylene chloride	1.8×10^{-7}	4.7×10^{-7}	+161
Nickel (subsulfide)	3.3×10^{-4}	4.8×10^{-4}	+45
Perchloroethylene	1.7×10^{-6}	5.8×10^{-7}	-66
Propylene oxide	1.2×10^{-4}	3.7×10^{-6}	-97
Styrene	2.9×10^{-7}	5.7×10^{-7}	+97
Trichloroethylene	4.1×10^{-6}	1.7×10^{-6}	-59
Vinyl chloride	2.6×10^{-6}	4.1×10^{-6}	+58
Vinylidene chloride	4.2×10^{-5}	5.0×10^{-5}	+19

TABLE I. KNOWN HUMAN CARCINOGENS (Continued)

Proposed

Substance	CAS No.[a]	End Use/Processes/Production	Unit Risk Factor[b]	In Maryland[f] (lb/year) Used	Produced	Handled	Total
Tobacco smoke[j]		Malignant tumors of the respiratory tract and upper digestive tract are causally related to smoking various forms of tobacco. Malignant tumors of the bladder, renal pelvis, and pancreas are causally related to smoking cigarettes.[g]					
Treosulphan[j]	299-75-2	Produced only in Denmark since 1969. Used in human medicine for treating ovarian cancer.					
Vinyl chloride	75-01-4	Used in the production of plastics, and the synthesis of other chemicals. Vinyl chloride - vinyl acetate copolymers are used in the manufacture of vinyl asbestos floor tiles. Annual production is about 7 billion pounds for the monomer and 5 billion pounds for the homopolymer.	4.1×10^{-6}				

[a] American Chemical Society Chemical Abstract Service Registry Number. Source used here: Registry of Toxic Effects of Chemical Substances, NIOSH, 1978 edition.

[b] Probability of contracting cancer if exposed to 1 ug/m^3 of a carcinogen for 70 years. Source: Personal Communication, M.A. Haviello to Mike Dusetzina, EPA/OAQPS/PAB. March 1985. These factors are subject to change and should be confirmed with EPA's Carcinogen Assessment Group before use.

[c] Beryllium compounds of commercial importance.

[d] Source for 97 percent of all arsenic products.

[e] Represents 94 percent of U.S. consumption.

[f] Source: Maryland Toxic Substance Registry System - Office of Environmental Programs, Science and Health Advisory Group, Chemical Inventory 1983, Quantity by Chemical for State of Maryland. (Blanks indicate the substance was not included in 1983 survey.)

[g] Source: IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Vol. 1-38. International Agency for Research on Cancer.

[h] Source: The Condensed Chemical Dictionary, Tenth Edition, Van Nostrand Reinhold Company, New York, 1981.

[i] Source: The Merck Index, Ninth Edition, Merck and Company, Rahway, New Jersey, 1976.

[j] Listed by IARC but not by NTP.

[k] Listed by NTP but not by IARC.

Source: (Unless otherwise noted) Third Annual Report on Carcinogens: Summary, National Toxicology Program, U.S. Department of Health and Human Services, September 1983.

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[illegible] ...ng process, the AALs have not been employed as strict ambient exposure standards.

In general, the states have used the AALs as guides, and if the limit for a pollutant is exceeded then the industry and regulatory agency tend to develop a mutually acceptable plan to reduce exposure. One difficulty is that the AALs are often derived by a unit or agency other than that which handles the permitting process (e.g., the Department of Public Health versus the Department of Environmental Protection/Management). The permitting group is usually not firmly bound by the AALs; the AAL is just one of a number of factors to be considered in the permit process, which essentially is a risk management process *(8)*.

Another aspect of the air toxics issue is the implementation of SARA Title 313, which requires reporting of routine emissions (in pounds per year) to communities. What do these numbers mean in terms of human health? Risk communication is likely to be a major challenge for the industries and states, and it is likely that major differences of How this may then affect the derivation of AALs and the permitting process remains to be seen.

In summary, the EPA air toxics strategy has led to the development of a highly decentralized approach for the regulation of air toxics at the state level. This in turn has led to the derivation of highly variable acceptable-exposure guidelines for mutagens, carcinogens, teratogens, and systemic toxicants. Such interstate variability in AALs for toxic substances may lead to differential protection of the public health from air toxics, confuse the public about air pollution and health concerns, and undercut the credibility of public health and environmental regulatory agencies.

