CHAPTER-III

AIR POLLUTION STATUS
OF THE JAUNPUR CITY

About thirty percent of the total human population residing in the urban and industrial areas. The villages, towns and cities have become densely populated due to population explosion, unemployment and poverty. The advancement of life style has demanded the high facilities and sudden increase in the crowd and number of automobile vehicles in urban areas, very often 'jam' is observed during peak hours in the urban areas. There has been spurt in the turn over of floating population and automobiles in the urban areas, during last two decades, resulted into the increase in pollution load and pollutant emission in the lower part of mentle.

A polluted atmosphere is generally considered as unbalanced and unnatural atmosphere. All the wastes are not necessarily pollutants in themselves but they all have the capacity to be so because the wastes become pollutant when it is misplaced. Every combustion of fossil fuel, transformation of energy and transportation of vehicles release pollutants as by-products in the atmosphere. Primary air pollutants may be \( \text{SO}_2 \), \( \text{NO}_2 \), particulate matter and hydrocarbons, and after chemical conversions they are transformed into secondary pollutants. Naturally originating dust and aerosol consists of \( \text{SO}_2 \), \( \text{NO}_x \). Pb. particulate matter, condensation nuclei, airborne particles from soil and vegetation, dust of meteoric origin and bacterial spores and pollen grain may frequently glomorate in the atmosphere.
AIR POLLUTION STATUS OF THE JAUNPUR CITY

In addition to the small scale industries an important source of air pollution in urban atmosphere is automobile exhausts and domestic consumption of low grade fuels resulting in intensely smoky atmosphere and smog reducing the visibility. The gaseous emissions from these sources mainly consists of aerosols and gases. Atmospheric concentration of carbon dioxide and other green house gases have been increasing due to burning of coal, destruction of forest trees combustion of fossil fuel and microbial decomposition of biomass. Green house gases in the atmosphere have the ability to allow solar radiation to pass down and reach ground surface but on the radiation and reradiation, the incoming and outgoing heat waves or infra-red radiations are trapped by them. It has been recognised for more than a decade that halocarbons also contribute to planetary warming by absorbing infra-red radiation. The potential green house warming effect results from the manufacturing of Chlorofluorocarbons (CFC) used in several industries including refrigerator and air conditioning.

Automobile emission is the major contributor to the environmental pollution in Indian cities (Singh 1987). The pollutants in this case are carbon monoxide, Hydrogensulphides, Hydrocarbon particulate matter, trace quantities of sulphurdioxide, formaldehyde and lead. The petrol consuming vehicles emit two-third of the carbon monoxide, one and half of the hydrocarbons and one third of the Nitrogenoxide emissions. Diesel engines emit relatively little of these but produce more particulates and smoke. These emissions are especially noted for their production of photochemical smog in the densely populated urban areas. The old engines running on rough road produces the emission having greater amount of gaseoline smoke and pollutants.
The present study was aimed to make a survey about the Air pollution status of small patches of the Jaunpur city. An air pollution survey is a critical study of a particular geographical area for the purpose of determining the sources, nature and the effects of the air pollution that exists within the area concerned. In the survey sampling sites are located at suitable place and it depends upon the number of factors such as population density, concentration of industries, intensity of traffic and movement of vehicle etc. The suspension, retention and movement of particles and gases largely depends on the temperature and relative humidity of the atmosphere.

**MATERIAL & METHODS:**

In order to assess the air quality the five sampling sites were selected in and around the Jaunpur city. Air samples were collected thrice a day in peak hours at monthly intervals preferably in the second and fourth weeks of each month from November 1998 to October 2000. Methods and formulae to collect and calculate the suspended particulate matters (SPM), dust fall (DF), sulphurdioxide(SO₂), nitrogendioxide (NO₂), ammonia (NH₃) and lead (Pb) are given below.

1. SUSPENDED PARTICULATE MATTER (SPM):

The mass concentration of suspended particulate in the ambient air is computed by measuring the mass of collected particulate and the volume of air sampled. Air is drawn into a thick polythene covered housing and through a filter by means of a high flow rate blower at a rate of 1.5m³ min⁻¹ that allows suspended particles having diameter of less than 100μ to pass through the filter surface. SPM were collected by drawing ambient air through a fibre glass filter paper (20×25 cm) by means of a high volume sampler capable of continuous
Fig. 3.1 Dust Fall Jar with guard frame and stand

