Laboratory Manual for Air Quality Sampling and Analysis

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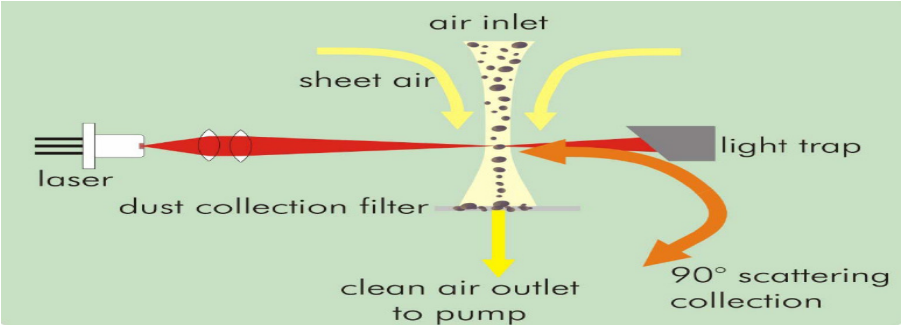
MONITORING OF RESPIRABLE PARTICULATE MATTER

1. **Objective**
   Sampling of respirable particulate matter in the ambient and indoor environment air and the demonstration of its concentration in various sizes.

2. **Instrument**
   Environmental dust monitor with weather house (automatic sampler) for $PM_{10,}$ $PM_{2.5}$ and $PM_{1.0.}$

3. **Working principle**
   The dust particles are measured by the physical principle of orthogonal light scattering. Here particles are illuminated by a laser light in an angle of 90 degree. All units of environmental dust monitor use light-scattering technology for single-particle counts. The scattered signal from the particle passing through the laser beam is collected at approximately 90° by a mirror and transferred to a recipient-diode. The signal of the diode is feed, after a corresponding reinforcement, to a multi-channel size classifier. This pulse height analyzer then classifies the signal high of each channel. These counts of each channel are converted each minute in a mass distribution from which the different PM values derive.



Measurement principle

4. **Sampling location guidelines**
   Sampling location should be located depending upon the objective of measurement campaign and be kept at an altitude depending upon the type of study region (roadways, industrial area, disposal sites, residential area, etc). Generally it is kept at a height of about 3m to 10m from the ground level and sufficiently away from the disturbance of direct obstacles from the source under consideration.

5. **Sampling frequency guidelines**
   Sampling is carried out for various purposes. The regular monitoring campaign of national ambient air quality includes measurement of particulate matter typically for 24 hours at least twice a week making about 104 samples a year.

6. **Steps for sampling**
   a. Prepare a sampling assembly.
   b. Set the time constant depending upon the required averaging period.

c. Instrument can be switch on and it will display concentration values in $\mu g/m^3$.
d. Simultaneously instrument will start recording the concentration values in the memory card.

7. References

a. CPCB (2011), Guidelines for the Measurement of Ambient Air Pollutants, Volume-1, Delhi.
b. IS 5182 (part 23), 2006, Indian standards – Methods for measurement of air pollution, Part-23 – Respirable suspended particulate matter (PM_{10}), cyclonic technique.
c. GRIMM, environmental dust monitor (model 1.107) manual.
d. IS 5182 (Part 14)-2000 (reaffirmed 2005): Indian standards, Method of measurement of air pollution: Guidelines for planning the sampling for atmosphere.
e. Rao, M.N., and Rao, H.V.N., Air pollution. Tata McGraw-Hill Publishing Co. Ltd., New Delhi 1989.

MONITORING OF GASES AND PARTICULATES IN AMBIENT AIR

1. Objective

To measure the ambient concentrations of gases and particulate matter by using High Volume Sampler (HVS).

