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ASSESSMENT OF AIR QUALITY BY AIR QUALITY INDEX OF AN URBAN AREA OF ARID ZONE OF INDIA

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ABSTRACT

Air Pollution become a major problem worldwide raising several issues for wellbeing and survival of human as well as environment. Sulphur dioxide, Nitrogen oxides, Suspended particulate matter and Respirable particulate matter are some of the major air pollutants. Present study has been carried out in Patan city, located in Gujarat state. Air samples were collected to evaluate major air pollutants like SO_2, NO_X, SPM and RSPM from four different zones, such as industrial, residential, commercial and suburb using the ambient fine dust sampler. The concentration of SO_2, NO_X, SPM were recorded high 1.68 µg m^{-3}, 10.42 µg m^{-3} & 155.64 µg m^{-3} respectively in industrial area and concentration of RSPM found high 90.84 µg m^{-3} in commercial area. The findings were used to calculate Air Quality Index for further monitoring ambient air in the city. The study shows the concentration of gaseous and suspended solid pollutants found below the Indian Standard values. AQI revealed that the ambient air quality of Patan is fairly clean; however rapid industrialization and increase in vehicular load in the city might change the situation in future. The study suggests that the urban cities in arid climate should regularly monitored for their air qualities to reduce the effects of desertification and climate change.

Key words: *Ambient air pollutants, Vehicles, SPM & RSPM, desertification, climate change*

I. INTRODUCTION

Increase with the population, the developmental activities like Industrialization and Urbanization cause degradation and drastic change in every component of environment namely Hydrosphere, Lithosphere, Atmosphere and Biosphere through the Pollution. Air pollution has become the most crucial problem to mankind in the past few decades [1]. Various pollutants are entering in to the atmosphere through natural and made activities which cause disease, toxicity and environmental decay. These air pollutants can be in solid, liquids or gaseous form [2]. There is also increasing evidence that the adverse effect of air pollution not only on the respiratory system but it also on the cardiovascular system [3]. Although the net effect of air pollutants on health is not clear but the Committee Of the Medical Effects of Air Pollution (COMEAP) which set up by the UK government has found the strongest link between health and pollution to be for PM_{10}, SO_2 and O_3 [4]. Keeping the air quality acceptable has become a challengeable task for decision makers as well as for NGOs. Particulate matter and gaseous emissions of pollutant emission from Industrial activity as well as auto exhausts

IJARSE
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was responsible for rising discomfort, increasing airway diseases and deterioration of artistic and cultural patrimony in urban areas [5]. Particulate matter was estimated to cause more than 3.7 million deaths per year worldwide [6]. In the majority of the developed world, legislation has already been introduced to the extent that local authorities are required by law to conduct regular Local Air Quality Reviews of key urban pollutants such as SO_2 and NO_x produced by Industrial activities and road transport activities [7]. In most urban areas, emissions from traffic or transport were major contributor of harmful pollutants such as NOx and Particulate Matter [8]. In India, pollution has become a great topic of debate at all levels and particularly the air pollution because of the enhanced anthropogenic activities. Among the harmful chemical compounds, burning puts CO_2, CO, NOx, SO_2 and tiny solid particles including lead from gasoline additives called particulates into the atmosphere [9]. SO_2 formed when fossil fuels such as coal, gas and oil were used for power generation; SPM was emitted from numerous manmade and natural sources such as industrial dust, volcanic eruptions and diesel powered vehicles; and NOx released from natural sources such as lightning and fires [10]. In fact, there is a strong seasonality in meteorological variable that modulate air quality levels [11], [12]. Air Quality Index can represent the overall air quality status in a better way by using all the pollutants and the related standard. Vast amount of data generated as a result of air quality monitoring program complicates the meaningful interpretation of data and demands extensive statistical and computational efforts. Patan is one of the less industrial cities in the state of Gujarat. The entire region having no such big industry could support air pollution. The city is dominated by educational institutes, hospitals and commercial as it is the one of the big city of the district. Various other countries throughout the world are making strategies to deal with the increase in air pollution especially due to SO_2, NO_X, SPM and RPM. My work deals with the Measurement of these pollutants in the study area and aims to come up with a result that can be referred if a strategy is to be made now or in the near future for the area under study, to combat the increase in air pollution.