Fig. 3.2 Sampling train
operation for 24 hours. In the high volume sampler (Envirotech APM 410) the flow rate of air passing through the filter is monitored by measuring the pressure drop in rotometer. The sampler was run for 24 hours at a suction rate of 1.5 m$^3$ min$^{-1}$ drawing a total volume of about 1500 m$^3$ of air. Thus concentration of SPM was obtained by measuring the total volume of air and the net weight of the deposited particles collected over the 24 hours operation of the samples. This method is referred to as Gravimetric high volume sampling (Katz 1977).

\[
SPM (\mu g m^{-3}) = \frac{W_2 - W_1}{V} \times 10^6
\]

Where:
- $W_1 =$ Initial weight of filter (g)
- $W_2 =$ Final weight of filter (g)
- $V =$ Volume of the air sampled (m$^3$)
- $10^6 =$ Conversion of g to $\mu g$

2. **DUST FALL (DF):**

The dusts floating in air becomes dense, settle under forces of gravity on surfaces of vegetation and soil and it has greater than 10 $\mu$m in size. For its sampling, cylindrical glass jar filled with distilled water were used. They were exposed to atmosphere for one month. Collected samples were brought to the laboratory for further investigations. Residual water in the container was filtered and the residue after drying and weighing was chemically analysed (Stern, 1976) for dustfall concentration. Dustfall concentrations are expressed as tons Km$^{-2}$ month$^{-1}$.

\[
\text{Dustfall} = \frac{g \text{ particles} \times 3500}{\text{diameter of Jar (cm)}}
\]
AIR POLLUTION STATUS OF JAUNPUR CITY

Fig. 3.3 High volume air sampler

Fig. 3.4 Standard midget impinger
3. **SULPHUR-DIOXIDE (SO₂):**

West-Gake method is used for the measurement of SO₂ concentration. SO₂ is absorbed in 0.1M sodium tetrachloromercurate (Na₂HgCl₄), which is converted into disulfitomercurate complex. Addition of acid bleached pararosaniline methylsulphonic acid which is determined spectrophotometrically. Impingers with 20ml absorbent were exposed in the ambient air for four hours. Samples were brought back in the laboratory and removed the plastic covers. Maintained the loss by additional absorbing reagent and adjusted the volume to 20ml. Add one ml sulphamic acid, 2ml pararosaniline hydrochloride and 2 ml formaldehyde. Finally maintained the level 30ml. Waited 30 min. for colour development then estimated at 560 nm. Sulphur dioxide concentration in the sample determined from the calibration curve (1ppm SO₂ = 2620 μg m⁻³)

\[
SO₂ (μgm⁻³) = \frac{μg SO₂}{volume \ of \ air \ sampled (lit)} \times 10^3
\]

4. **NITROGEN DIOXIDE (NO₂):**

The measurement of NO₂ in the ambient air is based on the modified Jacob and Hochheisicher method. Absorbing solution (Na OH - Sodium arsenite) for NO₂ determination was exposed for four hours. Took out the solution in laboratory for chemical analysis and maintain the original volume 20ml. After addition of 5ml sulphanilamide and 1ml NEDΔ (Coupling reagent) left it for colour development. Final readings were taken at 550nm and referred the standard graph to find out the quantity of NO₂ in sample (1ppm NO₂ = 1881 μgm⁻³).

\[
NO₂ (μgm⁻³) = \frac{μg NO₂}{volume \ of \ air \ sampled (lit)} \times 10^3
\]
5. AMMONIA (NH₃):

Ammonia is measured through the exposure of midget impinger containing dilute H₂SO₄. After maintaining the level of absorbent added 2ml of Nessler reagent and determined the absorbance after 10min at 440nm in spectrophotometer. The concentration of ammonia in the ambient air was found out by the drawing of standard curve (1ppm NH₃ = 695 µgm⁻³).

6. LEAD (Pb):

Flame method is utilized for the analysis of lead in the sample. The preweighed exposed filter paper was punched into eight circles of 2.5cm. These circles of known area were digested separately in 20ml of 1% HNO₃. This solution was reduced to one ml adding 15ml HNO₃ again it reduced to 1ml. filtered and finally adding 10ml of 15% HNO₃ was reduced to 1ml. one ml of concentrated HNO₃ was added in this filtrate and diluted it upto 50ml. This solution was analysed for lead using Atomic absorption spectrophotometer. For the preparation of the calibration curve standard solution of lead was serially diluted and observation was recorded.

RESULTS:

The seasonal variations in the ambient air quality of Jaunpur has been shown in the table 3.1, 3.2 & 3.3. An increasing trend of pollutants was observed from 1998 to 2000.

