



# Toxicological Profile for Creosote

July 2024



U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

## **DISCLAIMER**

Use of trade names is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry, the Public Health Service, or the U.S. Department of Health and Human Services.

## FOREWORD

This toxicological profile is prepared in accordance with guidelines developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The original guidelines were published in the *Federal Register* on April 17, 1987. Each profile will be revised and republished as necessary.

The ATSDR toxicological profile succinctly characterizes the toxicologic and adverse health effects information for these toxic substances described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a substance's toxicologic properties. Other pertinent literature is also presented, but is described in less detail than the key studies. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced.

The focus of the profiles is on health and toxicologic information; therefore, each toxicological profile begins with a relevance to public health discussion which would allow a public health professional to make a real-time determination of whether the presence of a particular substance in the environment poses a potential threat to human health. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to the protection of public health are identified by ATSDR.

Each profile includes the following:

- (A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a toxic substance to ascertain the levels of significant human exposure for the substance due to associated acute-, intermediate-, and chronic-duration exposures;
- (B) A determination of whether adequate information on the health effects of each substance is available or in the process of development to determine levels of exposure that present a significant risk to human health of acute, intermediate, and chronic health effects; and
- (C) Where appropriate, identification of toxicologic testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

The principal audiences for the toxicological profiles are health professionals at the Federal, State, and local levels; interested private sector organizations and groups; and members of the public.

This profile reflects ATSDR's assessment of all relevant toxicologic testing and information that has been peer-reviewed. Staffs of the Centers for Disease Control and Prevention and other Federal scientists have also reviewed the profile. In addition, this profile has been peer-reviewed by a nongovernmental panel and was made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.



Christopher M. Reh, Ph.D.

Associate Director

Agency for Toxic Substances and Disease Registry  
Centers for Disease Control and Prevention

## VERSION HISTORY

Date	Description
July 2024	Final toxicological profile released
August 2023	Draft for public comment toxicological profile released
September 2002	Final toxicological profile released
August 1996	Final toxicological profile released
December 1990	Final toxicological profile released

## CONTRIBUTORS & REVIEWERS

### CHEMICAL MANAGER TEAM

Breanna Alman, M.P.H. (Lead)  
Obaid Faroon, D.V.M., Ph.D.  
Carolyn Harper, Ph.D.  
Mohammad Shoeb, Ph.D.

Julie M. Klotzbach, Ph.D.  
Jessica L. Myers, Ph.D.  
Gary L. Diamond, Ph.D.  
Mario Citra, Ph.D.

ATSDR, Office of Innovation and Analytics,  
Toxicology Section, Atlanta, GA

SRC, Inc., North Syracuse, NY

### REVIEWERS

#### **Interagency Minimal Risk Level Workgroup:**

Includes ATSDR; National Center for Environmental Health (NCEH); National Institute for Occupational Safety and Health (NIOSH); U.S. Environmental Protection Agency (EPA); National Toxicology Program (NTP).

#### **Additional reviews for science and/or policy:**

ATSDR, Office of Community Health Hazard Assessment; ATSDR, Office of Capacity Development and Applied Prevention Science; ATSDR, Office of Science; NCEH, Division of Laboratory Sciences; NCEH, Division of Environmental Health Science and Practice; EPA, Office of Research and Development; EPA, Office of Water.

### PEER REVIEWERS

1. David Williams, Ph.D.; University Distinguished Professor; Department of Environmental and Molecular Toxicology; Oregon State University; Corvallis, Oregon
2. Robert Herrick, Sc.D.; Harvard School of Public Health; Department of Environmental Health; Boston, Massachusetts
3. Edward Levin, Ph.D.; Professor; Duke University; Durham, North Carolina

These experts collectively have knowledge of toxicology, chemistry, and/or health effects. All reviewers were selected in conformity with Section 104(I)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

ATSDR scientists review peer reviewers' comments and determine whether changes will be made to the profile based on comments. The peer reviewers' comments and responses to these comments are part of the administrative record for this compound.

The listing of peer reviewers should not be understood to imply their approval of the profile's final content. The responsibility for the content of this profile lies with ATSDR.