2. Instruments

a. High volume sampler (HVS)
b. Whatman filter paper
c. Impingers

3. Principle

PM10 and TSPM are measured by passing air at flow rate of about 1 liters/minute through high efficiency cyclone which retains the dust particles greater than 10 micron size and allow only fines (less than 10 micron particles) to reach the glass microfibre filter where these particles are retained. The instrument provides instantaneous flow rate and the period of operation (on-time) for calculation of air volume passed through the filter. Amount of particulates collected is determined by measuring the change in weight of the cyclone cup and filter paper.

4. Reagents for gaseous pollutants

a. 0.1 N Sodium tetra-chloratemercurate (SO_2)
b. Sodium hydroxide and sodium arsanite (NO_2)

5. Procedure

For particulates

a. Perform leak check of the instrument before starting the sample.
b. Filter paper need to be inspected for pin holes.
c. Filter conditioning need to be done at 20-25ºC temperature and less than 50% Relative Humidity.
d. Never fold filter completely.
e. Do not touch filters by dirty hands always use disposable hand gloves.
f. Under take regular cleaning of key components of the machine.
g. Ensure stable power supply to the machine. Do not leave loose contact of supply wire to the machine.
h. Always fill up distilled water in manometer assembly.
i. Do not switch on and off machine using Timer Switch.
j. Clean impinge and rotameter regularly and also clean manifold once in two months.
k. Do not take flow reading immediately after switching on the machine. Give 5 minute for flow stabilization and for heat up the blower components.
l. Always attach a new weighed cyclone cup with every filter change.
m. Do not switch on machine without filter paper.
n. If machine is not expected to be operated within 48 hrs drain out the manometer water and store machine with water in the manometer tank.
o. Do not run machine during rain in open atmosphere.

For gaseous

The increasing general awareness of atmospheric pollution and its hazards to the health and well-being of industrial workers, educational buildings, offices etc., is bound to result in greater stress on accurate, reliable and frequent assessment of work place pollution and worker-exposure. Use additionally impinge tray with HVS sampler simultaneously sample gaseous pollutants.

6. Calculation for particulates

a. Initial Manometer Reading =
b. Final Manometer Reading =
c. Initial Filter Paper Weight =
d. Final Filter Paper Weight =
e. Initial Cyclone Cup Weight =
f. Final Cyclone Cup Weight =
g. Total Suspended Particulate Matter Concentration =

7. References

a. CPCB (2011), Guidelines for the Measurement of Ambient Air Pollutants, Volume-1, Delhi.
b. IS 5182 Part 2 Method of measurement of air pollution: Sulphur dioxide
c. IS 5182 (Part 6)-2006: Indian standards, Method of measurement of air pollution: Nitrogen dioxide.
d. IS 5182 (Part 14)-2000 (reaffirmed 2005): Indian standards, Method of measurement of air pollution: Guidelines for planning the sampling for atmosphere.
e. Rao, M.N., and Rao, H.V.N., Air pollution. Tata McGraw-Hill Publishing Co. Ltd., New Delhi 1989.

INDOOR AIR QUALITY MONITORS

1. Objective

To understand how to operate the instrument and also know the basic knowledge of indoor air quality (IAQ) monitor.

2. Apparatus

Indoor air quality monitor (automatic sampler) for carbon monoxide (CO), carbon dioxide (CO_2), temperature and humidity.

3. Indoor Air Quality monitor

With 90% of our time spent indoors, determining the quality of the air we breathe indoors is essential for good health and productivity. The IAQ monitor key indoor air quality indicators including CO_2, humidity, temperature and CO. Should these measurements fall outside recognized guidelines; further tests can be made to suggest an appropriate course of action. For example, ventilation studies show that as room temperatures rise above 75°F(24°C) the ability of occupants to concentrate can drop by up to 50% and high levels of carbon dioxide will indicate poor ventilation that results in drowsiness and perceived stuffiness. Both situations are very common and seriously affect productivity. Over-ventilation wastes energy and results in increased building running costs. The Surveyor range has been designed with the user in mind. Minimal training is required to use the instruments as the intuitive menu system and display provide step-by-step guides for each operation that are updated when smart probes are plugged in.

