

Table of Contents

Brief .	About Air Pollution Control	1
1.1	How Air Pollution can Affect Us	3
1.2	Rules and Regulations for Air Pollution Control in the US	4
	1.2.1 Studies and Research Done for Air Pollution Control	
	in the USA	4
1.3	Revolutionary Years in U.S. Environmental Protection	
	Act - 1969-1970	6
1.4	Policies for Removal of Polluted Air and Gas Emission	8
1.5	Various Problems Raised Due to Air Pollution	10
1.6	Dispersion of Air Pollution and Vehicular Transmission	12
1.7	Measurement Scales for Determining Air Quality	13
Refer	ences	17

How A	Air Pollution Can Affect Us	19
2.	The Effects of Air Pollution	20
	2.1.1 Environmental Degradation	20
	2.1.2 Economy	23
	2.1.3 Human Health	24
2.2	2 Air Pollution Effects on Our Body	24
	A) Lungs	24
	B) Heart	25
	C) Brain	25
2.3	3 Air Pollution Leading to Various Illnesses	26
	A) Epilepsy	26
	B) Dementia and Alzheimer's Disease	27
	C) Autism and Schizophrenia	27
2.4	· ·	27
	A) Preterm Birth	28
	B) Women's Reproductive System	28
	C) Men's Reproductive Health	28
2.5	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	29
	2.5.1 How to control the haze?	30
2.6		31
Ref	ferences	31
Philos	sophies, Laws and Regulations to Control	
Air Po	llution	34
3.1	1 What Does The Government Do To Keep Air Pollution	
	in Control?	35
3.2	2 US Air Pollution Control Through Rules and Regulations	36
	3.2.1 Regulatory Details	36
	3.2.2 Fundamental Philosophies For Air Pollution Control	41
Ref	ferences	49
Air Po	llution Measurements, Emission Estimates	51
		51
	4.1 What is Air Quality Index?4.2 A Representative Sample	
4.2	4.2.1 Passive sampling	53 53
	4.2.1 Fassive sampling 4.2.2 Active Sampling	54
	4.2.3 Automatic Methods	54
4 3		5 <u>4</u>

Table of Contents		xi	
4.4	Standard Methods for Emission Estimation	55	
	4.4.1 Continuous Emission Monitoring System (CEMS)	55	
	4.4.2 Predictive Emission Monitoring System (PEMS)	56	
	4.4.3 Stack Sampling	56	
	4.4.4 Fuel Analysis	57	
	4.4.5 Emission Factors	57	
	4.4.6 Isokinetic Sampling	58	
4.5		58	
	4.5.1 Ways To Measure Visible Emissions	59	
Refe	rences	60	
Meteor	ology for Air Pollution Control Engineers	63	
5.1	Meteorological Aspects Which Affects The Pollutants		
	Concentration	64	
	5.1.1 The Atmosphere	64	
	5.1.2 Horizontal Atmospheric Motion	65	
	5.1.3 Vertical Motion in the Atmosphere	67	
	5.1.4 Meteorology of Winds	68	
	5.1.5 Temperature Inversions and Reversals	69	
5.2	What is Fumigation?	70	
	How does it help in the plantation?	70	
5.3	Meteorological and Weather Forecasts	70	
Refe	rences	71	
Models	to Check Air Pollution Concentration	75	
6.1	Types of Air Pollutants	76	
6.2	Various Air Quality Models	77	
	6.2.1 Fixed Box Models	77	
	6.2.2 Dispersion Models	78	
	6.2.3 Plume Rise Model	78	
6.3	Gaussian Plume Models	81	
	Parameters of the Gaussian Plume Model:	82	
	Mathematical equation for Gaussian plume diffusion model:	82	
6.4	Creation of Pollutants and Decay in the Atmosphere	84	
	Acid rain:	87	
	Global warming:	88	
	Other factors:	88	
6.5	Multiple Cell Model	88	
	Assumptions of the model:	88	

