

**TOXICOLOGICAL PROFILE FOR  
USED MINERAL-BASED CRANKCASE OIL**

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry

September 1997

## **DISCLAIMER**

The use of company or product name(s) is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry.

## **UPDATE STATEMENT**

Toxicological profiles are revised and republished as necessary, but no less than once every three years. For information regarding the update status of previously released profiles, contact ATSDR at:

Agency for Toxic Substances and Disease Registry  
Division of Toxicology/Toxicology Information Branch  
1600 Clifton Road NE, E-29  
Atlanta, Georgia 30333



## 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 the hazardous substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous 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 public health statement that describes, in nontechnical language, a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. 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 protection of public health are identified by ATSDR and EPA.

Each profile includes the following:

- (A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a hazardous substance to ascertain the levels of significant human exposure for the substance and the associated acute, subacute, and chronic health effects;
- (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, subacute, 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. Staff 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.



David Satcher, M.D., Ph.D.  
Administrator  
Agency for Toxic Substances and  
Disease Registry

\*Legislative Background

The toxicological profiles are developed in response to the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund). Section 211 of SARA also amended Title 10 of the U. S. Code, creating the Defense Environmental Restoration Program. Section 2704(a) of Title 10 of the U. S. Code directs the Secretary of Defense to notify the Secretary of Health and Human Services of not less than 25 of the most commonly found unregulated hazardous substances at defense facilities. Section 2704(b) of Title 10 of the U. S. Code directs the Administrator of the Agency for Toxic Substances and Disease Registry (ATSDR) to prepare a toxicological profile for each substance on the list provided by the Secretary of Defense under subsection (b).

## CONTRIBUTORS

### CHEMICAL MANAGER(S)/AUTHOR(S):

Alfred S. Dorsey Jr., D.V.M.  
ATSDR, Division of Toxicology, Atlanta, GA

Carolyn Rabe, Ph.D.  
Clement International Corporation, Fairfax, VA

Sujatha Thampi, Ph.D.  
Sciences International, Inc., Alexandria, VA

### THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

1. Green Border Review. Green Border review assures the consistency with ATSDR policy.
2. Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.
3. Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific minimal risk levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.



## PEER REVIEW

A peer review panel was assembled for Used Mineral-Based Crankcase Oil. The panel consisted of the following members:

1. Dr. Carson Conaway, Research Scientist, Mahopac, NY
2. Dr. Walter Decker, Private Consultant, El Paso, TX
3. Dr. David Warshawsky, Professor, Department of Environmental Health, University of Cincinnati, Cincinnati, OH

These experts collectively have knowledge of Used Mineral-Based Crankcase Oil's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(i)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.



## CONTENTS

FOREWORD .....	v
CONTRIBUTORS .....	vii
PEER REVIEW .....	ix
LIST OF FIGURES .....	xv
LIST OF TABLES .....	xvii
1. PUBLIC HEALTH STATEMENT .....	1
1.1 WHAT IS USED MINERAL-BASED CRANKCASE OIL? .....	1
1.2 WHAT HAPPENS TO USED MINERAL-BASED CRANKCASE OIL WHEN IT ENTERS THE ENVIRONMENT? .....	3
1.3 HOW MIGHT I BE EXPOSED TO USED MINERAL-BASED CRANKCASE OIL? ...	4
1.4 HOW CAN USED MINERAL-BASED CRANKCASE OIL ENTER AND LEAVE MY BODY? .....	5
1.5 HOW CAN USED MINERAL-BASED CRANKCASE OIL AFFECT MY HEALTH? ..	6
1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO USED MINERAL-BASED CRANKCASE OIL? .....	7
1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH? .....	8
1.8 WHERE CAN I GET MORE INFORMATION? .....	8
2. HEALTH EFFECTS .....	9
2.1 INTRODUCTION .....	9
2.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE .....	11
2.2.1 Inhalation Exposure .....	12
2.2.1.1 Death .....	12
2.2.1.2 Systemic Effects .....	12
2.2.1.3 Immunological and Lymphoreticular Effects .....	18
2.2.1.4 Neurological Effects .....	18
2.2.1.5 Reproductive Effects .....	19
2.2.1.6 Developmental Effects .....	19
2.2.1.7 Genotoxic Effects .....	19
2.2.1.8 Cancer .....	19
2.2.2 Oral Exposure .....	19
2.2.2.1 Death .....	19
2.2.2.2 Systemic Effects .....	20
2.2.2.3 Immunological and Lymphoreticular Effects .....	24
2.2.2.4 Neurological Effects .....	24
2.2.2.5 Reproductive Effects .....	24
2.2.2.6 Developmental Effects .....	24
2.2.2.7 Genotoxic Effects .....	24
2.2.2.8 Cancer .....	25