4. Steps for sampling

a. Prepare a sampling assembly.
b. Set the time constant depending upon the required averaging period.
c. Instrument can be switch on and it will display concentration.
d. Simultaneously instrument will start recording the concentration values in the memory card.
e. Using data transfer cable (i.e. RS232 cable) can download data from instrument to personal computers.

5. References

a. AQ-5000, indoor air quality monitors manual, QUEST technology, USA.

MEASUREMENT OF METEOROLOGICAL PARAMETERS

1. **Objective**
   Measurement of meteorological parameters in the ambient air.

2. **Instruments**
   Micrometeorological weather station

3. **Sampling location guidelines**
   Weather station should be located depending upon the objective of measurement campaign and be kept at an altitude depending upon the type of study region (for specialized research studies) and should be free from any other obstruction. Generally it is kept at a height of about 10m from the ground level.

4. **Sampling frequency guidelines**
   Measurements of weather properties are carried out for various purposes. The regular monitoring campaign includes measurements of wind speed, wind direction, temperature and relative humidity typically every hour continuously throughout year or for the period of interests.

5. **Steps for sampling**
   a. Select a location safe and free from any obstruction around. It should be ensured that the direct air flow is not obstructed from any direction.
   b. Prepare and install a stand firmly at the location.
   c. After installing wind vane, it is oriented with respect to north and finally fixed properly.
   d. Prepare and install sensors.
   e. Connect all the sensors and vane to the micro data-logger.
   f. Set the time constant for displaying the average statistics of the meteorological parameters.
   g. Use suitable data cable for retrieving data from the micro-data-logger in the personal computer where data to be stored.

6. **References**
   a. SP-61: 1994 – General guidelines for automatic weather stations.
   b. Rao, M.N., and Rao, H.V.N., Air pollution. Tata McGraw-Hill Publishing Co. Ltd., New Delhi 1989.

BIOAEROSOL SAMPLING

1. Objective

To assess the microorganisms present in the indoor environment.

2. Instruments

a. Nutrient Agar (28g/1 Lit.)
b. Impinger
c. Petri dish (Autoclave at 121^0C, 15 lbs pressure for 15-20 minutes)
d. Sampling pump capable of meeting sampler manufacturer's flow specification (e.g., 28.3 L/min), with flexible connecting tubing
e. Cotton gauze pad
f. Refrigerant packs, if necessary for keeping samples cool during shipment

3. Procedure

a. Calibrate each sampling pump with a representative sample in line.
b. Before each run, carefully and thoroughly wipe each sampler stage with rubbing alcohol. Allow to dry. Make sure air passages are not blocked.
c. Load sampling media into sampler, remove covers from media, and attach sampler to pump with flexible tubing.
d. Take special care to prevent contamination of media during loading and unloading. Do not touch agar surface.
e. Sample at known preset flow for an accurately known time. (In heavily contaminated areas, a shorter sampling time may be necessary.)
f. Keep collected samples and blanks cool (not necessarily ice-cold) and ship as quickly as possible to a laboratory for enumeration and identification.
g. Micro-organisms are spread over the solidified agar medium with a sterile L-shaped glass rod.
h. The plates should be incubated in an inverted position to prevent collection of condensation on the agar surface. Unless the surface is dry it will be difficult to obtain discrete surface colonies
i. During incubation, the isolated microbes multiply, giving rise to individually isolated colonies in the lightest inoculated areas.
j. Avoid pressing the loop or needle too firmly against the agar surface as this will damage it.
k. Plating of the medium should be done twenty-four hours in advance of performing the exercise.
l. To obtain good results with this technique, the agar surface should be smooth, moist, and free of contamination.

4. References

a. Bio sampler operating instructions, SKC Inc, USA.
b. Buttner, M.P., Willeke, K., Grinshpun, S.A., "Sampling and Analysis of Airborne Microorganisms," Manual of Environmental Microbiology, ASM Press, Washington, DC, 1997, pp. 629-640.