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A Review of Study of Ambient Air Quality Monitoring for the Research Project: "Characterization of Different Dust Sample for PM_{10} & $PM_{2.5}$ Fraction to Establish its Impact in Raising Ambient PM_{10} &$PM_{2.5}$ Levels in City of Narsinghpur"

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ABSTRACT

Ambient air quality refers to the quality of outdoor air that surrounds us in environment. It is influenced by variety of factors, including natural sources such as dust and pollen, as well as anthropogenic sources such as transportation and industry. Outdoor air pollution causes public health hazards like cardiovascular disease, respiratory diseases etc. Assessment is necessary to be carried out in urban areas which are severely exposed to outdoor air pollution. Air pollution is mainly associated with industrial and automobile sources of which motor vehicles are of major concern. To carry out study on assessment of ambient air quality parameters like Sulphur Dioxide (SO2), Oxides of Nitrogen as NO2, Respirable Suspended Particulate Matter (RSPM / PM10) and Fine Particulate Matter (PM2.5) various methods can be adopted to monitor air quality. This study will lead us to discuss various approaches and methods to assess ambient air quality and counter air pollution.

Keywords : Ambient Air , Air Pollution, Monitoring,

1. INTRODUCTION

The air pollution refers to the presence of harmful substances and particles in the air we breathe. These pollutants can come from a variety of sources, including factories, vehicles, power plants, and natural sources like wildfires and dust storms. The most common air pollutants include particulate matter, nitrogen oxides, sulphur dioxide, ozone, and carbon monoxide. Air pollution can have serious consequences for human health, including respiratory problems like asthma and bronchitis, increased risk of heart disease and stroke, and even cancer. It can also harm the environment, damaging crops and forests and contributing to climate change. The urban air quality is very important and enhanced the life of living beings. The recent studies in various places of the world revealed an increase in levels of ozone (O3) and particulate matter (PM).

Central Pollution Control Board is executing a nation-wide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP). The network consists of 804 operating stations covering 344 cities/towns in 28 states and 6 Union Territories of the country. Under N.A.M.P., four air pollutants viz., Sulphur Dioxide (SO2), Oxides of Nitrogen as NO2, Respirable Suspended Particulate Matter (RSPM / PM10) and Fine Particulate Matter (PM2.5) have been identified for regular monitoring at all the locations. to high levels of air pollution can cause a variety of adverse health outcomes. It increases the risk of respiratory infections, heart disease, stroke and lung cancer. Both short and long-term exposure to air pollutants have been associated with health impacts. More severe impacts affect people who are already ill. Children, the elderly and poor people are more susceptible. Although air quality in high-income countries has been generally improved over the last decades, the adverse health effects of particulate air pollution, even at relatively low levels, remain a global public health concern. Air pollution very often has multiple sources and acting on a single one may not bring enough benefits for health. Although most newer motor vehicles have more efficient engines and are using cleaner fuels, the absolute number of vehicles is still increasing in many cities worldwide -- and consequently so are levels of ambient air pollution. Indeed, in parts of Europe where stricter standards and regulations for vehicles have been enforced, ambient air pollution levels are stable or decreasing, yet air quality levels are still above the WHO AQG values. Air pollution is a matter of major concern in India. In recent years the world has seen the changes in climatic conditions and these changes have been significantly contributed to change in air quality in such manner that has been created a lot of circumstances causing inconvenience and diseases to human beings. Such type of challenges not only causing health hazards but also it causes more expenditure done by government to combat air pollution. The ministry of environment, forests and climate change has been allocated Rs 3,079 crore for financial year 2024 which is a 24% increase over the revised estimates of financial year 2023. The developing nations like India is facing increased air pollution because of ongoing urbanization. In Indian cities pollutants are either emitted from natural sources or anthropogenic sources. Under National Air Quality Monitoring

Programme (NAMP) which is executed by CPCB across the India, it has been suggested to focus mainly on four pollutants viz., Sulphur Dioxide (SO2), Oxides of Nitrogen as NO2, Respirable Suspended Particulate Matter (RSPM / PM10) and Fine Particulate Matter (PM2.5).

2. Air Pollution in Narsinghpur:

Geographically, Narsinghpur is located at 22.95°N 79.2°E. It has an average elevation of 347 metres (1,138 ft). Waves move slowly except during the south-west monsoon. The district's usual minimum temperature rests around 25–26 degrees Celsius (77–79 °F), and the maximum temperature rises up to 45–46 °C (113–115 °F). May is the hottest month of the year. It is very excessively hot during summer, and in the end of this season dust storms come. When the monsoon arrives, the hygrometer mercury goes very low. The district's 90% rainfall is observed during monsoon months only; i.e., June to September. The average rainfall is of 60 days per year, and measures approximately 40 inches (1,016 mm). During December–January it is cold, and the average temperature during day time is around 9 °C (48 °F) and 3.2 °C (38 °F) at night. Sometimes cold waves also occur, and heavy fog is also observed. Major air pollutant present in the city are; PM2.5, PM10, SO2, NO2, NH3, O3, CO, Ni & As. As per the data of CPCB, there is no data present till today .

