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Critical Analysis of Air Pollution over Chennai in India

Agnel Francis. J[1], Ashwin. A[2], Ajith Kumar. V [3], Gowtham. P [4], Siva Kumar. G[5]
Department of Mechanical Engineering, Panimalar Engineering College, Chennai-123, India.
*Corresponding Author: 〖Agnel Francis.J〗^*

Abstract: *Air pollution is the release of air pollutants into the atmosphere. Those pollutants may be gases or particulate matter and can come from a variety of sources. These are carbon monoxide, sulfur dioxide, nitrogen oxides, ozone, particulate matter and lead. Most of this air pollution we cause results from the burning of fossil fuels, such as coal, oil, natural gas, and gasoline to produce electricity and power our vehicles.* SO_2, $N0_2$ *and SPM is the good indicators of automobile pollution. In this paper, air quality of many places of Chennai in India was calculated and impact of human health is presented.*

Keywords: *- Sulphur dioxide, nitrogen dioxide, pollution, vehicles.*

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I. Introduction

Air pollutants in megacities 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. Chennai is one of the important cities in India. It is located on the eastern coastal side of South India. Many Industries have been established in the past few years. An air quality index is one of the important tools available for analyzing and representing air quality status uniformly. The Air Quality Index (AQI) can be used as a measure to assess the relative change in the ambient air concentrations. The ambient air quality data obtained by the TamilNadu Pollution Control Board, Chennai during 2016 to 2017 in Annanagar, kilpauk and T.Nagar. In this paper, three pollutants –Respirable Suspended Particulate Matter (RSPM), Sulphur dioxide (SO_2) and Oxides of nitrogen (NO_x) are analyzed and interpreted.

II. Methodology and Results

Air pollution is a major issue in Chennai and it is a hazardous concern for the urban area people. This issue is significant to govern and alleviate the pollution that affect the air is remarkably polluted area of the city . The cities and metropolis encourage high human exposure to the harmful substances due to the escalated pollution, vehicle activity, Infrastructure development & Industrial development. Ambient air quality is measured by TamilNadu Pollution Control Board (TNPCB) through National Ambient Air Quality Monitoring Programme (NAMP). The data available at TNPCB from the year 2015 to the year 2017 is used. The National ambient air quality standards are given in the Table 1.

Levels	SO_2& NO_2 ($\mu g/m^{3)}$	SPM ($\mu g/m^{3)}$
LOW	0-40	0-180
MODERATE	40-80	180-360
HIGH	80-120	360-540
CRITICAL	>120	>540

Table 1: National Ambient Air Quality Standards

The locations of test centers of Chennai is given in figure 1.

Figure 1: The locations showing the test centers of Chennai.

Ambient air quality report of Chennai:
The ambient air quality of Chennai at different locations of Anna Nagar, T. Nagar, and Kilpauk are given below in table No 2 to 7

Graph 1:

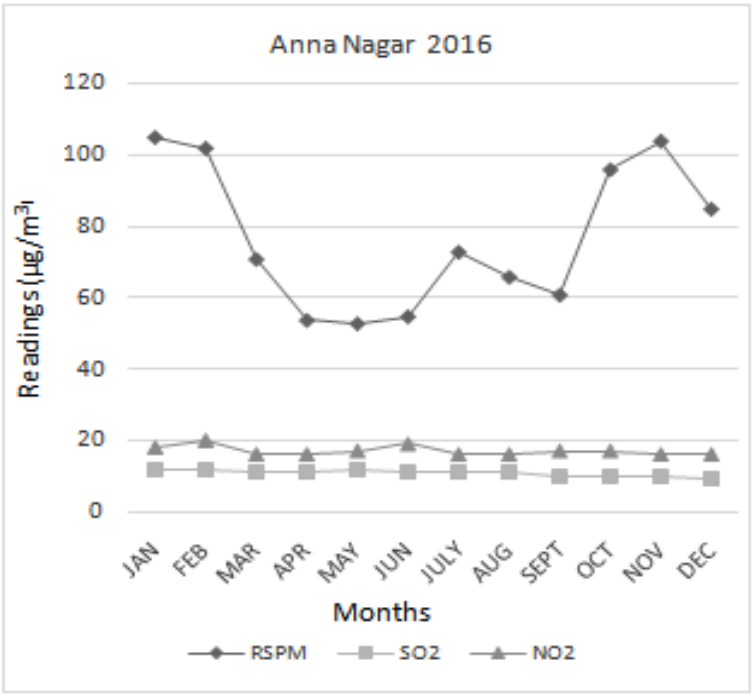


Table 2: Anna Nagar (2016)