2.2.3	Dermal Exposure	25
2.2.3.1	Death	25
2.2.3.2	Systemic Effects	25
2.2.3.3	Immunological and Lymphoreticular Effects	32
2.2.3.4	Neurological Effects	33
2.2.3.5	Reproductive Effects	33
2.2.3.6	Developmental Effects	33
2.2.3.7	Genotoxic Effects	33
2.2.3.8	Cancer	35
2.3	TOXICOKINETICS	36
2.3.1	Absorption	37
2.3.1.1	Inhalation Exposure	37
2.3.1.2	Oral Exposure	37
2.3.1.3	Dermal Exposure	38
2.3.2	Distribution	38
2.3.2.1	Inhalation Exposure	39
2.3.2.2	Oral Exposure	39
2.3.2.3	Dermal Exposure	39
2.3.3	Metabolism	40
2.3.4	Excretion	40
2.3.4.1	Inhalation Exposure	40
2.3.4.2	Oral Exposure	40
2.3.4.3	Dermal Exposure	41
2.4	MECHANISMS OF ACTION	41
2.5	RELEVANCE TO PUBLIC HEALTH	43
2.6	BIOMARKERS OF EXPOSURE AND EFFECT	56
2.6.1	Biomarkers Used to Identify or Quantify Exposure to Used Mineral-based Crankcase Oil	58
2.6.2	Biomarkers Used to Characterize Effects Caused by Used Mineral-based Crankcase Oil	58
2.7	INTERACTIONS WITH OTHER SUBSTANCES	59
2.8	POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE	59
2.9	METHODS FOR REDUCING TOXIC EFFECTS	61
2.9.1	Reducing Peak Absorption Following Exposure	61
2.9.2	Reducing Body Burden	62
2.9.3	Interfering with the Mechanism of Action for Toxic Effects	63
2.10	ADEQUACY OF THE DATABASE	64
2.10.1	Existing Information on Health Effects of Used Mineral-based Crankcase Oil	65
2.10.2	Identification of Data Needs	67
2.10.3	On-going Studies	73
3.	CHEMICAL AND PHYSICAL INFORMATION	75
3.1	CHEMICAL IDENTITY	75
3.2	PHYSICAL AND CHEMICAL PROPERTIES	76
4.	PRODUCTION, IMPORT, USE, AND DISPOSAL	79
4.1	PRODUCTION	79
4.2	IMPORT/EXPORT	80

4.3	USE	80
4.4	DISPOSAL	80
5.	POTENTIAL FOR HUMAN EXPOSURE	83
5.1	OVERVIEW	83
5.2	RELEASES TO THE ENVIRONMENT	86
5.2.1	Air	86
5.2.2	Water	88
5.2.3	Soil	89
5.3	ENVIRONMENTAL FATE	90
5.3.1	Transport and Partitioning	90
5.3.2	Transformation and Degradation	95
5.3.2.1	Air	95
5.3.2.2	Water	95
5.3.2.3	Sediment and Soil	96
5.4	LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT	98
5.4.1	Air	98
5.4.2	Water	99
5.4.3	Sediment and Soil	101
5.4.4	Other Environmental Media	102
5.5	GENERAL POPULATION AND OCCUPATIONAL EXPOSURE	103
5.6	POPULATIONS WITH POTENTIALLY HIGH EXPOSURES	104
5.7	ADEQUACY OF THE DATABASE	104
5.7.1	Identification of Data Needs	105
5.7.2	On-going Studies	108
6.	ANALYTICAL METHODS	109
6.1	BIOLOGICAL MATERIALS	109
6.2	ENVIRONMENTAL SAMPLES	114
6.3	ADEQUACY OF THE DATABASE	127
6.3.1	Identification of Data Needs	128
6.3.2	On-going Studies	129
7.	REGULATIONS AND ADVISORIES	131
8.	REFERENCES	145
9.	GLOSSARY	173
APPENDICES		
A.	MINIMAL RISK LEVEL WORKSHEETS	A-1
B.	USER'S GUIDE	B-1
C.	ACRONYMS, ABBREVIATIONS, AND SYMBOLS	C-1



## LIST OF FIGURES

2-1	Levels of Significant Exposure to Used Mineral-based Crankcase Oil - Inhalation . . . . .	15
2-2	Levels of Significant Exposure to Used Mineral-based Crankcase Oil - Oral . . . . .	22
2-3	Existing Information on Health Effects of Used Mineral-based Crankcase Oil . . . . .	66
5-1	Frequency of NPL Sites with Used Mineral-based Crankcase Oil Contamination . . . . .	87



## LIST OF TABLES

2-1	Levels of Significant Exposure to Used Mineral-based Crankcase Oil - Inhalation . . . . .	14
2-2	Levels of Significant Exposure to Used Mineral-based Crankcase Oil - Oral . . . . .	21
2-3	Levels of Significant Exposure to Used Mineral-based Crankcase Oil - Dermal . . . . .	26
2-4	Genotoxicity of Used Mineral-based Crankcase Oil <i>In Vitro</i> . . . . .	53
3-1	Chemical Identity of Used Mineral-based Crankcase Oil . . . . .	77
3-2	Physical and Chemical Properties of Used Mineral-based Crankcase Oil . . . . .	78
6-1	Analytical Methods for Determining Used Mineral-based Crankcase Oil in Biological Materials . . . . .	110
6-2	Analytical Methods for Determining Used Mineral-based Crankcase Oil in Environmental Samples . . . . .	115
7-1	Regulations and Guidelines Applicable to Used Mineral-based Crankcase Oil . . . . .	132