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# Air Quality Monitoring Methods and Sampling Devices: A Review

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***Abstract:*** ***Air pollution is a global environmental challenge that has continued to receive worldwide attention despite the recent decline in concentration of atmospheric pollutants following stringent environmental protection regulations.Air pollution occurs when the air contains gases, dust fumes, or odour in harmful amounts. To estimate the amount of air polluted air quality monitoring is needed. Some of the air sampling devices like high volume samplers are useful to collect the air samples. Pollutants are nothing but any substance that may present in an atmosphere in such a concentration that it may harmful to surrounding, living organism or human being. Sampling and analysis of air pollutants is known as Air quality monitoring. Data obtained by Air quality monitoring is used to take some action to reduce pollutant concentration to acceptable limits by Environmental Consultants. In this paper air quality monitoring methods and sampling devices are discussed.***
***Keywords: Air Pollutants, Monitoring, Air Pollution, Sampling Devices, High Volume Sampler***

## I. INTRODUCTION

The CPCB is executing nationwide monitoring network under NAQMP, which consists of 341 stations covering 126 cities/towns in 25 States and 4 Union Territories. Sulphur Dioxide (SO2), Oxides of Nitrogen (as NO2), Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM10), are regularly monitored at all locations in addition to the monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature [1]. The air quality monitoring is undertaken continuously for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have about 104 observations in a year. The monitoring is being carried out by CPCB in association with SPCBs, PCCs, National Environmental Engineering Research Institute (NEERI), Nagpur. The CPCB coordinates and supervises the uniformity and consistency of air quality data also and provides technical and financial support.

### *A. Survey of preliminary information*

During ambient air pollutants sampling, it is also necessary to collect information on qualitative and quantitative data on the local sources of air pollution, topography, population distribution, land use pattern, climatology, etc, depending upon the objectives of the survey or measurement campaign. It includes selection of sampling procedures and analysis of samples, sampling locations, period and frequency of sampling and duration, auxiliary measurements [2].

### *B. Selection of sampling procedure*

There are two types of sampling. They are continuous and time averaged in–situ samplings. Continuous sampling is carried out by automatic sensors, optical or electrochemical, and spectroscopic methods which produce continuous records of concentration values. The specific time-averaged concentration data can then be obtained from continuous records. Time-averaged data can also be obtained by sampling for a short time by sampling a known volume of air for the required averaging time. Samples are then analyzed by established physical, chemical, and biological methods for the concentration values which are the effective average over the period of sampling[3].So the most important objective of any air sampling exercise is to obtain a genuine & representative sample. There are both gaseous & particulate pollutants whose concentration is find out in milligram per cubic meter of air. Particulate sampling is done with help of high volume air sampler, Dust sampler. In these samplers, particles less than 10 micron are taken into consideration. Filter paper being used in that sampler. Difference between weights of filter papers divided by quantity of air passed gives you particulate matter present in air.

### *C. General classification of techniques and methods applied in air studies*

Generally, the techniques and methods used to study atmospheric air can be classified According to the following parameters:
Pollutant state (gaseous, liquid, aerosols, particulate matter),
Compound type and its concentration level,

Aim of measurements (estimation of emission, deposition),
Period of measurement (long- or short-term),
Manner of measuring (direct or with sample pre-concentration) and measurement site ( *in situ*, in laboratory),
Automation level of measurements

## II. AMBIENT AIR SAMPLING TYPES

There are many methods available for collection of Air pollutants from atmospheric Air i.e. Grab Sampling, absorption in liquids, adsorption on solids materials & Freeze-out sampling in process of Environmental Monitoring [4].

### *A. Grab Sampling*

In grab sampling, air sample is collected by filling an evacuated flask. This is very old and traditional Ambient Air Sampling Method. Plastic bags have been used for grab sampling for storage of gas & then subjected to analysis of grabbed sample. Grab sample may be taken using rigid wall containers made from glass or stainless steel. These containers first evacuated & then allow air to enter to fill the container.

Alternatively, a container may be filled with water & then used as a collector simply by draining water which is replaced by filling air sample. "Grab" sampling is just that...a short "grab" of air that is analyzed for particular contaminants of interest[5]. This type of sampling provides limited results on "exposure" and is typically incorporated into a qualitative evaluation to establish "presence" or "absence" of a particular contaminant.

It is commonly employed in indoor air quality evaluations, post-accident clearance sampling, and presence/absence testing to determine if a contaminant is present during a short process. Equipment used to complete this sampling often includes tedlar bags (to pull air into for laboratory evaluation), dragger tubes (drawing air through a detector tube for detection of known contaminants), and direct-reading instruments (to test for presence/absence of contaminants or oxygen content).