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	105	12	18
FEB	102	12	20
MAR	71	11	16
APR	54	11	16
MAY	53	12	17
JUN	55	11	19
JULY	73	11	16
AUG	66	11	16
SEPT	61	10	17
OCT	96	10	17
NOV	104	10	16
DEC	85	9	16
STANDARD	100	80	

Graph 2

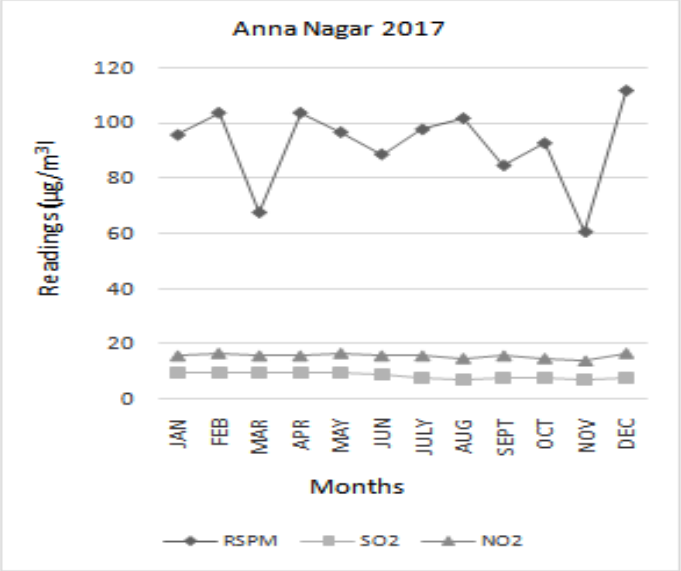


Table 3: Anna Nagar (2017)

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	96	10	16
FEB	104	10	17
MAR	68	10	16
APR	104	10	16
MAY	97	10	17
JUN	89	9	16
JULY	98	8	16
AUG	102	7	15
SEPT	85	8	16
OCT	93	8	15
NOV	61	7	14
DEC	112	8	17
STANDARD	100	80	

Graph 3

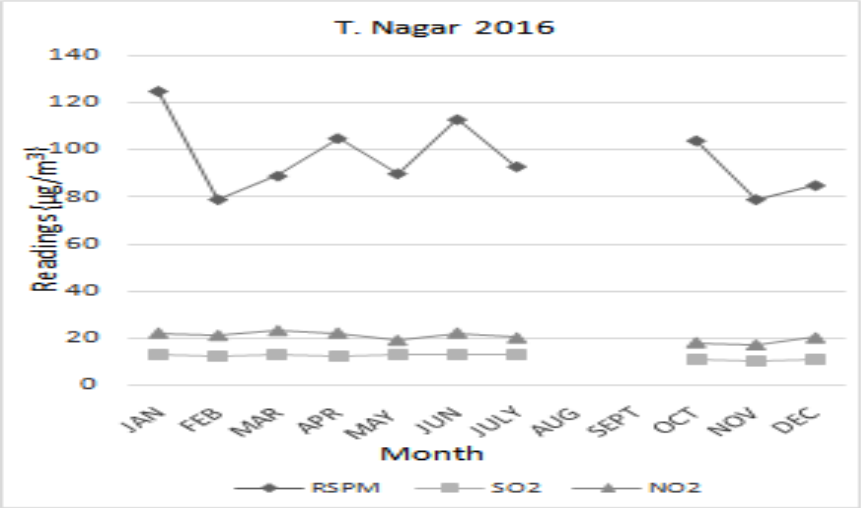


Table 4: T. Nagar (2016):

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	125	13	22
FEB	79	12	21
MAR	89	13	23
APR	105	12	22
MAY	90	13	19
JUN	113	13	22
JULY	93	13	20
AUG	Data not available		
SEPT			
OCT	104	11	18
NOV	78	10	17
DEC	85	11	20
STANDARD	100	80	

Graph 4

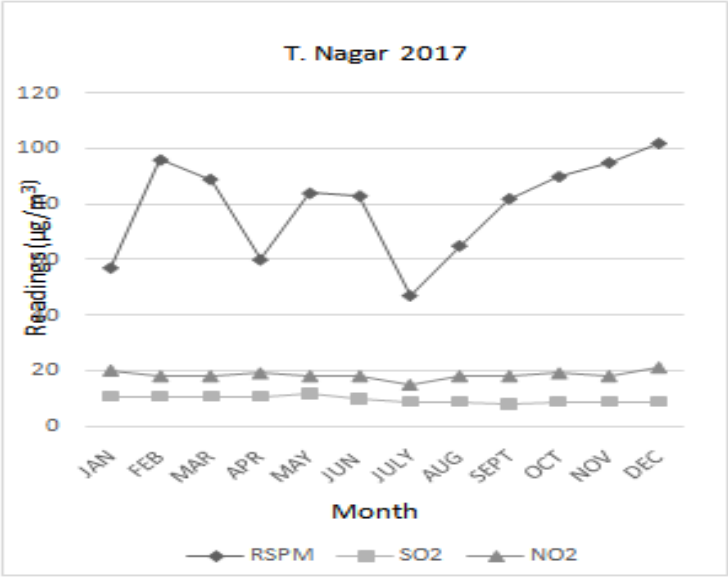


Table 5: T. Nagar (2017)

