

Studies on Atmospheric Pollution over Chennai - A Mega South East Coastal City in India

G. Sudhakar¹, M. Shanawaz Begum², D. Punyaseshudu³

¹. Lecturer, Department of Physics, Govt. Degree College (Men), Kurnool.

². Lecturer, Department of Physics, Govt. Degree College (Women), Warangal.

³. D. Punyaseshudu, Professor, Department of Physics, Rayalaseema University, Kurnool.

Abstract:

Pollutants are substances which, when present at high enough concentrations, produce harmful effects on people and/or the environment. Air pollution was first perceived as a local problem in urban industrialized areas, hence taller smoke-stacks for industries and power plants were a ready solution. Urban population is growing very rapidly throughout the world, besides the world population is urbanizing much faster than is growing. Air pollutants emitted from different sources are transported, dispersed or deposited by meteorological and topographical conditions.

Key words: volatile organic compounds, particulates, motor vehicles, countryside, atmospheric chemistry, urban areas, Suspended particulate matter (SPM), Thermal Internal Boundary Layer etc.,

Introduction:

Air pollutants released from various sources affect directly or indirectly man and his environment. The resulting ground level concentration patterns have to be estimated for a wide variety of air quality analyses for social planning and industrial growth[1]. Air pollutants in mega cities arise from a wide variety of sources although they are mainly a result of combustion processes. Today, the largest source of pollution in most urban areas is motor vehicles, and to a lesser extent industry[2]. Traffic-generated pollutants include nitrogen oxides, carbon monoxide, volatile organic compounds and particulates. On warm summer days the strong sunlight leads to a buildup of ozone through the oxidation of volatile organic compounds (VOCs) such as benzene in the presence of nitrogen oxides. However, due to the special atmospheric chemistry of ground level ozone, levels are very often lower in urban areas than in the countryside.

Geographical features of Chennai :

Chennai is one of the important coastal mega cities in India. It is located in the eastern coastal side of South India. Many industries have come up in the city over the past two decades which are located near the coast. Due to change in the roughness length and difference in land and sea temperatures, sea breeze is developed and Thermal Internal Boundary Layer is observed. Due to this all the pollutants released from the industries will be dispersed towards the inland and in turn affect the environment and health[6]. Tamil Nadu constitutes the south-eastern extremity of the Indian peninsula. Chennai is the capital city of the State, besides being an important district. The district city is one of the metropolises of India and serves as the gateway of the culture of South India. Chennai is situated on the north-east end of Tamil Nadu on the coast of Bay of Bengal. It lies between 12° 9' and 13° 9' of the northern latitude and 80° 12' and 80° 19' of the southern longitude on a 'sandy shelving breaker swept beach'. It stretches nearly 25.60 kms along the Bay coast from Thiruvanniyur in the south to Thiruvottiur in the north and runs inland in a rugged semi-circular fashion. It is bounded on the east by the Bay of Bengal. Chennai is one of the leading cities in India today from the point of view of trade and commerce, with the fourth largest port in the country and the first to have developed a full-fledged container terminal to

international standards. Chennai is also one of the most important industrial cities of the sub-continent.

Theory and methodology:

Air pollutants consist of gaseous pollutants, odors, and SPM, (suspended particulate matter) such as dust, fumes, mist, and smoke. The concentration of these in and near the urban areas causes severe pollution to the surroundings. The largest sources of human-created air pollution are energy generation, transportation, and industries that use a great deal of energy sources. Depending on their source and interactions with other components of the air, they can have different chemical compositions and health impacts[3,7]. Since these pollutants are generally concentrated in and around urban areas, the outdoor urban pollution levels are far higher than in the rural areas. Some of the gases mentioned below can seriously and adversely affect the health of the population and should be given due attention by the concerned authorities.

The gases like oxides of nitrogen, CO, SO₂, SPM etc., are mainly outdoor air pollutants that can and do occur indoor depending on the source and the circumstances.

a. Oxides of nitrogen:

This gas can make children susceptible to respiratory diseases in the winters.

b. Carbon monoxide:

CO (carbon monoxide) combines with hemoglobin to lessen the amount of oxygen that enters our blood through our lungs. The binding with other haeme proteins causes changes in the function of the affected organs such as the brain and the cardiovascular system, and also the developing foetus. It can impair our concentration, slow our reflexes, and make us confused and sleepy[5,6].

c. Sulphur dioxide:

SO₂ (Sulphur dioxide) in the air is caused due to the rise in combustion of fossil fuels. It can oxidize and form Sulphuric acid mist. SO₂ in the air leads to diseases of the lung and other lung disorders such as wheezing and shortness of breath. Long-term effects are more difficult to ascertain as SO₂ exposure is often combined with that of SPM.

d. Suspended particulate matter:

Suspended matter consists of dust, fumes, mist and smoke. The main chemical component of SPM that is of major concern is lead, others being nickel, arsenic, and those present in diesel exhaust. These particles when breathed in, lodge in our lung tissues and cause lung damage and respiratory problems [4,5]. The importance of SPM as a major pollutant needs special emphasis as a) it affects more people globally than any other pollutant on a continuing basis; b) there is more monitoring data available on this than any other pollutant; and c) more epidemiological evidence has been collected on the exposure to this than to any other pollutant.