	6.6	Air Pollution Models Based on Receptors	89	
		Mathematically,	89	
	6.7	Source Oriented Air Pollution Models	90	
	6.8	Advantages of Air Pollution Modeling	90	
	6.9	Disadvantages of Air Pollution Modeling	91	
	Refer	rences	91	
C	General	l Ideas To Control Air Pollution	94	
	7.1	Resource Recovery	96	
	7.2	Fate of Pollutants	96	
	7.3	Minimizing Volumetric Flow-rate and Pressure Drop	97	
	7.4	A Brief About Penetration, Efficiency, Nine	98	
	7.5	Homogenous and Non-Homogenous Pollutants	99	
	7.6	Basing Calculations on Inert Flow Rates	100	
	7.7	A Brief About Combustion	101	
		7.7.1 Heat of combustion	102	
		7.7.2 Limits of combustion or explosion	102	
	7.8	How Volumetric Flow Rate Changes?	102	
	7.9	What is Acid Dew Point?	103	
	7.10	Catalysts for Air Pollution Control	105	
	7.11	Ways to Control Air Pollution	106	
		7.11.1 Controlling the particulate matter	106	
		7.11.2 Cyclones	106	
		7.11.3 Electrostatic Precipitators	107	
		7.11.4 Scrubbers	109	
		7.11.5 Baghouse Filters	110	
	Refer	rences	112	
E	ssentia	al Attributes of Particulate Pollutants	115	
	8.1	A Brief About Primary and Secondary PM (Particulate Matter)	117	
	8.2	What are Settling Velocity and Drag Forces?	118	
	8.3	What are Particle Size Distribution Functions?	120	
	8.4	Particles in Our Bodies	121	
	8.5	Secondary Fine Particles	122	
	8.6	How Particles Behave in the Atmosphere?	123	
		8.6.1 Atmospheric Particulate Matter	123	
	8.7	How Can Particulate Matter Affect Your Health?	125	
	8.8	Effect on Climate	126	
	References			

Table of C	Contents		xiii
Elimina	tion of	Primary Particulates	128
9.1	Wall Co	llection Devices	129
9.2	Devices	to Control Emissions	130
	9.2.1	Absorption and Wet Scrubbing Equipment	131
	9.2.2	Adsorption	133
	9.2.3	Fabric Filters or Baghouses	134
	9.2.4	Catalytic Reactors	136
	9.2.5	Cyclones	137
	9.2.6	Electrostatic precipitators (ESPS)	137
	9.2.7	Incinerators	138
	9.2.8	Biofilters	139
9.3	How to Ch	noose a Collector	140
	9.3.1	Performance	140
	9.3.2	Size of a Control Device	141
	9.3.3	Instrumentation	141
	9.3.4	Power input	141
	9.3.5	Accessibility	141
	9.3.6		142
	9.3.7	Abrasion	142
	9.3.8	Moisture and freezing	142
	9.3.9	,	142
		Solid Removal Equipments	142
	9.3.11		143
		System operation and maintenance	143
		Prevention maintenance	143
		Recordkeeping	143
	9.3.15	Training	144
Refe	rences		144
		l Volatile Organic Compounds	
(VOCs)	in the A	Atmosphere	149
10.1	A Brief	About Volatile Organic Compounds (VOC)	150
	10.1.1	Source of VOCs?	151
	10.1.2	Are they harmful?	152
	10.1.3	How it affects children's health?	153
10.2	How atr	nosphere gets affected with VOCs	153
10.3	What is	Vaporization?	154
	Factors	Affecting the Rate of Vaporization	155