II. EXPERIMENTAL METHODOLOGY

2.1 Study area

Patan city is situated at the Northern part of Gujarat Region of India and geographically located between 23° 51' 5.81796" North and 72° 6' 53.49096" East. As the area falls near to Little Ran of Kutch, climate is dry. The temperature is goes down to 12°C in the winter and increases up to 48°C in the summer. The main concern of the work was to study Air Quality of Patan City by measuring the concentration of Air Pollutants like NOx, SO_2, RPM and SPM at different stations with the help of ambient fine dust sampler. These two critical gaseous pollutants and a little change in their concentration in ambient air can make a strong effect on the existing living community can cause many adverse effects on health. As I was primarily concerned about the environment around us, means inside the city, mainly the residential area, commercial markets and industrial area, so I decided to choose the sampling stations inside the city area rather than other highly polluted area. The monitoring stations chosen and classified as follows

IJARSE
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Table: 1 Air Quality Study Station of Patan City

Station	Type of Area	Place	Area Descriptions
ST-1	Residential Area	*Bhadra*	This place having Residences, Patan Nagar Palika Offices and Patan City Police station
ST-2	Industrial Area	*GIDC, NR-Navjivan Cross Road*	There are no industries which support air pollution but this area includes high vehicles loads due to highway and also having the commercial shops.
ST-3	Commercial Area	*Bagwada*	This commercial area falls in middle of city so it has high rush of vehicles and also a covered bus station inside it.
ST-4	Sub Urb Area	*Deesa Road*	Are falls in the out of the city area.

2.2 Sampling and Analysis

For the study and sample collection, four sites were selected in different zones like a each from Residential area, Industrial area, Commercial area and also in suburbs area. Samples were collected in two different months of February and March, 2012 from all the selected sites. The Gaseous (SOx and NOx) and Particulate (SPM and RPM) Samples were collected by **Ambient Fine Dust Sampler.** The Collected samples were bringing to the laboratory for further analysis according to Indian Standard Methods. The gaseous pollutant like SO_2 was analyzed by Modified West and Gaeke method and NOx was analyzed by Modified Jacob and Hochheiser Methods [13]. All the analyzed data were compared with Indian Standards and used to calculate Air Quality of Patan City according to Air Quality Index.

2.3 Air quality Index calculation

The quality of air in the study area was estimated from the air quality index. The air quality index was calculated from the observed SPM, RPM, NOx and SO_2 values using the formula.

$$\mathbf{AQI = ¼ \times (ISPM / SSPM + IRPM / SRPM + ISO_2 / SSO_2 + INO_X / SNO_X) \times 100}$$

Where:

ISPM, IRPM, ISO_2 and INO_X = Individual values of SPM, RPM, SO_2, NO_X respectively.

SSPM, SRPM, SSO_2 and SNO_X = Standards of ambient air quality. [14]

Table: 2 Air Quality category of Air Quality Index

Category	Range	Description
I	<10 AQI	Very clean
II	10-25 AQI	Clean

IJARSE
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III	25-50 AQI	Fairly clean
IV	50-75 AQI	Moderately Polluted
V	75-100 AQI	Polluted
VI	100-125 AQI	Heavily Polluted
VII	Beyond 125 AQI	Severely Polluted

