

TOXICOLOGICAL PROFILE FOR
ACRYLONITRILE

Agency for Toxic Substances and Disease Registry
U.S. Public Health Service

December 1990

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.

FOREWORD

The Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) extended and amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund). This public law directed the Agency for Toxic Substances and Disease Registry (ATSDR) to prepare toxicological profiles for hazardous substances which are most commonly found at facilities on the CERCLA National Priorities List and which pose the most significant potential threat to human health, as determined by ATSDR and the Environmental Protection Agency (EPA). The lists of the 250 most significant hazardous substances were published in the Federal Register on April 17, 1987, on October 20, 1988, on October 26, 1989, and on October 17, 1990.

Section 104(i)(3) of CERCLA, as amended, directs the Administrator of ATSDR to prepare a toxicological profile for each substance on the list. Each profile must include the following content:

- (A) An examination, summary, and interpretation of available toxicological information and epidemiological evaluations on the hazardous substance in order 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 which present a significant risk to human health of acute, subacute, and chronic health effects, and
- (C) Where appropriate, an identification of toxicological testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

This toxicological profile is prepared in accordance with guidelines developed by ATSDR and EPA. The original guidelines were published in the Federal Register on April 17, 1987. Each profile will be revised and republished as necessary, but no less often than every three years, as required by CERCLA, as amended.

The ATSDR toxicological profile is intended to characterize succinctly the toxicological and adverse health effects information for the hazardous substance being described. Each profile identifies and reviews the key literature (that has been peer-reviewed) that describes a hazardous substance's toxicological properties. Other pertinent literature is also presented but 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.

Foreword

Each toxicological profile begins with a public health statement, which describes in nontechnical language a substance's relevant toxicological properties. Following the public health statement is information concerning significant health effects associated with exposure to the substance. The adequacy of information to determine a substance's health effects is described. Data needs that are of significance to protection of public health will be identified by ATSDR, the National Toxicology Program (NTP) of the Public Health Service, and EPA. The focus of the profiles is on health and toxicological information; therefore, we have included this information in the beginning of the document.

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 our assessment of all relevant toxicological testing and information that has been peer reviewed. It has been reviewed by scientists from ATSDR, the Centers for Disease Control, the NTP, and other federal agencies. It has also been reviewed by a panel of nongovernment peer reviewers and is being made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.



William L. Roper, M.D., M.P.H.
Administrator
Agency for Toxic Substances and
Disease Registry

CONTENTS

FOREWORD	iii
LIST OF FIGURES	ix
LIST OF TABLES	xi
1. PUBLIC HEALTH STATEMENT	1
1.1 WHAT IS ACRYLONITRILE?	1
1.2 HOW MIGHT I BE EXPOSED TO ACRYLONITRILE?	2
1.3 HOW CAN ACRYLONITRILE ENTER AND LEAVE MY BODY?	2
1.4 HOW CAN ACRYLONITRILE AFFECT MY HEALTH?	2
1.5 WHAT LEVELS OF EXPOSURE HAVE RESULTED IN HARMFUL HEALTH EFFECTS?	3
1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO ACRYLONITRILE?	4
1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?	4
1.8 WHERE CAN I GET MORE INFORMATION?	9
2. HEALTH EFFECTS	11
2.1 INTRODUCTION	11
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	18
2.2.1.3 Immunological Effects	21
2.2.1.4 Neurological Effects	21
2.2.1.5 Developmental Effects	22
2.2.1.6 Reproductive Effects	22
2.2.1.7 Genotoxic Effects	22
2.2.1.8 Cancer	23
2.2.2 Oral Exposure	24
2.2.2.1 Death	24
2.2.2.2 Systemic Effects	33
2.2.2.3 Immunological Effects	36
2.2.2.4 Neurological Effects	36
2.2.2.5 Developmental Effects	37
2.2.2.6 Reproductive Effects	37
2.2.2.7 Genotoxic Effects	38
2.2.2.8 Cancer	38
2.2.3 Dermal Exposure	39
2.2.3.1 Death	39
2.2.3.2 Systemic Effects	39
2.2.3.3 Immunological Effects	39
2.2.3.4 Neurological Effects	41
2.2.3.5 Developmental Effects	41
2.2.3.6 Reproductive Effects	41
2.2.3.7 Genotoxic Effects	41

