

TABLE OF CONTENTS

<i>Chapter</i>	<i>Page</i>
LIST OF FIGURES	xiv
LIST OF TABLES	xiv
1. INTRODUCTION	1-1
2. NATURE, SOURCES, AND PRINCIPLES OF CONTROL OF ATMOSPHERIC HYDROCARBON	2-1
A. INTRODUCTION	2-1
B. HYDROCARBON CLASSES	2-1
C. HYDROCARBON ATMOSPHERIC REACTIONS	2-2
1. General Discussion	2-2
2. Expected Photooxidation Products	2-5
a. Commonly Recognized Products in Photochemical Air Pollution	2-5
b. Products of Photooxidation of Hydrocarbons in Experimental Studies	2-6
D. ESTIMATION OF HYDROCARBON EMISSIONS	2-10
1. Emission Levels of Hydrocarbons from Natural Sources	2-10
2. Emission Levels of Hydrocarbons from Technological Sources	2-12
a. National Emission Estimates	2-12
b. Regional Emission Estimates	2-13
3. Technological Sources of Hydrocarbons	2-13
a. Carbureted Gasoline Engines	2-14
b. Diesel Engines	2-14
c. Gas Turbines and Aircraft Jet Engines	2-15
d. Stationary Sources	2-15
4. Emission Factors	2-15
E. PRINCIPLES OF HYDROCARBON EMISSION CONTROL	2-16
1. General Principles of Control	2-16
2. Motor Vehicle Controls	2-16
a. Present Controls	2-16
b. Proposed Controls	2-16
3. Stationary Source Control	2-17
a. Evaporation Emission Controls	2-17
b. Control by Incineration	2-17
c. Control by Adsorption	2-17
d. Control by Absorption	2-17
e. Control by Condensation	2-17
f. Control by Substitution of Materials	2-17
F. SUMMARY	2-17
G. REFERENCES	2-18
3. ATMOSPHERIC LEVELS OF HYDROCARBONS AND THEIR RELATED PRO- DUCTS	3-1
A. INTRODUCTION	3-1
B. HYDROCARBONS	3-1
1. Hydrocarbons in Ambient Air	3-2

<i>Chapter</i>	<i>Page</i>
2. Diurnal Variation	3-3
3. Seasonal Variation	3-3
4. Community Levels	3-4
C. SECONDARY CONTAMINANTS	3-9
1. Aldehydes	3-9
2. Aerosols	3-10
D. SUMMARY	3-12
E. REFERENCES	3-14
4. GENERAL STANDARDIZATION AND ANALYSIS METHODS	4-1
A. INTRODUCTION	4-1
B. CALIBRATION TECHNIQUES	4-1
1. Dynamic	4-1
2. Static	4-2
C. METHODS FOR ANALYSIS OF TOTAL HYDROCARBONS	4-2
1. Flame Ionization	4-2
2. Spectrophotometric Methods	4-2
D. METHODS FOR ANALYSIS OF SPECIFIC HYDROCARBONS	4-2
1. Subtractive Columns	4-2
a. Nomenthane Hydrocarbons	4-2
b. Reactive Hydrocarbons	4-3
2. Gas Chromatography	4-3
3. Spectrometric Methods	4-3
4. Methods for Olefins	4-4
E. METHODS FOR ANALYSIS OF GASEOUS ALDEHYDES AND KETONES	4-4
1. General	4-4
2. Bisulfite Method	4-4
3. Other Condensation Reagents	4-4
F. SAMPLE COLLECTION AND HANDLING	4-4
G. AEROSOL MEASUREMENTS	4-5
H. SUMMARY	4-5
I. REFERENCES	4-5
5. RELATIONSHIP OF ATMOSPHERIC HYDROCARBONS TO PHOTOCHEMICAL AIR POLLUTION LEVELS	5-1
A. INTRODUCTION AND GENERAL DISCUSSION	5-1
B. ANALYSIS OF AEROMETRIC DATA	5-2
C. SUMMARY	5-11
D. REFERENCES	5-12
6. EFFECTS OF HYDROCARBONS AND CERTAIN ALDEHYDES ON VEGETATION	6-1
A. INTRODUCTION	6-1
B. RELATIVE IMPORTANCE OF HYDROCARBON GASES IN CAUSING IN- JURY TO VEGETATION	6-1
C. EFFECTS OF ATMOSPHERIC ALDEHYDES ON VEGETATION	6-2
D. SYMPTOMS OF EFFECTS OF ETHYLENE ON VEGETATION	6-3
E. ESTIMATES OF ECONOMIC LOSS (DAMAGE) ASSOCIATED WITH ETHYL- ENE INJURY TO VEGETATION	6-4
F. DOSE-INJURY RELATIONSHIPS FOR VARIOUS PLANTS EXPOSED TO ETHYLENE.	6-4

<i>Chapter</i>	<i>Page</i>
G. NEED FOR FURTHER RESEARCH	6-7
H. SUMMARY	6-7
I. REFERENCES	6-7
7. TOXICOLOGICAL APPRAISAL OF HYDROCARBONS AND ALDEHYDES	7-1
A. INTRODUCTION	7-1
B. TOXICOLOGY OF HYDROCARBON COMPOUNDS	7-1
1. General Discussion	7-1
2. Aliphatic Hydrocarbons	7-1
3. Alicyclic Hydrocarbons	7-2
4. Aromatic Hydrocarbons	7-2
5. Summary	7-2
C. TOXICOLOGY OF ALDEHYDES	7-2
1. General Discussion	7-2
2. Mechanisms of Toxicity	7-7
a. Primary Irritation of the Skin, Eyes, and Respiratory Mucosa	7-7
b. Sensitization	7-7
c. Anesthesia	7-7
d. Pathological Effects	7-7
3. Formaldehyde and Acrolein	7-8
a. General Discussion	7-8
b. Formaldehyde	7-8
c. Acrolein	7-12
d. Sensory Physiology and Central Nervous System Responses	7-15
4. Acetaldehyde and Other Aldehydes	7-16
5. Summary	7-18
D. HYDROCARBON-MIXED ATMOSPHERE EXPERIMENTATION	7-18
1. Introductory Discussion	7-18
2. Changes in Pulmonary Function	7-19
3. Eye Irritation	7-20
4. Summary	7-26
a. Pulmonary Function	7-26
b. Eye Irritation	7-26
E. SUMMARY	7-27
F. REFERENCES	7-28
8. SUMMARY AND CONCLUSIONS	8-1
A. INTRODUCTION	8-1
B. SOURCES, NATURE, AND PRINCIPLES OF CONTROL OF ATMOSPHERIC HYDROCARBONS	8-1
C. ATMOSPHERIC LEVELS OF HYDROCARBONS AND THEIR RELATED PRODUCTS	8-1
D. SAMPLING AND STANDARDIZATION METHODS FOR MEASUREMENT OF HYDROCARBONS	8-2
E. RELATIONSHIP OF ATMOSPHERIC HYDROCARBONS TO PHOTO-CHEMICAL AIR POLLUTION LEVELS	8-2
F. EFFECTS OF HYDROCARBONS AND CERTAIN ALDEHYDES ON VEGETATION	8-3

Chapter

Page

G. TOXICOLOGICAL APPRAISAL OF HYDROCARBONS AND ALDEHYDES . . .	8-3
H. CONCLUSIONS	8-4
I. RESUME	8-5
APPENDIX	A-1
SUBJECT INDEX	I-1