
CONTENTS

ENVIRONMENTAL HEALTH CRITERIA FOR SELECTED SYNTHETIC ORGANIC FIBRES

INTRODUCTION	11
1. SUMMARY	13
1.1 Identity, physical and chemical properties	13
1.2 Sources of human and environmental exposure	14
1.3 Environmental levels and human exposure	14
1.4 Deposition, clearance, retention, durability and translocation	15
1.5 Effects on experimental animals and <i>in vitro</i> test systems	15
1.6 Effects on humans	17
1.7 Summary of evaluation	17
2. IDENTITY, PHYSICAL AND CHEMICAL PROPERTIES, AND ANALYTICAL METHODS	18
2.1 Identity, physical and chemical properties	18
2.1.1 Carbon/graphite fibres	18
2.1.2 Aramid fibres	19
2.1.3 Polyolefin fibres	22
2.2 Production methods	25
2.2.1 Carbon/graphite fibres	25
2.2.2 Aramid fibres	25
2.2.3 Polyolefin fibres	27
2.3 Sampling and analytical methods	27
3. SOURCES OF HUMAN AND ENVIRONMENTAL EXPOSURE	29
3.1 Production	29
3.1.1 Carbon/graphite fibres	29
3.1.2 Aramid fibres	29
3.1.3 Polyolefin fibres	30
3.2 Uses	30
3.2.1 Carbon/graphite fibres	30
3.2.2 Aramid fibres	31
3.2.3 Polyolefin fibres	31
3.3 Emissions into the environment	32
3.3.1 Fibre emissions	32

3.3.2 Decomposition products	33
4. ENVIRONMENTAL LEVELS AND HUMAN EXPOSURE	35
4.1 Occupational environment	35
4.1.1 Carbon/graphite fibres	35
4.1.1.1 Production	35
4.1.1.2 Processing of composites	35
4.1.2 Aramid fibres	39
4.1.2.1 Production	39
4.1.2.2 End-use processing and processing of composites	39
4.1.3 Polyolefin	42
4.1.3.1 Production	42
4.2 General environment	42
5. DEPOSITION, CLEARANCE, RETENTION, DURABILITY AND TRANSLOCATION	44
5.1 Introduction	44
5.2 Studies in experimental animals	47
5.2.1 Carbon/graphite fibres	47
5.2.2 Aramid fibres	48
5.2.3 Polyolefins	49
5.3 <i>In vitro</i> solubility studies	50
6. EFFECTS ON EXPERIMENTAL ANIMALS, AND <i>IN VITRO</i> TEST SYSTEMS	51
6.1 Experimental animals	51
6.1.1 Introduction	51
6.1.2 Carbon/graphite fibres	53
6.1.2.1 Inhalation	53
6.1.2.2 Intratracheal administration	54
6.1.2.3 Intraperitoneal administration	56
6.1.2.4 Dermal administration	56
6.1.3 Aramid fibres	56
6.1.3.1 Inhalation	56
6.1.3.2 Intratracheal administration	63
6.1.3.3 Intraperitoneal administration	63
6.1.4 Polyolefin fibres	66
6.1.4.1 Inhalation	66
6.1.4.2 Intratracheal administration	67
6.1.4.3 Intraperitoneal administration	67

6.2	<i>In vitro</i> studies	68
6.2.1	Carbon fibres	68
6.2.2	Aramid fibres	69
6.2.3	Polyolefin fibres	69
7.	EFFECTS ON HUMANS	71
7.1	Carbon/graphite fibres	71
7.2	Aramid fibres	72
8.	EVALUATION OF HUMAN HEALTH RISKS	73
8.1	Exposure	73
8.2	Health effects	74
9.	CONCLUSIONS AND RECOMMENDATIONS FOR PROTECTION OF HUMAN HEALTH	76
10.	FURTHER RESEARCH	77
10.1	Sampling and analytical methods	77
10.2	Exposure measurement and characterization	77
10.3	Human epidemiology	77
10.4	Toxicology studies	78
REFERENCES		79
APPENDIX 1.	SUMMARY OF PATHOLOGY WORKSHOP ON THE LUNG EFFECTS OF PARA-ARAMID FIBRILS AND TITANIUM DIOXIDE	84
RESUME		87
RESUMEN		94