Study of Suspended Particulate Matter in Ambient of Delhi

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Abstract—*Variation in the levels of different pollutants Suspended Particulate Matter and respirable Suspended Particulate Matter at different sites shows the location and meteorological effects, which may be attributed to varying nature and quantum of emissions from stationary and mobile sources, wind pattern and transported pollution load from other sources / areas etc. It is further supported by analysis of variance of monthly SPM & RSPM data which revealed significant variation between sites and between months.*

1. INTRODUCTION

India accounts for 16% of the world population but it has only 2.42% of the total world area. The landarea of India is only 3.28 million km2. The density of the population continues to rise and on an average it is269/km^2. Increased population demand more power, the generation of which is associated with environment pollution and can sequent health effects. Population explosion leads to air, water soil, and noise pollution.

2. REVIEW OF LITERATURE

Small solid particles and liquid droplets are collectively termed as particulate matter. Particulate matter is called primary if is in the same from chemical form in which it is emitted into the atmosphere. The primary particulate matter includes wild blown dust such as road dust, fly ash. Soot etc particulate matter is called secondary if is formed by chemical reaction in the atmosphere. Secondary particulate matter included sulfur, nitrates etc. Tripathi has compiled the mass and size distribution of atmosphere aerosols in different urban areas of the world Miss J.K. Parik (1977) estimated emission of major pollutants from non-commercial source. Various scientist have worked on particulate matter like Schonherr and Huber, 1997; Lovett and Lindbeys, 1984 etc.

3. MATERIAL AND METHOD:

Sampling of suspended particulate matter (SPM) is based upon the gravimetric method. In this method, air is drawn into covered housing of high volume sampler through the filter by means of a turbine boiler at nominal flow rates from 1.10 to 0.50 cubic meters per minute. This allows suspended particulate having diameters of less than 100 μm to pass the filter surface. Particles within the size range of 100 to 01. μm are ordinarily collected on glass fiber filters. Due to uncertainly in the air flow, the flow rate was noted down at an interval of 1 hours to determine the average flow rate of 8 hourly sampling. The mass concentration of suspended particles in ambient air, expressed in micrograms per cubic meter is calculated by taking the difference between the final and initial weights of filter paper ad dividing by the volume of air sampled.

(A) CALCULATIONS

i) Calculation of Volume of air Sampled

$$V = Q.T.$$

Where, V = Volume of air sample in-m^3

Q = Average airflow rate in m^3/min

T = Sampling time, in minutes

ii) Calculation of Mass Concentration of Suspended Particulate Matter:

The mass concentration of suspended particulate matter may be calculated as follows and recorded to the nearest microgram per cubic meter.

$$\text{SPM } \mu g/m^3, = \frac{(W_2 - W_1) \times 10^6}{V}$$

Where SPM = Mass concentration of suspended particulate matter in ug/m^3

W_1 = Initial weight of filter paper, in gram

W_2 = Final weight of exposed filter paper, in gram

V = Volume of air sampled in cubic meter

10^6 = Conversation factor from grams to microgram.

2. Sampling of RSPM

The Respirable dust sample is a vital tool for studies relating the impact of industrialization to the air environment, and for work relating diseases of the respiratory system to air pollution.

A. SPECIFICATION OF APM 460

Flow rate : 0.9 – 1.2 m^3/min

Particulate size : 10 microns to 0.5 micron collected on filter paper.

Filter holder designed to accept any standard filter sheet of 8" x 10" size. SPM bigger than 10 micron collected in the separate sampling cone.

B. Calculation:-

Initial weight of filter paper	=	W_1gms.
Final weight of filter paper	=	W_2gms.
Mass of Particulate collected W	=	$W_1 - W_2$
W	=	gms.
Initial Flow Rate of Air	=	Q_1 m^3/min.
Final Flow Rate of Air	=	Q_2 m^3/min.
Flow Rate of Air (Q) (Manometer reading 8 hours average)	=	m^3/min.
Total Time of Sampling T	=	480 min.
Volume of Air Sampled V	=	Q x T
V	=	m^3
RSPM (μ g/m^3)	=	(W x 10^6)/V

4. DISCUSSION

1. Suspended Particulate Matter (SPM)

The results of monthly (8 hrly) data for two year study during Jan 2008 – Dec 2009, (Table 4.1 and 4.2) shows that SPM concentration in Delhi varies between 39 $\mu g/m^3$ at ITO (Minimum value) during August 2008 and 662 $\mu g/m^3$ at Pitampura (Maximum) during February 2009. Annual SPM average values ranges between 114.58 $\pm$ 67.42 $\mu g/m^3$ at ITO to 530.25 $\pm$ 74.70 $\mu g/m^3$ at Shahadara region.

