

CONTENTS

Preface.....	IX
1. SCOPE OF THE PROBLEM.....	1
1.1 History and Background.....	1
1.2 Methodological Questions.....	4
REFERENCES.....	6
2. CRITERIA FOR THE SAMPLING PROCESS.....	7
2.1 Requirements.....	7
2.1.1 General Discussion.....	7
2.1.2 Criteria for Sampling.....	9
2.1.3 Sample Types and Sampling Problem.....	10
2.2 Problems of Sampling and Post-Samples.....	12
2.3 Regulations.....	13
2.4 Standards.....	14
2.4.1 Discussion.....	14
2.4.2 Availability and Source of Samples and Supplies.....	16
REFERENCES.....	22
3. SAMPLING TECHNIQUES.....	25
3.1 Introduction.....	25
3.2 Background and General Discussion.....	26
3.2.1 Theory and Statistical Foundation of Sampling.....	29
3.2.1.1 Significance and Rejection of Data.....	35
3.2.1.2 Reliability and/or Confidence in Analytical Data.....	36
3.2.2 Aerosols.....	37
3.2.3 Gases and Vapors.....	40
3.2.3.1 Flow Measurements.....	41
3.2.3.2 Volume Measurements.....	42
3.2.4 Liquids.....	42
3.2.5 Sampling Proportional to Time and Flow.....	43
3.2.6 Solids.....	44
3.2.6.1 Soils.....	45
3.2.6.2 Particulates.....	46
3.3 Grab Sampling.....	49
3.3.1 Air.....	49
3.3.2 Liquids.....	54
3.3.2.1 Composite Sampling.....	55
3.3.2.2 Continuous Sampling.....	56
3.3.3 Stack Sampling.....	56
3.4 Adsorption Techniques.....	59
3.4.1 Gases.....	60
3.4.2 Water.....	68
3.5 Chemical Reaction Techniques.....	69
3.6 Freeze-Out or Cryogenic Techniques.....	72
3.7 Trapping Techniques.....	74
3.8 Dipping Techniques and Tube Sampling.....	77
3.9 Headspace Sampling.....	78
REFERENCES.....	79
4. SAMPLE TREATMENT.....	87
4.1 Introduction.....	87
4.2 Storage of Samples.....	87
4.3 Extraction Techniques.....	88
4.3.1 Liquid-Liquid Extraction.....	91

4.3.1.1	Macro-Liquid-Liquid Extractions.....	91
4.3.1.2	Micro-Liquid-Liquid Extractions.....	94
4.3.2	Gas-Liquid Extraction.....	95
4.3.2.1	Headspace and/or Vapor Equilibration.....	98
4.3.2.1.1	Preparation of Gas Standard Mixtures.....	108
4.3.2.1.2	Error Involved When Preparing a Binary Gas Mixture.....	109
4.3.2.2	Purging, Sparging and/or Vapor Stripping.....	109
4.3.2.3	Change in Ionic Strength of Sample Solution.....	111
4.4	Clean-up.....	112
4.5	Derivatization.....	120
	REFERENCES.....	129
5.	THE USE OF GAS CHROMATOGRAPHY IN ENVIRONMENTAL ANALYSIS.....	137
5.1	Introduction.....	137
5.2	Standards and Calibration.....	137
5.2.1	Volume Measurement and Standards for Air Samples.....	141
5.2.2	Volume Measurement and Standards for Water Samples.....	147
5.3	Sample Introduction Onto the Column.....	147
5.3.1	Syringe Injection.....	149
5.3.2	Gas Sampling Valves.....	149
5.3.3	Automatic Sample Injection.....	150
5.3.4	Miscellaneous Injection Systems.....	150
5.4	Columns and Column Selection for Separation and Analysis.....	151
5.5	Detection of Sample Components.....	154
5.6	Qualitative and Quantitative Information.....	157
5.6.1	Qualitative Analysis by Gas Chromatography.....	157
5.6.1.1	Retention Data.....	158
5.6.1.2	Retention Index.....	159
5.6.1.3	Auxiliary Techniques.....	160
5.6.2	Quantitative Analysis by Gas Chromatography.....	161
5.7	Analysis of Air and Water Contaminants.....	165
	REFERENCES.....	171
6.	USE OF LIQUID CHROMATOGRAPHY IN ENVIRONMENTAL ANALYSIS.....	187
6.1	Standards and Calibration.....	187
6.2	Sample Introduction Onto the Column.....	187
6.2.1	Syringe Injection.....	187
6.2.2	Valve Injection.....	188
6.3	Selection of Separation Conditions.....	188
6.3.1	Water Soluble Samples.....	190
6.3.2	Organic Soluble Samples.....	190
6.3.3	Thin-Layer Chromatography (TLC) Screening.....	191
6.3.4	Guard Columns and Precolumns.....	191
6.3.5	Applications.....	192
6.4	Detection of Sample Components.....	196
6.4.1	Refractive Index Detector.....	196
6.4.2	Ultraviolet Absorption Detector.....	197
6.4.3	LC-GC Detectors.....	197
6.4.4	Infrared Detectors.....	198
6.4.5	Fluorescence Detectors.....	198
6.4.6	Electrochemical Detector.....	198
6.4.7	Thermal Energy Detector.....	198
6.4.8	Conductivity Detector.....	199
6.4.9	Derivatives.....	199
	REFERENCES.....	200