### *B. Absorption in Liquids*

Absorption of gaseous pollutants in liquid medium is one of the most common methods for collecting air samples. To bring out high degree (pollutant) gas-liquid contact, impingers & midget type's devices are used. These devices can handle sample flow rates about 30 to 3 litres per minutes respectively. Particular absorbent-liquid (say 0.1 N NaOH) is filled inside Impinge[6]. Flow is controlled with help of flow control devices. If done with sampling procedure, particular absorbent is then desorbed into lab for analysis & then concentration of (say, NOx) required gas is find out. Majority of Environmental Consultancy firms prefer this absorption in liquids among Ambient air sampling Methods because of there is very negligible loss of degree of quality as well as quantity of pollutants while carrying it to laboratory

### *C. Adsorption on Solids*

In this Ambient Air Sampling Method pollutant gas is absorbed on surface of solid. The air sample is passed though packed column containing finely divided adsorbent on whose surface pollutants are retained. Commonly used adsorbent is activated charcoal & silica gel, activated alumina, and a molecular sieve which is synthetic sodium or calcium alumina silicate. After sampling, sample gases are desorbed into lab for analysis. This may be accomplished by washing adsorbent with liquid solvent.

### *D. Freeze-out sampling*

Freeze-out sampling contains series of cold traps which being used to condensate air pollutants from air. The traps are bought into laboratory, samples are removed, & analysis be means of mass spectro-photometry, Gas Chromatography, Spectro-photometry,etc.

This method is used to collect hydrocarbons, radioactive gases and insoluble or non-reactive vapours. Air pollutants, existing as gases, can be trapped or removed by the freeze out or condensation method; trapping implies collecting a pollutant, and removal implies freeing unwanted gas contaminants from the gas stream. The mechanics of the freeze out condensation process is as follows: Air is drawn through collection chambers at a progressively lower temperature; if the chamber temperature is equal to or less than the boiling point of the gas, the gas will change into a liquid

## III. AIR SAMPLING METHODS

Air sampling methods vary according to the contaminants. The most common types of air sampling methods include the following:
The 5 Types of Air Sampling Methods

### *A. Whole Air sampling*

This is the most simple of all air sampling methods. It involves collecting a whole air sample in a sample bag or can. This method is perfectly acceptable for sampling permanent gases, such as oxygen. The difficulty with this sampling method is that the holding time for bag samples is only around 1 to 3 days. That means a sample would need to be rushed to the laboratory immediately upon collecting the sample to ensure best results.

*B. Solid Sorbent Sampling (Active*)

This method of air sampling involves drawing air through a tube filled with solid sorbent material. Any contaminants that may be in the air are chemically absorbed within the material inside the tube. It's important to note that this is not a catch-all solution[7]. There is no sorbent material designed to capture all types of air contaminants at once. However, there are numerous types of sorbent materials available for capturing the particular chemical or class of chemicals that are used for testing.

*C. Solid Sorbent Sampling (Passive)*

Select sorbent material can be used in passive mode. The difference between active and passive is that passive mode means the contaminants are absorbed into the sorbent material via diffusion. Active mode means having to actively pull the air through the sorbent material with a pump. Passive sorbent sampling has a few advantages over active sampling. It is discreet, the sampling material is easy to work with, and it's a method that can be used for long-term sampling. Investigating odors and ambient air perimeter ("fence line") monitoring can be accomplished especially well with passive solid sorbent sampling.

*D. Impinger Sampling*

Liquid impinges can be used to sample certain contaminants in the air. This method is very similar to active solid sorbent sampling in the sense that it works by having contaminants chemically react with a solution as a sample of air is bubbled through the liquid[8]. This method of air sampling is not as commonly used as it once was; there are now many alternative methods which use treated sorbent tubes instead of impingers.

*E. Filter Sampling*

This method of air sampling is designed for collecting contaminants in the form of vapors. Collecting contaminants in the vapor phase involves using chemically treated filter material designed to cause a reaction when the contaminant you're testing for passes through it. This method is also similar to active sorbent sampling, in the sense that filter sampling involves using a sampling pump to pull a known volume of air through a filter cassette.

These are the five most common types of air sampling methods. If indoor air quality is a concern of yours, know that we offer an air quality testing kit that tests for over 700,000 compounds affecting indoor air quality. To see if the air you're breathing every day contains any toxic organic chemicals, order one of our home air quality testing kits today.

## IV. RESULTS AND CONCLUSIONS

Ambient air monitoring is an integral part of an effective air quality management system. Reasons to collect such data include to:
assess the extent of pollution;
provide air pollution data to the general public in a timely manner;
support implementation of air quality goals or standards;
evaluate the effectiveness of emissions control strategies;
provide information on air quality trends;
provide data for the evaluation of air quality models; and
support research (e.g., long-term studies of the health effects of air pollution).
There are different methods to measure any given pollutant.

A developer of a monitoring strategy should examine the options to determine which methods are most appropriate, taking into account the main uses of the data, initial investment costs for equipment, operating costs, reliability of systems, and ease of operation.