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	57	11	20
FEB	96	11	18
MAR	89	11	18
APR	60	11	19
MAY	84	12	18
JUN	83	10	18
JULY	47	9	15
AUG	65	9	18
SEPT	82	8	18
OCT	90	9	19
NOV	95	9	18
DEC	102	9	21
STANDARD	100	80	

Graph 5

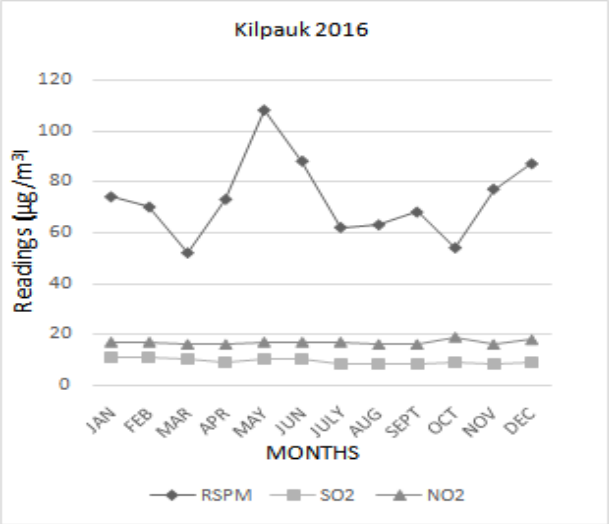


Table 6: Kilpauk (2016

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	74	11	17
FEB	70	11	17
MAR	52	10	16
APR	73	9	16
MAY	108	10	17
JUN	88	10	17
JULY	62	8	17
AUG	63	8	16
SEPT	98	8	16
OCT	54	9	19
NOV	77	8	16
DEC	87	9	18
STANDARD	100	80	

Graph 6

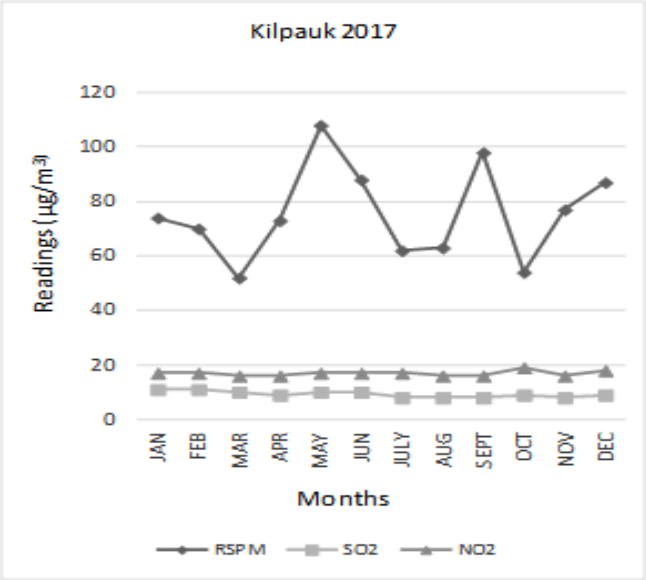


Table 7: Kilpauk (2017)

MONTH	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
JAN	80	12	18
FEB	71	14	20
MAR	57	12	19
APR	74	12	19
MAY	91	12	18
JUN	94	12	20
JULY	105	12	18
AUG	104	12	18
SEPT	102	12	18
OCT	125	11	19
NOV	104	11	19
DEC	114	11	19
STANDARD	100	80	

Health Effects Of The Air Pollutants

3.1. Respirable Suspended Particulate Matter:

RSPM is particulate matters with an aerodynamic diameter less than or equal to 10 micrometers, thus also named as PM_{10}. They are produced from combustion processes, vehicles, and industrial sources. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes, also generate significant amounts of particulates. Coal combustion in developing countries is the primary method for heating homes and supplying energy.

Health Effects due to RSPM:-Increasing respiratory symptoms, such as irritation of the airways, coughing, or difficulty in breathing, Decreasing lung function, Aggravation of asthma.