10.	4 What are Mobile Source Problems?	155
	10.4.1 Imposing Danger	155
	10.4.2 Toxic Emissions	156
	10.4.3 Realizing our Duty	156
10.	5 Preventive Methods	157
	10.5.1 Vapor pressure and evaporation	157
	10.5.2 Preventing the release of Volatile organic compounds	157
	10.5.3 Adsorption	158
	10.5.4 Condensation	159
	10.5.5 Cryogenic Condensation	159
	10.5.6 Gas absorption	160
	10.5.7 Control by Oxidation	160
Refe	erences	161
How to	o Control Sulfur Oxides	166
11.	Details about the Sulfur Problem	166
	11.1.1 Oxides of Sulfur	167
	11.1.2 Sulfur Oxides and their Negative Affects	167
11.	2 How to Control Sulfur Oxides and Pollution?	169
	11.2.1 Choice of Fuel and Cleaning	169
	11.2.2 Technology and Modifications	170
11.	3 How to Remove Sulfur Compounds from Natural Gas	
	and Petroleum Emissions	170
	11.3.1 Methods Used For The Removal of Sulfur	171
	11.3.2 Reduction of Sulfur From Natural Gas Streams	172
11.	4 How to Remove SO ₂ from the Lean Waste Gases	173
	11.4.1 Tail-Gas from Industrial Sources	173
	11.4.2 Flue Gas Cleaning Technology	173
	11.4.3 Limestone Scrubbing	174
11.	5 How to Remove SO ₂ from Rich Waste Gases	175
	11.5.1 What is the cause that SO ₂ is posing a threat on	
	the environment?	175
	11.5.2 Methods to Remove SO ₂	176
11.	6 Control Technologies for SO ₂	176
	11.6.1 Control Technologies	177
Refe	erences	178

ΧV

How to	Contro	l Nitrogen Oxides	181
12.1	A Brief	About Nitrogen Oxide	181
12.2	Nitroge	n Oxide - A Big Problem	182
12.3	Major S	ources of NO _x Formation During Combustion	184
	12.3.1	Thermal NO_x	184
	12.3.2	Prompt NOX	186
	12.3.3	Fuel NO _x	188
12.4	Sources	of Nitrogen Oxides (NO _x) Emissions	190
	12.4.1	Natural Sources	190
	12.4.2	Human Source	190
12.5	Control	ling Nitrogen Oxide Emissions	191
	12.5.1	Decrease in Temperature	191
		Reducing Residence Time	192
	12.5.3	Chemical Reduction of NO_{χ}	192
		Oxidation of Nitrogen Oxides	192
		Removal of Nitrogen from Combustion	192
	12.5.6	Sorption: Adsorption and Absorption	193
	. —	Combination of these Methods	193
12.6		es Adopted for NO _x Control	193
		NO_{x} RACT (Reasonably Available Control Technology)	194
	12.6.2	Ozone Transport Region $\mathrm{NO}_{\!\scriptscriptstyle X}$ Cap and allowance	
		Trading Program (OTR)	195
Refer	ences		196
Underst	anding	the Commotion	199
13.1	The Inte	ernal Combustion Engine (ICE)	200
13.2	What is	Crankcase and Evaporative Emissions?	202
	13.2.1	Crankcase Emission Control (PCV System)	202
	13.2.2	Evaporative Emission Controls	203
13.3	Tailpipe	Emissions: How They Affect Human Health	205
13.4	Tamperi	ng And Emission Testing	207
13.5	Transfer	and Storage Emissions	208
13.6	Indirect	Energy Sources	209
How	to use su	stainable energy directly?	210
13.7	Visualiz	ing a Future Less Dependent on Motor Vehicles	212
Refer	ences		213

Table of Contents

Global Climate and Air Pollutants Affects on it	215
14.1 Climate Change	216
14.1.1 Climate Change Performance Index (CCPI)	217
14.2 Depletion of the Ozone Layer	219
Did You Know?	221
The Chapman Cycle	221
14.3 Chemistry of Ozone Depletion	222
14.4 Acid Rain	223
References	224
Miscellaneous Topics	225
15.1 Carbon Monoxide	225
15.1.1 What are the harmful effects of CO?	226
15.2 Lead	226
15.2.1 How Lead Affects Our Body	226
15.2.2 How Lead Affects the Ecosystems	227
15.3 A Brief About the Hazards of Air Pollutants	227
15.3.1 The Pollutants 15.3.2 The Sources	228
15.3.2 The Sources 15.4 Indoor Pollution	228 228
15.4.1 Various Sources of Indoor Pollution	229
References	231
Nomenclature	234
Appendix	238
Units of Measured Weather Elements:	238
Surface Observations	239
Routine Upper Air Observations:	239
Types of Weather Forecasting	240
Short Range Forecast	240
Medium Range Forecast	240
How M R F is useful to Agriculture?	240
Long Range Forecasts (LRF)	241
Local Forecasts	241
Glossary	242
Index	257