Data Base:

The data is collected from Central Pollution Control Board (CPCB) New Delhi, for the period from 2000-2004 in industrial and residential areas for the selected coastal Mega City-CHENNAI.

Analysis and Results:

The concentration of SO₂, NO₂ and SPM in Chennai are analyzed from 2000 to 2004. The pollution levels in this mega city of India have been exceeded the WHO air quality guidelines[1]. The data is collected for three industrial and two residential areas at different locations in the city, these are Kathivakkam (I), Manali PS (I), Thiruvottiyur (I), General Hospital (R), Santhome (R). The National Ambient Air Quality Standards (NAAQS) of SO₂, NO₂ and SPM are shown in Table. Behavior of SO₂, NO₂ and SPM in the selected Chennai mega city are discussed as follows:

From the Figure, the concentration levels of SO₂, NO₂ and SPM are observed from the data collected from CPCB. The concentrations of SO₂ and NO₂ are observed to be in low conditions according to NAAQS standards in both industrial and residential areas ⁽⁶⁾. But compared to residential areas i.e., General Hospital and Santhome the concentrations in the industrial areas i.e., Kathivakkam, Manali PS and Thiruvottiyur are observed to be more. The concentrations of SO₂ range from 6.10µgm⁻³ at residential areas and 40.90µgm⁻³ in industrial areas. An increase in the concentrations of SO₂ and NO₂ is observed from 2000 to 2004. Low conditions of NAAQS standards are observed in the concentrations of SPM in both industrial and residential areas. Here also the concentrations of

SPM are observed more near in industrial areas than in residential areas.

Conclusions:

The analysis of data collected from CPCB, Delhi during 2000 to 2004 in the four mega cities shows that the concentration levels have been increased from 2000 to 2004 due to dense population and rapid industrialization. In mega cities, industries, automobiles, domestic fuel consumption and the use of domestic appliances contribute to the emissions while gases from garbage dumps contaminate the air. Due to increase in pollutants the temperatures inside the cities are higher around 4⁰ C to 6⁰ C compared to the surrounding rural areas. Hence Government and the people has to take up some severe precautions to bring down the concentration of pollutants and reduce the use of energy consumable goods.

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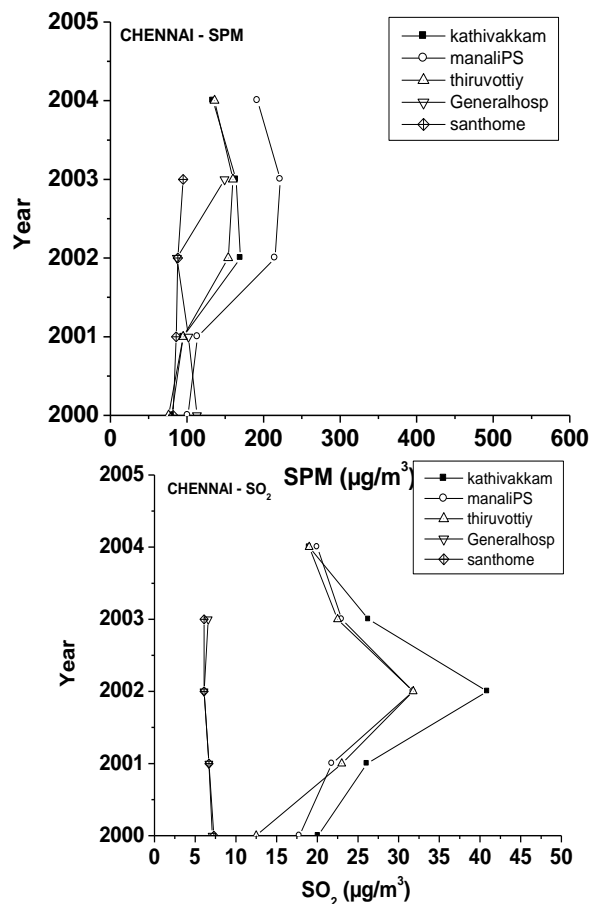
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Pollution Industrial Level

	S0 ₂ & NO ₂	SPM
Low (L)	0-40	0-180
Moderate (M)	40-80	180-360
High (H)	80-120	360-540
Critical (C)	>120	>540

Table :National Ambient Air Quality Standards



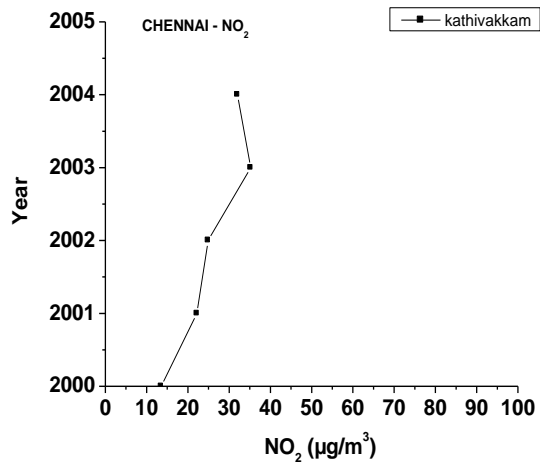


Figure: Concentration of SO₂, NO₂ and SPM from 2000-2004 in South east coastal city-CHENNAI