7.	SAFETY IN THE CHROMATOGRAPHY LABORATORY.....	202
7.1	Hazardous Materials.....	202
7.1.1	Types.....	202
7.1.2	Use, Disposal and Storage of Hazardous Materials.....	204
7.1.3	Compressed Gases.....	206
7.2	Personal Protection.....	208
7.2.1	Protective Devices.....	208
7.2.2	Housekeeping.....	210
7.3	Safety Literature.....	211
7.3.1	Books and Pamphlets.....	211
7.3.2	Journals and Papers.....	211
7.3.3	Films and Audiovisual Presentations.....	212
7.3.4	Miscellaneous.....	212
	REFERENCES.....	212
8.	REGULATIONS, REGULATORY AND ADVISORY GROUPS.....	213
8.1	Governmental Agencies, Legislation, and Related Groups.....	213
8.1.1	International Organizations.....	213
8.1.1.1	UNEP (United Nations Environment Program).....	213
8.1.1.2	WHO (World Health Organization).....	213
8.1.1.3	CEC (Council of European Communities).....	213
8.1.2	National Organizations.....	213
8.1.2.1	Canada.....	213
8.1.2.2	Austria.....	216
8.1.2.3	Belgium.....	217
8.1.2.4	Denmark.....	219
8.1.2.5	Federal Republic of Germany.....	219
8.1.2.6	France.....	220
8.1.2.7	Iceland.....	220
8.1.2.8	Ireland.....	220
8.1.2.9	Italy.....	220
8.1.2.10	Luxembourg.....	221
8.1.2.11	The Netherlands.....	221
8.1.2.12	Norway.....	221
8.1.2.13	Sweden.....	221
8.1.2.14	Switzerland.....	221
8.1.2.15	Japan.....	222
8.1.2.16	United States of America.....	222
8.1.2.17	U.S.S.R.....	225
8.1.2.18	Australia.....	226
8.1.2.19	Israel.....	226
8.1.2.20	Mexico.....	226
8.1.2.21	New Zealand.....	226
8.1.2.22	South Africa.....	226
8.2	Literature.....	226
8.2.1	Scientific Journals and Periodicals.....	226
8.2.2	Scientific Books.....	228
8.2.3	Regulatory Information Sources.....	229
8.2.4	Other Sources.....	229
	APPENDIX I: The Determination of Adsorption-Desorption Efficiency of Chromatographic Traps.....	231
	APPENDIX II: Comparison of Modes of Sample Introduction in Capillary Gas Chromatography.....	233
	SUBJECT INDEX.....	235