The concentration of suspended particulate matter ranged from a minimum 46.2 µgm⁻³ in the month of July at VBS (Site I) to a maximum 961 µgm⁻³ in the month of May at MTS (site V) in 1998-99. For the Year 1999-2000 the value ranged from a minimum 58.4 µgm⁻³ in the July at VBS (site I) to maximum 970 µgm⁻³ in May at MTS (site V). An increasing trend in the values
Table No. 3.1: The Concentration of SPM (µg m⁻²) and Dustfall (tons km⁻² month⁻¹) in all the three Seasons (Average of the peak hours)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VBS</td>
<td>W8 69 37 99</td>
<td>R8 49 69 37 99</td>
<td>S8 43 99 69 37 99</td>
</tr>
<tr>
<td></td>
<td>RSS</td>
<td>W8 191 205</td>
<td>R8 176 183 35.93</td>
<td>S8 161 35.93 41.9 56.39</td>
</tr>
<tr>
<td></td>
<td>SMS</td>
<td>W8 309 289</td>
<td>R8 328 298 305 205</td>
<td>S8 298 305 205 56.39</td>
</tr>
<tr>
<td></td>
<td>BPS</td>
<td>W8 571 693</td>
<td>R8 361 709 505 68.21</td>
<td>S8 709 505 68.21 37.19</td>
</tr>
<tr>
<td></td>
<td>MTS</td>
<td>W8 807 970</td>
<td>R8 415 961 70.01</td>
<td>S8 70.01 961 70.01 309 571 361 709 914 87.61</td>
</tr>
</tbody>
</table>
THE CONCENTRATION OF SPM (µg m⁻³) IN ALL THE THREE SEASON
THE CONCENTRATION OF DUST FALL (TONS KM$^{-2}$ MONTH$^{-1}$) IN ALL THE THREE SEASON

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**VBS**  |  |  
**RSS**  |  |  
**SMS**  |  |  
**BPS**  |  |  
**MTS**  |  |  

**SEASON-1998-99**

**SEASON-1999-2000**
Table No. 3.2 The Concentration of SO$_2$ ($\mu$g m$^{-3}$) & NO$_2$ ($\mu$g m$^{-3}$) in all the three seasons (Average of the peak hours)

<table>
<thead>
<tr>
<th>Study Sites</th>
<th>Parameters</th>
<th>SO$_2$</th>
<th></th>
<th></th>
<th></th>
<th>NO$_2$</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VBS</td>
<td>W</td>
<td>19.3</td>
<td>18.6</td>
<td>16.2</td>
<td>19.7</td>
<td>18.1</td>
<td>15.9</td>
<td>15.42</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>27.8</td>
<td>27.2</td>
<td>20.3</td>
<td>31.4</td>
<td>28.3</td>
<td>21.2</td>
<td>39.09</td>
<td>32.8</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>41.2</td>
<td>37.7</td>
<td>29.8</td>
<td>41.3</td>
<td>39.2</td>
<td>28.9</td>
<td>57.3</td>
<td>51.1</td>
</tr>
<tr>
<td>RSS</td>
<td>W</td>
<td>49.2</td>
<td>49.4</td>
<td>31.3</td>
<td>51.2</td>
<td>46.3</td>
<td>32.1</td>
<td>78.01</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>50.9</td>
<td>49.1</td>
<td>39.4</td>
<td>52.3</td>
<td>47.3</td>
<td>38.9</td>
<td>78.03</td>
<td>75.3</td>
</tr>
<tr>
<td>BPS</td>
<td>W</td>
<td>19.3</td>
<td>18.6</td>
<td>16.2</td>
<td>19.7</td>
<td>18.1</td>
<td>15.9</td>
<td>15.42</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>27.8</td>
<td>27.2</td>
<td>20.3</td>
<td>31.4</td>
<td>28.3</td>
<td>21.2</td>
<td>39.09</td>
<td>32.8</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>41.2</td>
<td>37.7</td>
<td>29.8</td>
<td>41.3</td>
<td>39.2</td>
<td>28.9</td>
<td>57.3</td>
<td>51.1</td>
</tr>
<tr>
<td>MTS</td>
<td>W</td>
<td>49.2</td>
<td>49.4</td>
<td>31.3</td>
<td>51.2</td>
<td>46.3</td>
<td>32.1</td>
<td>78.01</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>50.9</td>
<td>49.1</td>
<td>39.4</td>
<td>52.3</td>
<td>47.3</td>
<td>38.9</td>
<td>78.03</td>
<td>75.3</td>
</tr>
</tbody>
</table>

W = Winter  
S = Summer  
R = Rainy
THE CONCENTRATION OF SO$_2$ ($\mu$g m$^{-3}$) IN ALL THE THREE SEASON