	2.2.3.8 Cancer	41
2.3	TOXICOKINETICS	41
	2.3.1 Absorption	41
	2.3.1.1 Inhalation Exposure	41
	2.3.1.2 Oral Exposure	41
	2.3.1.3 Dermal Exposure	42
	2.3.2 Distribution	42
	2.3.2.1 Inhalation Exposure	42
	2.3.2.2 Oral Exposure	42
	2.3.2.3 Dermal Exposure	43
	2.3.3 Metabolism	43
	2.3.4 Excretion	46
	2.3.4.1 Inhalation Exposure	46
	2.3.4.2 Oral Exposure	46
	2.3.4.3 Dermal Exposure	46
2.4	RELEVANCE TO PUBLIC HEALTH	47
2.5	BIOMARKERS OF EXPOSURE AND EFFECT	54
	2.5.1 Biomarkers Used to Identify and/or Quantify Exposure to Acrylonitrile	55
	2.5.2 Biomarkers Used to Characterize Effects Caused by Acrylonitrile	55
2.6	INTERACTIONS WITH OTHER CHEMICALS	56
2.7	POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE	57
2.8	ADEQUACY OF THE DATABASE	57
	2.8.1 Existing Information on the Health Effects of Acrylonitrile	57
	2.8.2 Identification of Data Needs	59
	2.8.3 On-going Studies	62
3.	CHEMICAL AND PHYSICAL INFORMATION	67
	3.1 CHEMICAL IDENTITY	67
	3.2 PHYSICAL AND CHEMICAL PROPERTIES	67
4.	PRODUCTION, IMPORT, USE, AND DISPOSAL	71
	4.1 PRODUCTION	71
	4.2 IMPORT	71
	4.3 USE	71
	4.4 DISPOSAL	72
5.	POTENTIAL FOR HUMAN EXPOSURE	73
	5.1 OVERVIEW	73
	5.2 RELEASES TO THE ENVIRONMENT	73
	5.2.1 Air	73
	5.2.2 Water	75
	5.2.3 Soil	75
	5.3 ENVIRONMENTAL FATE	75
	5.3.1 Transport and Partitioning	75
	5.3.2 Transformation and Degradation	76
	5.3.2.1 Air	76
	5.3.2.2 Water	77
	5.3.2.3 Soil	78

5.4	LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT	78
5.4.1	Air	78
5.4.2	Water	78
5.4.3	Soil	79
5.4.4	Other Media	79
5.5	GENERAL POPULATION AND OCCUPATIONAL EXPOSURE	80
5.6	POPULATIONS WITH POTENTIALLY HIGH EXPOSURES	80
5.7	ADEQUACY OF THE DATABASE	80
5.7.1	Identification of Data Needs	82
5.7.2	On-going Studies	83
6.	ANALYTICAL METHODS	85
6.1	BIOLOGICAL MATERIALS	85
6.2	ENVIRONMENTAL SAMPLES	85
6.3	ADEQUACY OF THE DATABASE	87
6.3.1	Identification of Data Needs	87
6.3.2	On-going Studies	89
7.	REGULATIONS AND ADVISORIES	91
8.	REFERENCES	95
9.	GLOSSARY	125
	APPENDIX	129

000000
000000

000000
000000
000000

000000

000000

000000

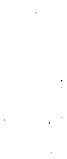
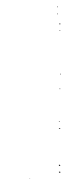
000000

000000
000000

000000

LIST OF FIGURES

2-1	Levels of Significant Exposure to Acrylonitrile - Inhalation	16
2-2	Levels of Significant Exposure to Acrylonitrile - Oral	30
2-3	Metabolic Scheme for Acrylonitrile	44
2-4	Existing Information on Health Effects of Acrylonitrile	58
5-1	Frequency of Sites with Acrylonitrile Contamination	74



LIST OF TABLES

1-1	Human Health Effects from Breathing Acrylonitrile	5
1-2	Animal Health Effects from Breathing Acrylonitrile	6
1-3	Human Health Effects from Eating or Drinking Acrylonitrile	7
1-4	Animal Health Effects from Eating or Drinking Acrylonitrile	8
2-1	Levels of Significant Exposure to Acrylonitrile - Inhalation	13
2-2	Levels of Significant Exposure to Acrylonitrile - Oral	25
2-3	Levels of Significant Exposure to Acrylonitrile - Dermal	40
2-4	Genotoxicity of Acrylonitrile <u>In Vitro</u>	51
2-5	Genotoxicity of Acrylonitrile <u>In Vivo</u>	53
2-6	On-going Studies on Acrylonitrile	63
3-1	Chemical Identity of Acrylonitrile	68
3-2	Physical and Chemical Properties of Acrylonitrile	69
5-1	Estimated Levels of Human Exposure to Acrylonitrile for Nonoccupational and Occupational Exposure	81
6-1	Analytical Methods for Determining Acrylonitrile in Biological Materials	86
6-2	Analytical Methods for Determining Acrylonitrile in Environmental Samples	88
7-1	Regulations and Guidelines Applicable to Acrylonitrile	92