2.4 Results and Discussion

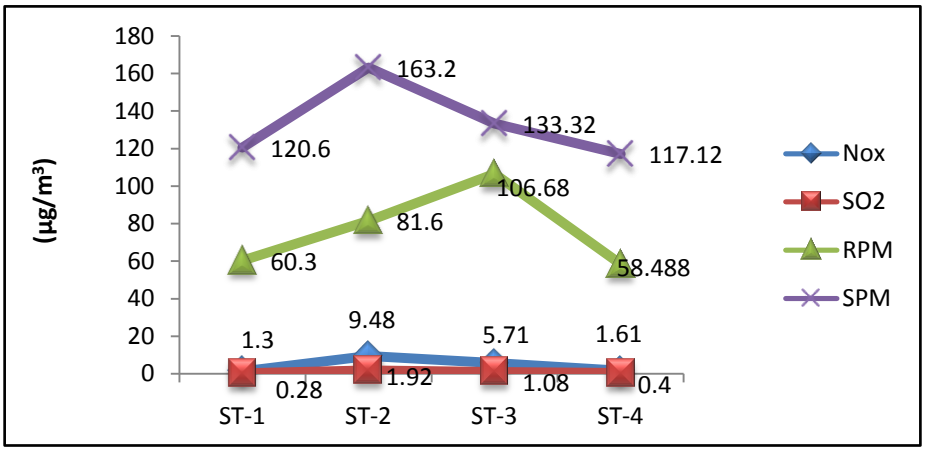

Figure 1: Graphical representation of Air Pollutants (µg m^{-3}), February 2012

Figure 1 shows that the concentration of air pollutants found high of NOx in ST-2 with 9.48 µg m^{-3}, SO_2 in ST-2 with 1.92 µg m^{-3}, SPM in ST-2 with 163.2 µg m^{-3} and RPM in ST-3 with 106.68 µg m^{-3}. The Gaseous pollutants like NOx and SO_2 were found low concentration 1.3 µg m^{-3} and 0.28 µg m^{-3} in ST-1 respectively and Particulate matter like SPM and RPM found very low 117.12 µg m^{-3} and 58.48 µg m^{-3} in ST-4 respectively.

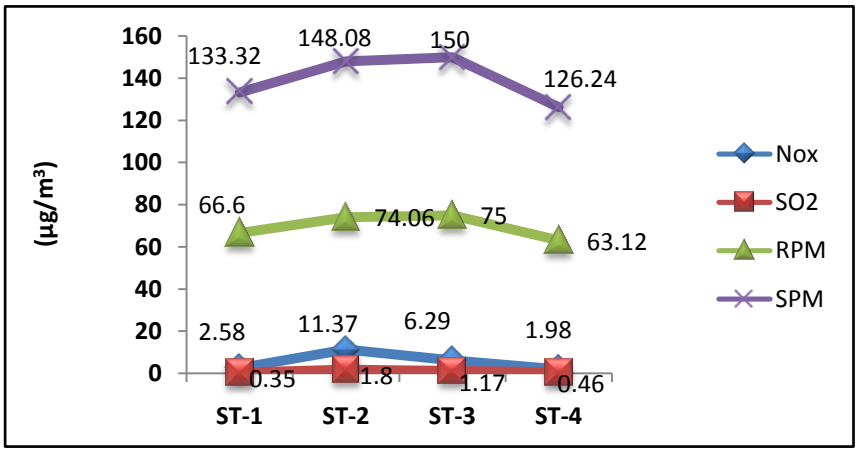

Figure 2: Graphical representation of Air Pollutants (µg m^{-3}), March 2012

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Figure 2 presents that the gaseous pollutants like NO_X and SO_2 were found high concentration of 11.37 µg m^{-3} and 1.8 µg m^{-3} respectively in ST-2 and Particulate Matter like SPM and RPM found high of 150 µg m^{-3} and 75 µg m^{-3} respectively in ST-3. Air Pollutants concentration were found low in ST-4 with 1.98 µg m^{-3}, ST-1 with 0.35 µg m^{-3}, ST-4 with 126.24 µg m^{-3} and ST-4 with 63.12 µg m^{-3} respectively for NO_X, SO_2, SPM and RPM .