Two years combined annual average SPM value for different sites in order increasing of concentration was as 117.58 $\mu g/m^3$ at ITO < 418.41 $\mu g/m^3$ at Sirifort< 440 $\mu g/m^3$ at ShahzadaBagh< 450.58 at Janakpupri< 510.25 at Pitampura< 521.16 $\mu g/m^3$ at Shahadara.

Two years seasonal and total average SPM for Delhi (all sites combined) worked out to be 383 $\mu g/m^3$, 467 $\mu g/m^3$, 452 $\mu g/m^3$, 370 $\mu g/m^3$ for monsoon, postmonsoon, winter, summer, respectively and 418 $\mu g/m^3$ for total average.

Total annual average values for Delhi (combined all sites) has increased from 270 $\mu g/m^3$ during 2008 to 519 $\mu g/m^3$ during 2008 and increased from 267 $\mu g/m^3$ during 2009 to 532 $\mu g/m^3$ during 2009. Total seasonal average varies 127 $\pm$ 75.19 $\mu g/m^3$ at ITO 524 $\pm$ 35.41 $\mu g/m^3$ at Shahadara.

Seasonal (8 hrly) average concentrations at different sites are presented (Table 4.3 and 4.4) lowest values occurs in summer and highest in post monsoon as expected due to storm and wind and inversion condition. The highest variation (8 hrly) monthly concentration was observed at ITO Region (% CV 60) during 2009 and least variation at Shahdra Region (% CV 6) during 2008. Two years combined average level (524 $\mu g/m^3$) in the present study are much major than prescribed limit (i.e. 500 $\mu g/m^3$) proposed by CPCB for Shahadra region.

The highest concentration of SPM in post monsoon may be attributed frequent dust storms and transportation of high dust load from nearly Rajasthan desert area, while lowest levels in summer are because of wash out of rain. High concentration in winter may be because of local inversion condition and also due to low wind velocity around this period.

5. RESPIRABLE SUSPENDED PARTICULATE MATTER (RSPM)

The result of monthly (8 hrly) data for two years study during Jan 2008 Dec 2009 (Table 4.5 and 4.6) shows that RSPM concentration in Delhi varies between 30 $\mu g/m^3$ ITO (minimum value) during August 2008 and 319 $\mu g/m^3$ at Pitampura (maximum) during August 2009. Annual RSPM average values ranges between 113 $\pm$ 68.71 $\mu g/m^3$ at ITO to 259 $\pm$ 61.04 $\mu g/m^3$ at Pitampura Region.

Two years combined annual average RSPM values for different sites in the order increasing of concentration was as ITO (117.42 $\mu g/m^3$) <Sirifort (152.67 $\mu g/m^3$) <ShahzadaBagh (222.25 $\mu g/m^3$) <Pitampura (223 $\mu g/m^3$) <Janakpuri (227.67 $\mu g/m^3$) <Shahadara (232.17 $\mu g/m^3$).

Two years seasonal and total average RSPM for Delhi (all sites combined) worked out to be 151 $\mu g/m^3$, 224 $\mu g/m^3$, 215 $\mu g/m^3$, 176 $\mu g/m^3$, 192 $\mu g/m^3$ for monsoon, post monsoon, winter, summer and total average respectively.

Total annual average values for Delhi (combined all sites) has increased from 112 $\mu g / m^3$ during 2008 to 259 $\mu g / m^3$ during 2008 and increased from 145 $\mu g / m^3$ during 2009 to 274 $\mu g / m^3$ during 2009. Total seasonal average varies between 122 $\mu g / m^3 \pm 74.28$ $\mu g / m^3$ at ITO to 229 $\mu g / m^3 \pm 17.26 \mu g / m^3$ at Janakpuri.

Total seasonal average (all sites combined) increased from 186 $\mu g / m^3$ during 2008 to 210 $\mu g / m^3$ during 2009, approximately by 12%.Seasonal (8 hrly) average concentration at different site are presented in Table 4.7 and 4.8. Lowest value occur in monsoon and highest on post monsoon as expected as due to calm wind and inversion condition. The highest variation in (8 hrly) monthly concentration was observed at ITO region (% CV61) during 2008 and least variation at Janakpuri region (% CV3) during 2008. Two years combined average level (228 $\mu g / m^3$) in the present study are much major than prescribed limit (i.e. 150 $\mu g / m^3$) proposed study by CPCB for Shahadara region.The highest concentration of RSPM in post monsoon may be attributed frequent dust storms and transportation of high dust load from nearly Rajasthan desert are, While low level in monsoon are mainly because of washout by rain. High concentration in winter may be because of local inversion condition and also due to low wind velocity around this period.

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