3.2. Sulphur dioxide:

Sulfur dioxide. Sulfur dioxide (SO_2) is a gas primarily emitted from fossil fuel combustion at power plants and other industrial facilities, as well as fuel combustion in mobile sources such as locomotives, ships, and other equipment.

Table 8:-Health Effects due to SO_2

S.NO	Concentration (ppm)	Effects
1.	0 to 1.0	No detectable response.
2.	1.0 to 2.0	The cardiorespiratory response in healthy persons.
3.	2.0 to 5.0	Detectable responses, tightness in the chest.
4.	5.0 to 10.0	Chocking and increased lung resistance to air flow.
5.	10.0 to 20.0	Severe distress, some nose bleeding.
6.	>20.0	Digestive tract affected eye irritation
7.	400 to 500	Fatal.

Note: The Effects of SO_2 concentration in ambient air depends on the exposure time, age group and health of the receptor.

3.3. Nitrogen dioxide:

Fossils fuels burning in motor vehicles cause 49%. At higher temperatures, it is a reddish-brown gas that has a characteristic sharp, biting odor and is a prominent air pollutant

Table 9:- Health Effects due to NO_2.

S.NO	Concentration (ppm)	Effects
1.	0.12	Odor threshold.
2.	0.7 to 2.0	Increased resistance of the lung airway.
3.	5 to 20	Eye and Nasal irritation.
4.	20 to 50	Pulmonary discomfort.
5.	50 to 100	Inflammation of lung tissues.
6.	100 to 150	Bronchiolitis fibrosa obliterans.
7.	>150	Fatal.

Table 10: Health effects of CoHb at various levels in the blood.

S.NO	Carboxyhemoglobin CoHb level %	Co level ($\mu g/m^{3)}$	Effects
1.	<1.0	<5	No apparent effect.
2.	1 to 2	5 to 10	Some evidence of an effect on behavioral performance.
3.	2 to 5	10 to 30	Central nervous system affects impairment of time interval discrimination, visual perception, brightness discrimination and psychomotor.
4.	>5	>30	Cardiac and pulmonary function changes.
5.	10 to 25	30 to 200	Headaches and dizziness.
6.	25 to 40	200 to 400	Loss of consciousness.
7.	40 to 60	400 to 750	Respiratory failure , coma , death after several hours.
8.	>15	>1000	Rapid death.

III. Environmental Effects Of RSPM, SO_2 & NO_2

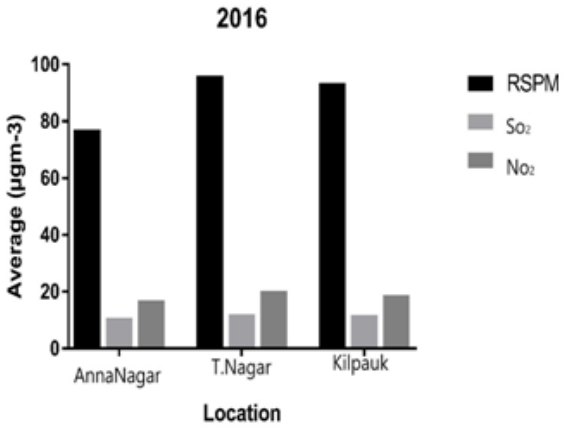
- An increase in particulates may reduce photosynthesis, increase precipitation, and reduce temperatures.
- Ground-level ozone: Chemical reactions involving air pollutants create a poisonous gas ozone (O3). Gas Ozone can affect people's health and can damage vegetation types and some animal life too.
- Nitrogen and sulfur-oxides are pollutants. They also create acids in the atmosphere that fall as acid rain.
- Formation of photochemical smog: When pollutants like hydrocarbons and nitrogen oxides combine in the presence of sunlight, smog is formed. This is a mixture of gases and since it is formed by photochemical reactions, it is called the photochemical smog.
- Aerosol formation: Aerosol is formed by the dispersion of solid or liquid matter in the atmosphere. If the aerosols from a thick layer in the troposphere, they affect the weather conditions by blocking the solar radiation
-

