List of Figures

Fig. No.	Figure caption	Page No.
1.1	Variables influencing the toxicity of airborne particulate matter	3
1.2	Pollution sources in the environment through anthropogenic and nonanthropogenic dust associated with relative amounts of contaminant concentration, emission	4
1.3	Size comparison of particulate matter	7
1.4	Size distributions of particle numbers along with the mode of formation	8
1.5	Hypothetical mixed particle distribution	8
1.6	Global satellite-derived concentration of $PM_{2.5}$	9
1.7	Range of national ambient air quality standards for 24-hr PM_{10}	10
2.1	Flow diagram of the methodology of the research work	40
3.1	Location map of air quality monitoring station at Singrauli coalfield	43
3.2	Samplers used for collecting particulate matter	51
3.3	EPM 2000 filter paper before and after collection of particulate matter	52
3.4	PTFE filter paper of $PM_{2.5}$	52
3.5	Desiccator	52
3.6	Acid digestion chamber for filter paper	63
3.7	Digestion of filter papers	64
3.8	Schematic diagram of double beam atomic absorption spectrometer	69
3.9	Schematic diagram of differential pulse stripping voltammetry	76
3.10a	Calibration curve Cd, Pb, Cu, Ni, and Co by DPASV	77
3.10b	Calibration curve of Th and U by DPASV	77
3.11	Flowsheet of sample processing in direct mercury analyzer	78
3.12	Flow chart of working principle of ICP–OES instrument	79
3.13	Using the dual–channel alpha beta counter model PNC–αβ for αβ counting	79
3.14	Chromatogram of IC analysis of anions	80
3.15	Schematic diagram and working with CHNS analyzer	84
4.1	Showing fluctuation in concentration of major air pollutants of two consecutive years (2016 & 2017)	117
4.2	Comparison of the level of average seasonal variation of major air pollutants around the study area of two consecutive years (2016 & 2017)	118

4.3	Variation of monthly average concentration at Rooftop and Ground level of major air pollutants at AQMS–03	123
4.4	Monthly average concentration variation ratio in Rooftop and Ground level of major air pollutants at AQMS–03	123
4.5	Monthly Variations of $PM_{2.5}$ over the two consecutive years (2016 & 2017)	124
4.6	Monthly Variations of PM_{10} over the two consecutive years (2016 & 2017)	124
4.7	Monthly Variations of SPM over the two consecutive years (2016 & 2017)	125
4.8	Monthly Variations of NO_2 over the two consecutive years (2016 & 2017)	125
4.9	Monthly Variations of SO_2 over the two consecutive years (2016 & 2017)	126
4.10	Average weight percentage concentration of particulate matters in SPM	126
4.11	Concentration of the frequency distribution of $PM_{2.5}$ during over the sampling period for two consecutive years (2016 & 2017)	129
4.12	Concentration of the frequency distribution of PM_{10} during over the sampling period for two consecutive years (2016 & 2017)	129
4.13	Concentration of the frequency distribution of SPM during over the sampling period for two consecutive years (2016 & 2017)	130
4.14	Concentration of the frequency distribution of NO_2 during over the sampling period for two consecutive years (2016 & 2017)	130
4.15	Concentration of the frequency distribution of SO_2 during over the sampling period for two consecutive years (2016 & 2017)	135
4.16	Monthly variations of measured air pollutants and temperature of two consecutive years (2016 & 2017)	135
4.17	Monthly variations of measured air pollutants and relative humidity of two consecutive years (2016 & 2017)	136
4.18	Monthly variations of measured air pollutants and wind speed of two consecutive years (2016 & 2017)	136
4.19	Frequency distribution of air quality index during two consecutive years (2016 & 2017)	138
5.1	Percentage distribution of elements in the particulate matter at AQMS–01 during two consecutive years (2016 and 2017)	171
5.2	Percentage distribution of elements in the particulate matter at AQMS–02 during two consecutive years (2016 and 2017)	172
5.3	Percentage distribution of elements in the particulate matter at AQMS–03 during two consecutive years (2016 and 2017)	173
5.4	Percentage distribution of elements in the particulate matter at AQMS–04 during two consecutive years (2016 and 2017)	174