## CONTENTS

DISCLAIMER .....	ii
FOREWORD .....	iii
VERSION HISTORY .....	iv
CONTRIBUTORS & REVIEWERS .....	v
CONTENTS .....	vi
LIST OF FIGURES .....	viii
LIST OF TABLES .....	ix
CHAPTER 1. RELEVANCE TO PUBLIC HEALTH .....	1
1.1 OVERVIEW AND U.S. EXPOSURES .....	1
1.2 SUMMARY OF HEALTH EFFECTS .....	3
1.3 MINIMAL RISK LEVELS (MRLs) .....	7
CHAPTER 2. HEALTH EFFECTS .....	8
2.1 INTRODUCTION .....	8
2.2 DEATH .....	64
2.3 BODY WEIGHT .....	70
2.4 RESPIRATORY .....	72
2.5 CARDIOVASCULAR .....	75
2.6 GASTROINTESTINAL .....	76
2.7 HEMATOLOGICAL .....	77
2.8 MUSCULOSKELETAL .....	81
2.9 HEPATIC .....	81
2.10 RENAL .....	83
2.11 DERMAL .....	86
2.12 OCULAR .....	88
2.13 ENDOCRINE .....	89
2.14 IMMUNOLOGICAL .....	90
2.15 NEUROLOGICAL .....	92
2.16 REPRODUCTIVE .....	94
2.17 DEVELOPMENTAL .....	96
2.18 OTHER NONCANCER .....	99
2.19 CANCER .....	100
2.20 GENOTOXICITY .....	114
CHAPTER 3. TOXICOKINETICS, SUSCEPTIBLE POPULATIONS, BIOMARKERS, CHEMICAL INTERACTIONS .....	120
3.1 TOXICOKINETICS .....	120
3.1.1 Absorption .....	120
3.1.2 Distribution .....	128
3.1.3 Metabolism .....	131
3.1.4 Excretion .....	138
3.1.5 Physiologically Based Pharmacokinetic (PBPK)/Pharmacodynamic (PD) Models .....	141
3.1.6 Animal-to-Human Extrapolations .....	142
3.2 CHILDREN AND OTHER POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE .....	142
3.3 BIOMARKERS OF EXPOSURE AND EFFECT .....	145

3.3.1	Biomarkers of Exposure.....	146
3.3.2	Biomarkers of Effect.....	147
3.4	INTERACTIONS WITH OTHER CHEMICALS.....	148
CHAPTER 4.	CHEMICAL AND PHYSICAL INFORMATION.....	150
4.1	CHEMICAL IDENTITY.....	150
4.2	PHYSICAL AND CHEMICAL PROPERTIES.....	152
CHAPTER 5.	POTENTIAL FOR HUMAN EXPOSURE.....	163
5.1	OVERVIEW.....	163
5.2	PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL.....	165
5.2.1	Production.....	165
5.2.2	Import/Export.....	168
5.2.3	Use.....	168
5.2.4	Disposal.....	169
5.3	RELEASES TO THE ENVIRONMENT.....	170
5.3.1	Air.....	172
5.3.2	Water.....	175
5.3.3	Soil.....	177
5.4	ENVIRONMENTAL FATE.....	178
5.4.1	Transport and Partitioning.....	179
5.4.2	Transformation and Degradation.....	182
5.5	LEVELS IN THE ENVIRONMENT.....	185
5.5.1	Air.....	187
5.5.2	Water.....	189
5.5.3	Sediment and Soil.....	190
5.5.4	Other Media.....	193
5.6	GENERAL POPULATION EXPOSURE.....	194
5.7	POPULATIONS WITH POTENTIALLY HIGH EXPOSURES.....	197
CHAPTER 6.	ADEQUACY OF THE DATABASE.....	200
6.1	INFORMATION ON HEALTH EFFECTS.....	200
6.2	IDENTIFICATION OF DATA NEEDS.....	200
6.3	ONGOING STUDIES.....	212
CHAPTER 7.	REGULATIONS AND GUIDELINES.....	213
CHAPTER 8.	REFERENCES.....	216
APPENDICES		
APPENDIX A.	ATSDR MINIMAL RISK LEVEL WORKSHEETS.....	A-1
APPENDIX B.	LITERATURE SEARCH FRAMEWORK FOR CREOSOTE.....	B-1
APPENDIX C.	FRAMEWORK FOR ATSDR'S SYSTEMATIC REVIEW OF HEALTH EFFECTS DATA FOR CREOSOTE.....	C-1
APPENDIX D.	USER'S GUIDE.....	D-1
APPENDIX E.	QUICK REFERENCE FOR HEALTH CARE PROVIDERS.....	E-1
APPENDIX F.	GLOSSARY.....	F-1
APPENDIX G.	ACRONYMS, ABBREVIATIONS, AND SYMBOLS.....	G-1