IV. Discussion

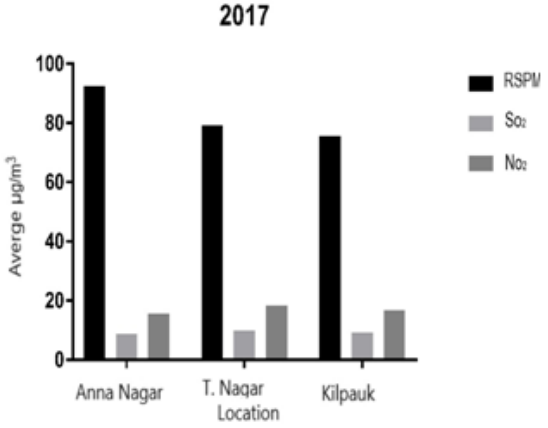
These data were collected from TNPCB and from these we can clearly interpret that RSPM affects the most compared to Sulphur dioxide and nitrogen dioxide. The level of RSPM and Sulphur dioxide in the year 2016 is high during the Festive seasons (Jan, Oct, Nov, Dec). Whereas in the year 2017 the pollutant levels in most of the areas were reduced significantly. The RSPM level is higher than the standard level during Jan & Feb

2016 in Annanagar area. The highest RSPM 125 µg/m^3 was observed during Oct 2016 & Jan 2016 at Kilpauk & T.Nagar areas. The maximum of 23 µg/m^3 of NO_2 and 14 µg/m^3 of SO_2 was observed during March 2016 at T.Nagar & Feb 2016 at Kilpauk area.

Graph 7: Average air quality during 2016



Graph 8: Average air quality during 2017



It was observed from the graph,

We can clearly see that average RSPM, SO_2, NO_2 values of 2016 are quite higher than 2017. This was due to the construction of metro rail, bridges, buildings, drainage activities in the above-mentioned areas. The values in the first quarter of 2016 were high due to the effect of Chennai floods in Dec- 2015. The values of RSPM, SO_2& NO_2 are high in the months of Jan-March (due to festivals like Bhoghi), Apr-June (due to high humidity), Nov-Dec (festive seasons like Diwali and Christmas). In the year of 2016, the number of commercial vehicles registered was more in quantity as compared to the year 2017. In Annanagar, Industries such as Plastic fabrication contributes the increase in SO_2 and NO_2. In T.Nagar, due to many public places like shopping plaza's the vehicle density is quite high which also contributes to air pollution. In Kilpauk, Industries such as Steel manufacturing, Leather fabrication are high which causes an increase in SO_2 and NO_2. From the above graphs, we can see that the amount of RSPM in Annanagar 2017 is slightly higher than2016. This is due to heavy infrastructure works in Annanagar area during 2017. In 2017 we can interpret that the amount of RSPM has decreased in T. Nagar & Kilpauk.

V. Recommendation

- **Use Public Transportation:** Use your vehicle a lot less often. Consider using public transportation instead of walking.
- **Buy Energy Efficient Vehicles:** Buy vehicles and other items that are helpful to the environment. There are so many options that you have now that are either efficient on gas or they are hybrids, so you don't have to worry about them putting additional gas and pollution into the atmosphere.
- **Plant a Garden:** Plant a garden that is going to give the air the nutrients that it needs to be cleaner. There are so many plants out there that will eat up the junk in the atmosphere.
- **BuyGreenElectricity:** Buy electricity generated from renewable energies i.e. hydroelectric, wind or solar power.
- **Make use of Solar Energy:** Consider using solar power instead of regular power. Solar power can save a ton of energy for you and, on top of that, it could also end up saving you a lot of cash in the long run as well.
- **Avoid Plastic Bags:** They are made from oil products and they can hurt the environment because it takes them forever to decompose (and some never decompose).
- **Quit Smoking:** Quit smoking and encourage those around you to do the same. The smoke is terrible for you
  and for the air quality around you as well,
- **Use Broom Instead of Leaf Blower:** Don't use items that are going to kick up a lot of dust into the air; consider using other items instead. For example, instead of using a leaf blower.
- Strict implementation of pollution control act.

- **Consolidate Your Trips:** Try to make sure that everything that you're doing can be done in one trip instead of going out several times in your vehicle. That way, you're using less gas while you're out and about.
- **Use Fan Instead of AC:** If it isn't incredibly hot outside, you may want to consider using a fan instead of air conditioning if you can. It takes a lot less power and energy to take care of it.
- **Industrial areas** should be located at a safe distance from the residential areas.
- **Electrostatic Precipitators:** When the polluted air containing particulate pollutants is passed through an electrostatic precipitator, it induces an electric charge on the particles and then the aerosol particles get precipitated on the electrode.
- Strict implementation of pollution control act.
- Usage of the Electric vehicle can reduce the air pollution.
- Usage of bio-fuel can reduce carbon contents in the air.
- Implementing Eco-Friendly design and catalytic converter can reduce.

VI. Conclusion

It is very clear that the RSPM level is going higher in Chennai. It is the right time to control the RSPM levels. SO_2 & NO_2 levels are under safety level. The possible recommendation is given below.

Acknowledgment: -

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