5.5	Percentage distribution of elements in the particulate matter at AQMS–05 during March, April, and May 2016	175
5.6	Percentage distribution of elements in the particulate matter at AQMS–06 during March, April, and May 2016	176
5.7	Average seasonal variation of particulate matter associated species at AQMS–01	177
5.8	Average seasonal variation of particulate matter associated species at AQMS–02	177
5.9	Average seasonal variation of particulate matter associated species at AQMS–03	178
5.10	Average seasonal variation of particulate matter associated species at AQMS–04	178
6.1	Monthly variation of (a) isotope activity in $PM_{2.5}$, (b) isotope activity in PM_{10}, (c) isotope activity in SPM, collected during two consecutive years (2016 and 2017) in Singrauli coalfield. All the activities are given in $\mu Bq\ m^{-3}$	205
6.2	Lifetime cancer risk in $PM_{2.5}$, and PM_{10}	206
7.1	Frequency distribution of: (a) gross α activity in $PM_{2.5}$, (b) gross α activity in PM_{10}, (c) gross α activity in SPM, (d) gross β activity in $PM_{2.5}$, (e) gross β activity in PM_{10} and (f) gross β activity in SPM for the collected during two consecutive years (2016–2017) in the area. All the activities concentration is given in 10^{-6} Bq m^{-3}	215
7.2	Monthly variation of gross alpha (α) and gross beta (β) activity concentration in particulate matters	216
7.3	Box–Whisker plot for the logarithm of gross alpha and beta in particulate matters in Bq m^{-3} considering the seasonal factor	216
8.1	Lowest, average, and highest health risk with due respect to air pollutants	229
8.2	A risk related to non-carcinogen metals components of $PM_{2.5}$ for different demographic groups	235
8.3	A risk related to non-carcinogen metals components of PM_{10} for different demographic groups	235
8.4	A risk associated with carcinogen metals components of $PM_{2.5}$ for different demographic groups	236
8.5	A risk associated with carcinogen metals components of PM_{10} for different demographic groups	236
9.1	X–ray diffraction patterns of different size particulate matter at industrial–cum–residential area of the study area	241
9.2	X–ray diffraction patterns of different size particulate matter at mining area of the study area	242

9.3	Scanning electron micrograph of particles according to morphological similarities, i.e. soot particles; spherical particles; biological particles; natural and anthropogenic silicate particles and stick–shaped in $PM_{2.5}$ collected in PTFE at study area; a) different particles deposited on filter paper; b) twinned crystal aggregates of silicate (EDS, Si, Al, Hg, C, S); c) capsule shape along with soot particles; d) aluminosilicate (EDS: Si, Al, O; size: 1.62 μm); e) capsule shape along with soot particles (EDS: S, Fe, Cu; size 1.75 μm); f) smooth surface (EDS: Al, Si, C, Fe; size: 570 nm)	245
9.4	Scanning electron micrograph of particles according to morphological similarities, i.e. soot particles; spherical particles; biological particles; natural and anthropogenic silicate particles and stick–shaped in PM_{10} collected in glass fiber at study area; a) different particles deposited on filter paper; b) soot particles; spherical particles; c, e, & f) natural and anthropogenic silicate particles and stick–shaped (EDS: Al, Si, Cl, S, C; size 3.26 μm); d) rough spherical (EDS: Si, Al, Ca, S)	246
9.5	Scanning electron micrograph of particles according to morphological similarities, i.e. soot particles; spherical particles; biological particles; natural and anthropogenic silicate particles and stick–shaped in SPM collected in glass fiber at study area; a) different particles deposited on filter paper; b) rod shape (EDS: Ca, C, O); c) rough spherical (EDS: Si, Al, Ca, S); d, e, & f) soot particles; spherical particles; natural and anthropogenic silicate particles (EDS: Al, Si, Cl, S, C; size 3.26 μm)	247
9.6	Source profiles of $PM_{2.5}$ aerosol for industrial–cum–residential area	255
9.7	Source profiles of PM_{10} aerosol for industrial–cum–residential area	255
9.8	Source profiles of SPM aerosol for industrial–cum–residential area	256
9.9	Source profiles of $PM_{2.5}$ aerosol for mining area	256
9.10	Source profiles of PM_{10} aerosol for mining area	257
9.11	Source profiles of PM_{10} aerosol for mining area	257
10.1	Hypothetical system for air quality management	272
10.2	Line diagram of the experimental setup of reduction for the total suspended particulate matter	275
10.3	Dust scrubbing set up to study the effect of bubbles on TSPM suppression	276
10.4	One–hour average concentration of particulate matters with different wind speed in the laboratory	279
10.5	$PM_{2.5}$ reduction by using bubbles with wind speed 1.0 km h^{-1} in the laboratory	279

10.6	PM_{10} reduction by using bubbles with wind speed 1.0 km h^{-1} in the laboratory	280
10.7	TSPM reduction by using bubbles with wind speed 1.0 km h^{-1} in the laboratory	280
10.8	$PM_{2.5}$ reduction by using bubbles with wind speed 2.0 km h^{-1} in the laboratory	281
10.9	PM_{10} reduction by using bubbles with wind speed 2.0 km h^{-1} in the laboratory	281
10.10	TSPM reduction by using bubbles with wind speed 2.0 km h^{-1} in the laboratory	282
10.11	$PM_{2.5}$ reduction by using bubbles with wind speed 3.0 km h^{-1} in the laboratory	282
10.12	PM_{10} reduction by using bubbles with wind speed 3.0 km h^{-1} in the laboratory	283
10.13	TSPM reduction by using bubbles with wind speed 3.0 km h^{-1} in the laboratory	283
10.14	$PM_{2.5}$ reduction by using bubbles with wind speed 5.0 km h^{-1} in the laboratory	284
10.15	PM_{10} reduction by using bubbles with wind speed 5.0 km h^{-1} in the laboratory	284
10.16	TSPM reduction by using bubbles with wind speed 5.0 km h^{-1} in the laboratory	285
10.17	Percentage control of TSPM in various wind speed in the laboratory	285