## LIST OF FIGURES

1-1. Origin of Wood Creosotes and Coal Tar Products .....	1
2-1. Overview of the Number of Studies Examining Creosote (Coal Tar Products) Health Effects.....	14
2-2. Overview of the Number of Studies Examining Creosote (Wood Creosotes) Health Effects .....	15
2-3. Levels of Significant Exposure to Coal Tar Products – Inhalation .....	23
2-4. Levels of Significant Exposure to Coal Tar Products – Oral .....	36
2-5. Levels of Significant Exposure to Wood Creosotes – Oral .....	49
3-1. Proposed Metabolic Scheme for Benzo[a]pyrene .....	132
5-1. Number of NPL Sites with Coal Tar Creosote, Coal Tars, and Coal Tar Pitch Contamination.....	163
6-1. Summary of Existing Health Effects Studies on Creosote (Coal Tar Products) by Route and Endpoint .....	201
6-2. Summary of Existing Health Effects Studies on Creosote (Wood Creosotes) by Route and Endpoint .....	202



## LIST OF TABLES

1-1. Minimal Risk Levels (MRLs) for Coal Tar Products .....	7
1-2. Minimal Risk Levels (MRLs) for Wood Creosotes.....	7
2-1. Levels of Significant Exposure to Creosote (Coal Tar Products) – Inhalation.....	16
2-2. Levels of Significant Exposure to Creosote (Coal Tar Products) – Oral.....	29
2-3. Levels of Significant Exposure to Creosote (Wood Creosotes) – Oral .....	43
2-4. Levels of Significant Exposure to Creosote (Coal Tar Products) – Dermal.....	56
2-5. Summary of Studies Evaluating Associations Between Occupational Exposures to Creosote, Coal Tar, Coal Tar Pitch, and Coal Tar Pitch Volatiles and Mortality.....	64
2-6. Hematological Effects in Rodents Exposed to Inhaled Coal Tar Aerosol.....	80
2-7. Summary of Studies Evaluating Developmental Effects in Rodents Exposed to Coal Tar Products .....	97
2-8. Summary of Studies Evaluating Associations Between Occupational Exposures to Creosote, Coal Tar, Coal Tar Pitch, and Coal Tar Pitch Volatiles and Cancer .....	102
2-9. Summary of Studies Evaluating Tumor Response in Rodents Exposed to Creosote Compounds by Inhalation, Oral, and Dermal Routes.....	107
2-10. Genotoxicity of Coal Tar Creosote, Coal Tar, Coal Tar Pitch, or Coal Tar Pitch Volatiles <i>In Vitro</i> .....	115
2-11. Genotoxicity of Coal Tar Creosote, Coal Tar, Coal Tar Pitch, or Coal Tar Pitch Volatiles <i>In Vivo</i> .....	116
4-1. Chemical Identity of Wood Creosote .....	150
4-2. Chemical Identity of Coal Tar Creosote.....	151
4-3. Chemical Identity of Coal Tar .....	151
4-4. Identity of Major Components of Beechwood Creosote .....	153
4-5. Physical and Chemical Properties of Wood Creosote .....	153
4-6. Some Constituents and Weight Percentage of Eight Coal Tar Creosote Mixtures.....	155
4-7. Physical and Chemical Properties of Coal Tar Creosote.....	158
4-8. Identity of PAH Components of Coal Tar Pitch.....	159
4-9. Physical and Chemical Properties of Coal Tar .....	161
5-1. Facilities that Produce, Process, or Use Creosote.....	166

5-2. Manufacturers of EPA Restricted Use Coal Tar Creosote Products.....	167
5-3. Releases to the Environment from Facilities that Produce, Process, or Use Creosote .....	172
5-4. Reported Emissions from the 2017 NEI for Coal Tar .....	175
5-5. Lowest Limit of Detection for PAHs and VOCs in Creosote Mixtures Based on Standards .....	186
5-6. Summary of Environmental Levels of Creosote.....	186
5-7. Coal Tar Creosote Levels in Water, Soil, and Air of National Priorities List (NPL) Sites .....	187
7-1. Regulations and Guidelines Applicable to Coal Tar Creosote, Coal Tar, Coal Tar Pitch, Coal Tar Pitch Volatiles, and Wood Creosote .....	213