The locations for monitoring stations depend on the purpose of the monitoring [9]. Most air quality monitoring networks are designed to support human health objectives, and monitoring stations are established in population centers. They may be near busy roads, in city centers, or at locations of particular concern (e.g., a school, hospital, particular emissions sources). Monitoring stations also may be established to determine background pollution levels, away from urban areas and emissions sources

## V. CONCLUSION

A great number of analytes and the broad range of concentrations in which they can be present means that there is no universal method for air sampling. The different aims of analysis and the necessity of getting the desired information require the application of specific sampling techniques and methods for final determination. This can be confirmed by literature concerning the analysis of air in which many different systems for air sampling and analysis are presented. In this paper some exemplary solutions have been presented[10]. Many review papers deal with these problems. The study of air pollution and air quality monitoring has evolved from simple box model studies to advanced models that can handle different meteorological conditions and complex situations, such that the problem of air pollution even though not yet solved is better understood and can be better controlled.

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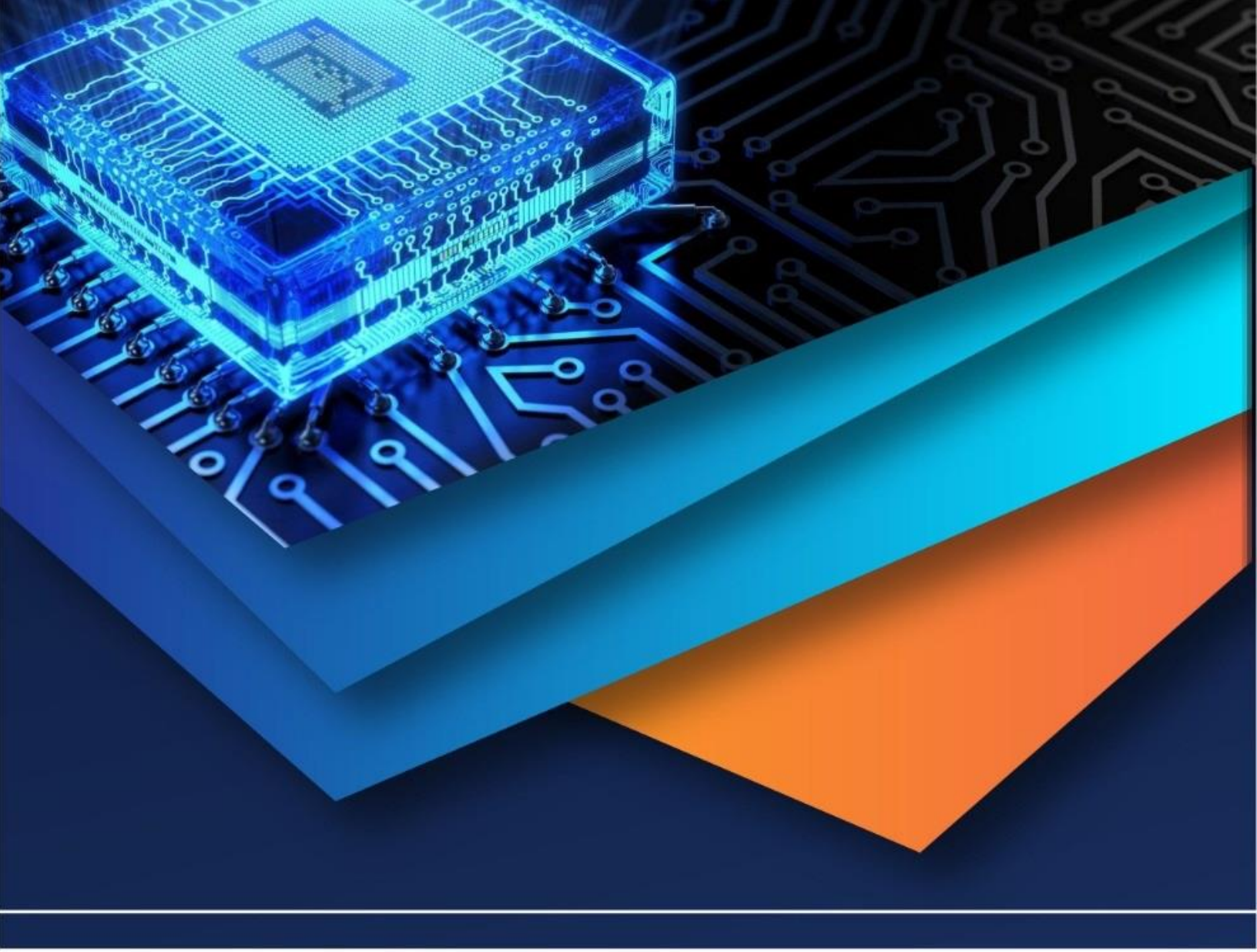

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