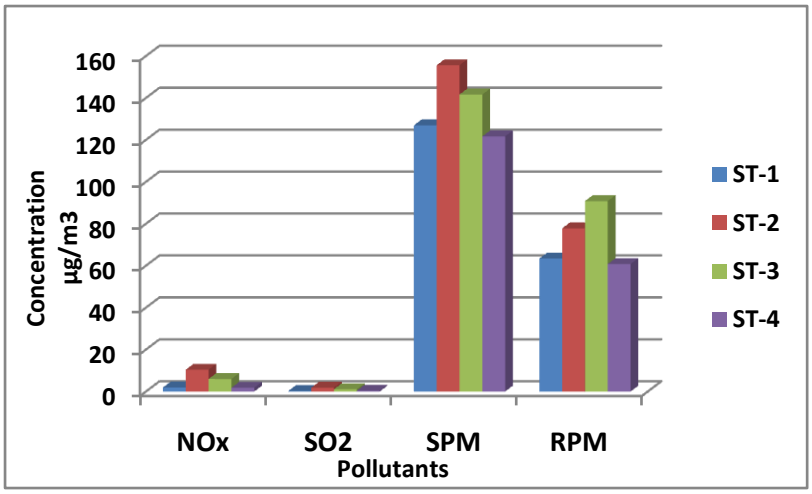

Figure 3: Graphical representation of Average Concentration of Air Pollutants (µg m^{-3})

Figure 3 present that ST-2 having the highest NO_X, SO_2 and SPM concentration then other stations and ST-3 having high concentration of RPM. Out of all the stations, ST-4 was having lowest concentration of NOx, SPM & RPM and ST- 1 having lowest concentration of SO_2 then other areas.

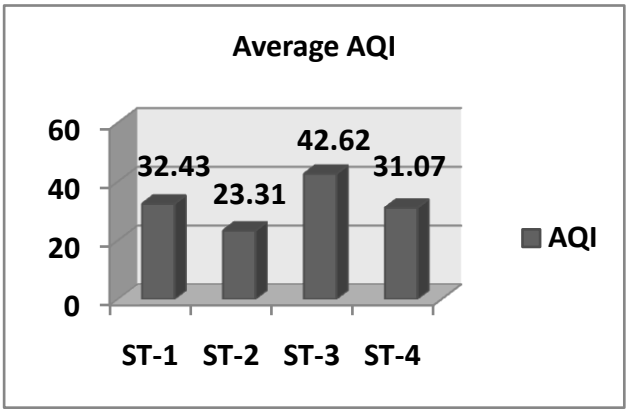

Figure 3: Average AQI level of different station

Figure 3 Shows Air Quality of ST-1, ST-3 and ST-4 were falls under the category III of Air Quality Index so the Air quality of these stations were Fairly clean and the ST-2 was a Industrial area but there was no industries were present in the area which can affect the air quality more. Due to this reason Air quality of this area comes under the Category II of the AQI means the quality of air is clean as per industrial standards.

IJARSE
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III. CONCLUSION

Ambient air pollutants were monitored at four locations within city; the study reveals the levels of air pollutants for SPM, RPM, NO_x and SO_2. The values of all these pollutants (Particulates and Gaseous) were observed to be very much below the Indian Standards and air quality was fairly clean in ST-1, ST-3 and ST-4; the Air Quality of ST-2 was clean however as per industrial standards due to no industries were available into the area which may responsible to change quality of air. So from the result, it is evident that for the time being, the ambient air inside city area do not responsible for any major change in city climate and does not need any attention from the policy makers, but may be in the future we need to formulate some ways to counteract the increase in air pollution at specific sites as we may never know when the growing industrialization, urbanization and the traffic will increase the air pollution level inside the city much more than the maximum permissible limits, so there is a need of further studies and intervention.

IV. ACKNOWLEDGEMENTS

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