3. Air Quality Monitoring

The methods of measurement prescribed by CPCB for respective parameters are the combination of physical method, wet-chemical method and continuous online method. The continuous online ambient air quality monitoring systems are equipped with analyzers for measurement of PM10, PM2.5, SO2, CO, NO2, O3, NH3 and Benzene. The metallic parameters Pb, Ni, As are measured offline using filter based air samplers. The ambient air quality monitoring station (AQMS) consists of following systems:

· PM10 & PM2.5: Operates on the principle of Beta Ray Attenuation and measures Particle Mass concentration ranging from 0 to 5 mg/m3 with Minimum detection limit 1 µg/m3 . The equipment includes a PM10 inlet and PM2.5 inlet.

· NOx and NH3: Operates on the principle of Chemiluminescence method, ranging from 0 to 2000µg/m3 with minimum detection limit 0.5µg/m3 .

· SO2 Analyser: Operates on the principle of UV Fluorescence method, ranging from 0 to 2000 µg/m3 with minimum detection limit 0.5 µg/m3.

· O3 Analyser: Operates on the principle of UV Photometry method, range : 0 to 2500µg/m3 with minimum detection limit 0.5 µg/m3.

· Multigas Calibrator: to calibrate gas analyzers manually, remotely controlled or automatically, for quality assurance. Multi Calibration upto 20 points.

· Automatic Weather Station (AWS): Ultrasonic Wind Sensor, Barometric Pressure, Temperature, Relative Humidity, Rainfall, Solar Radiation etc.

All these instruments except AWS are housed in a room or walk-way shelter with proper sampling system for gaseous and particulate matter parameters. AQMS should have the calibration facility for onsite calibration with zero and standard gases. Beta Ray Attenuation for the measurement of PM10 and PM2.5 should be calibrated with standard filters. The detailed guideline for site selection, measurement frequency, reporting etc has been notified by CPCB. Each AQMS should also have a PC for recording and transmission of the data via internet.

4. Air Quality Monitoring Mechanisms

A. Air Quality Monitoring System (AQMS): This system consists the Air Quality Walkway Shelters with different air quality analyzers, Calibration System, Zero Air Generator, Sampling System, UPS, ACs and control computer installed in the Shelter. The main control room computer receives data from all AQMS control computers in a particular city, Central Control Room Server at IITM, Pune and FTP server at each stations control room.

B. Digital Display System (DDS): It consists of LED and LCD digital display boards along with a control computer to receive data from FTP server and to transmit the same to display boards.

C. Automatic Weather Stations (AWS): AWSs have been installed in some cities adjacent to Air Quality Walkway Shelters with a computer in control room of respective city to receive data from different stations in a particular city and to transmit the received data to Central Control Server at IITM, Pune.

5. Ambient Air Quality Monitoring Equipment

various instruments are used to monitor ambient air quality such as high-volume sampler, low volume sampler, Dichotomous sampler, respirable dust samplers etc.

A. High volume sampler: High volume sampler is a basic instrument used to monitor airborne particulate matter having diameter less than 10 micrometre. It draws large volume of air which is more than 1500 m^3 of air over 24 hours.

B. Low Volume Sampler: Basic difference between high volume sampler and low volume Samper is amount of air sampled. low volume sampler draws only 24 m^3 of air or less.

C. Dichotomous Sampler: The dichotomous air sampler is a dual-filter air sampler for the simultaneous collection of the fine $PM_{2.5}$ and the course $PM_{10-2.5\ particles}$ contained within PM_{10}. In this sampler virtual impacted allows to separate aerosol particles based on virtual impaction principle.

D. Respirable Dust Sampler: The primary purpose of personal respirable dust sampling is to characterize (with regard to mass and size) the quality of the ambient air to evaluate a miner's dust exposure. The mass of respirable dust inhaled can be determined by sampling. Their extremely small size also means they can be breathed deep into your lungs and lead to lung damage.

6. Air Pollution Control Devices

A. Mechanical Dust Collectors: mechanical dust collector is defined as a device which separates dust in a dry state from gas through the application of inertial and gravitational forces only. The most widely used type of mechanical dust collector is the cyclone, in which centrifugal force plays the major role in effecting

the separation of dust from gas.

B. Electrostatic Precipitators : An electrostatic precipitator is a type of filter that uses static electricity to remove soot and ash from exhaust fumes before they exit the smokestacks.[2] Unburned particles of carbon in smoke are pulled out of the smoke by using static electricity in the precipitators, leaving clean, hot air to escape the smokestacks.[2] It is vital to remove this unreacted carbon from the smoke, as it can damage buildings and harm human health - especially respiratory health.

C. Cyclone Separators : A cyclone separator is a separation device that uses the principle of inertia to remove particulate matter from flue gases.[3] In these separators, dirty flue gas enters a chamber containing a vortex, similar to a tornado. Because of the difference in inertia of gas particles and larger particulate matter, the gas particles move up the cylinder while larger particles hit the inside wall and drop down. This separates the particulate matter from the flue gas, leaving cleaned flue gas.

D. Bag House : A baghouse, also known as a baghouse filter, bag filter, or fabric filter is an air pollution control device and dust collector that removes particulates or gas released from commercial processes out of the air.

7. Conclusion:

Various researches have been conducted to analyse the change in air quality parameters with change in climatic conditions. Environmental monitoring methods are used according severity of polluted zones, thus this work is an attempt to assess available research studies on ambient air quality. A review of various researches reveals data with a specific focus on particular areas. Review study shows that there is a large contribution from industrial activities, transportation and dust in the ambient air. I will be doing monitoring the PM concentration of the Narsinghpur city which will be helpful in knowing current air quality in the city by collecting samples from top 10 busiest location in Narsinghpur city. This can be useful for further research studies.

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