![Graph showing concentration of SO$_2$ in different seasons for two different years, 1998-99 and 1999-2000.]
THE CONCENTRATION OF NO$_2$ (µgm$^{-3}$) IN ALL THE THREE SEASON
Table No. 3.3 The Concentration of Ammonia ($\mu g m^{-3}$) and Lead ($\mu g m^{-3}$) in all the three seasons (Average of the peak hours)

<table>
<thead>
<tr>
<th>Study Sites</th>
<th>Ammonia ($NH_3$)</th>
<th>Lead (Pb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VBS</td>
<td>10.2 9.18 9.02</td>
<td>12 10.4 8.96</td>
</tr>
<tr>
<td>RSS</td>
<td>23.2 21.9 19.4</td>
<td>26 21.9 12.1</td>
</tr>
<tr>
<td>SMS</td>
<td>40.2 39.8 30.5</td>
<td>41 39.4 21.4</td>
</tr>
<tr>
<td>BPS</td>
<td>58.1 54.3 41</td>
<td>53.3 51.3 30.1</td>
</tr>
<tr>
<td>MTS</td>
<td>65.9 61.4 47.3</td>
<td>61.8 59.1 42</td>
</tr>
</tbody>
</table>

W = Winter
S = Summer
R = Rainy
Concentration of NH$_3$ (µgm$^{-3}$) in all the three Seasons

Winter  Summer  Rainy
--------- Season-1999-2000
CONC. of NH$_3$

Winter  Summer  Rainy
--------- Season-1998-99

CONC. of NH$_3$ (µgm$^{-3}$)
THE CONCENTRATION OF Pb ($\mu$gm$^{-3}$) IN ALL THE THREE SEASON
of suspended particulate matter was recorded from the month of March to May i.e. Summer months when dusty winds are the regular feature of every day (Table 3.1).

Dust fall concentration in air varied from a minimum 4.3 tons Km$^{-2}$ month$^{-1}$ at site II (RSS) in March to maximum 76.03 tons Km$^{-2}$ month$^{-1}$ at site V (MTS) in April in 1998-99 and minimum 6.09 tons Km$^{-2}$ month$^{-1}$ in July at Site I (VBS) to a maximum 87.61 tons Km$^{-2}$ month$^{-1}$ at Site V (MTS) in May in 1999-2000 (Table 3.1). Both years data clearly shows maximum dustfall during summer followed by winter and mansoon seasons.

Sulphurdioxide concentration ranged from minimum 2.9 pg m$^{-3}$ at Site I (VBS) in the month of September to a maximum 53.6 pg m$^{-3}$ at Site V (MTS) in the month of November in the year 1998-99. For the year 1999-2000 this concentration ranged from a minimum 3.9 pg m$^{-3}$ in July at Site II (RSS) to maximum 58.8 pg m$^{-3}$ in December at Site IV (BRS). Highest SO$_2$ concentration in the air was recorded during winter seasons while lowest in rainy season.

The concentration of nitrogendioxide in the ambient air varied from a minimum 2.98 pg m$^{-3}$ in August at Site I (VBS) in August to a maximum 78.03 pg m$^{-3}$ at Site V (MTS) in December in 1998-99 and minimum 3.21 pg m$^{-3}$ at Site I (RSS) in September to a maximum 82.9 pg m$^{-3}$ at Site IV (BPS) in January in 1999-2000 (Table 3.2). NO$_2$ concentration were usually lower during in mansoon and higher during summer season.

The concentration of ammonia (NH$_3$) in the air varied from a minimum 2.90 pg m$^{-3}$ in August at Site I (VBS) to a maximum 68.3 pg m$^{-3}$ at Site V (MTS) in the month of January in 1998-99 (Table 3.3). For the year
1999-2000 this concentration ranged from a minimum 3.9 mg/m$^3$ at Site II in September to maximum 63.6 $\mu$g/m$^3$ at Site IV (BPS) in December. Lowest values of ammonia were recorded in the rainy season probably due to precipitation.

The highest values of lead (Pb) was recorded in winter season with a maximum 0.739 $\mu$g/m$^3$ and 0.785 $\mu$g/m$^3$ at Site V (MTS) in the month of November for both the years i.e. 1998-99 and 1999-2000 respectively (Table-3.3). However, the lowest values (0.002 $\mu$g/m$^3$ and 0.003 $\mu$g/m$^3$) of lead (Pb) were recorded in rainy season (July) at Site I (VBS) for the year 1998-99 and 1999-2000 respectively.