It is interesting to note that while EPA encouraged the development of such divergence in air toxics regulatory approaches and implementation at the state level, the Food and Drug Administration funded a National Academy of Sciences (NAS) assessment of the federal process of risk assessment. The goal was to determine if greater consistency could be achieved across agen- regulation of chronic health hazards. This effort resulted in the publication of the highly influential work, *Risk Assessment in the Federal Government: Managing the Process (11)*. A

Thus, while the NAS report addressed the lack of agreement in assessing risk at the federal level and recommended ways to minimize it, EPA was encouraging just the opposite with respect to air toxics regulation at the state level. For example, the NAS committee strongly recommended "that uniform inference guidelines be developed for the use of federal regulatory agencies in the risk assessment process" *(12)*. Although there can be compelling reasons for different emission regulations in different regions and states, EPA should strongly encourage the development of consistent risk assessment methodologies that assist the risk manager in the final decision-making process.

References

(1) Calabrese, E. J. *Methodologic Approaches to Deriving Environmental and Occupational Health Standards;* Wiley: New York, 1978.

TABLE 2
Highest and lowest ambient air levels (AALs) standardized to a 24-h averaging time by compound for representative known and probable human carcinogens, in $\mu g/m^3$ [a]

Compound	Original AAL		Standardized highest AAL	Original AAL		Standardized lowest AAL	Ratio standardized highest/lowest AAL
Acrylonitrile	15	(NY)	257	0.15	(MA)	0.15	1713
Arsenic and compounds as As	0.67	(NY)	11.5	0.0002	(RI)	0.0034	3382
Benzene	100	(NY, RI)	1718	1.2	(MA)	1.2	1432
Epichlorohydrin	33.3	(NY)	572	2.7	(MA)	2.7	212
Ethylene dibromide	1500	(VA)	1500	0.045	(NC)	0.773	1940
Ethylene oxide	450	(IN)	160	0.01	(RI)	0.17	941
Formaldehyde	7.2	(Philadelphia)	123.7	0.77	(MA)	0.77	161
Nickel subsulfide	24	(NV)	8.54	0.0017	(NC)	0.029	294
PCBs	1.67	(NY)	28.7	0.0081	(MA)	0.0081	3543
Vinyl chloride	6.57	(Philadelphia)	112.9	0.038	(NC)	0.65	174

[a]The original AALs and their averaging times were obtained from Reference 4. These substances are all classified in IARC groups 1 or 2A. AALs were standardized to 24-h averaging times for convenience based on information provided in Reference 11. Annual averaging times are in reality more appropriate for chronic endpoints such as carcinogenicity. These figures are highest and lowest standardized AALs; other state and local agencies may have had higher or lower original AALs. When unstandardized highest and lowest AALs are compared, the differences are generally larger.

TABLE 3
Highest and lowest ambient air levels (AALs) standardized to a 24-h averaging time by compound for representative noncarcinogens, in $\mu g/m^3$ [a]

Compound	Original AAL		Standardized highest AAL	Original AAL		Standardized lowest AAL	Ratio standardized highest/lowest AAL
Acetone	35.6	(NY)	611.7	11.8	(CT, SD)	4.2	146
Ammonia	0.36	(NY)	6.186	0.024	(MA)	0.024	258
Ethylene glycol	2.976	(NY)	1.06	0.17	(MA)	0.17	6.2
N-hexane	30	(VA)	30	1.8	(ND)	0.64	47
Napthalene	0.167	(NY)	2.87	0.014	(MA)	0.014	205
Phenol	0.456	(Philadelphia)	7.84	0.095	(IN)	0.034	230
Toluene	7.5	(NY)	128.9	0.051	(MA)	0.051	2527
Xylenes	1.45	(NY)	24.91	0.0592	(MA)	0.0592	421

[a]The original AALs and their averaging times were obtained from Reference 4. Units are standardized to 24 h for comparison, based on information provided in Reference 11. These figures are highest and lowest standardized AALs; other state and local agencies may have had higher or lower original AALs. When unstandardized highest and lowest AALs are compared, the differences are generally larger.