Chapter 5:
Ambient and Source Air Quality Monitoring

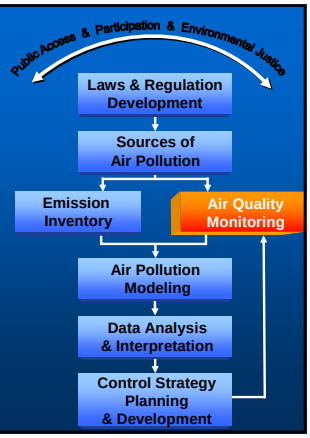
Chapter Overview

- Ambient Air Quality Monitoring
- Measurement of Emissions from Emission Sources

Lecture Support Items

- Ambient and Stack Gas Monitors Located Around the Room for Hands-On Experience
- “Show-and-Tell” Sampling Equipment Involving Filters, Impactors, and Hardware

Role of Air Quality Monitoring in an Air Quality Management Program.



Ambient Air Quality Monitoring

- Ambient air quality monitoring is the systematic, long-term assessment of pollutant levels in our communities.
- The primary goal of all air pollution control programs is the protection of the health of individuals living in communities from excessive exposure to atmospheric pollutants.

Why Monitor Emissions at the Ambient Level?

- Determine compliance with regulations
- Support compliance and enforcement activities
- Establish baselines in communities
- Assist with policy development
- Provide short-term data for control plans
- Provide data for epidemiological studies
- Provide public information through air quality reporting
- Assist with model validation
- Assess trends in a community or nationwide

Designing an Air Quality Monitoring Network in an AQMP

1. Set Objectives
2. Choose Parameters
3. Select Sites
4. Scheduling
5. Select Methods
6. Equipment Selection
7. Calibration Procedures
8. Recoding Methods
9. Data Analysis
10. Reporting Results

Network Design Objectives and Options

- The design should determine one of the following:
  1. Highest Concentrations
  2. Representative Concentrations
  3. Impact
  4. Background Concentration Levels
  5. Regional Pollutant Transport
  6. Welfare-Related Impacts

Matching Objectives to a Scale

Monitoring Objectives	Appropriate Siting Scales
Highest concentration	Micro, Middle, neighborhood or urban
Population	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
General/Background	Neighborhood, urban, regional
Regional transport	Urban/regional
Welfare-related impacts	Urban/regional
micro (1-100 metres), middle (100-500 m), neighborhood (0.5-4 km), urban (4-50 km), regional (tens to hundreds of km)	

Ambient Sampling Techniques

There are essentially two types of sampling collection techniques: gaseous collection, and particulate matter collection.

Gas Collection
- Absorption
- Adsorption
- Evacuated Container
- Condensation

PM Collection
- Filtration
- Impaction

Ambient Sampling Equipment

SSI PM-10 Sampler

Airmetrics MiniVol PM-10 Sampler

Ambient Sampling Equipment

Ogawa Passive Badges for SO_2, NO_2, and O_3

Used with Ion Chromatograph

Draeger Diffusion Tubes for CO

Ambient Sampling Equipment Cost

Item	Approximate Cost
SSI PM10 sampler, complete system	$5,500
Airmetrics MiniVol PM-10 (or PM-2.5) sampler, complete system	$2,100
Ogawa badge with clip (for passive sampling of O_3, NO_2, or SO_2)	$72 each
Pads (filters) for Ogawa O_3	$112 for 40 pads
Pads (filters) for Ogawa SO_2	$112 for 40 pads
Pads (filters) for Ogawa NO_2	$112 for 40 pads
Draeger tubes for CO	$87/set of 10 tubes
Filters (glass, microfiber, high purity) for SSI PM-10 sampler	$33/box of 100 filters
Brushes for SSI sampler motor	$10.50/set of 2 brushes

Typical Monitoring Station Equipment Cost

Pollutant	Technique	Cost
SO_2	UV Fluorescence	$ 9,167
NO_x	Chemiluminescence	$ 10,050
O_3	UV Absorption	$ 12,200
CO	Gas Filter Correlation	$ 8,900
PM-2.5	Beta Radiation	$ 13,885
Calibrator	Multi-Point Calibrator	$ 7,376
Met Station	Weather Station	$ 8,050
Data Logger	Data Logger	$ 9,100
Visibility	Digital Camera	$ 3,000

Typical Supporting Equipment Needs

Item	Cost
Weather Enclosed Temperature Controlled Housing with Concrete Floor	$ 2,500
Telephone/Electrical Connections	$ 750
Support and Calibration Gases	$ 4,900
Tools, Rack Mount,Transformer	$ 2,000
Sample Gas Manifold w/Inlet	$ 2,100

Typical QA/QC Activities For PM-2.5 Real-time Monitors

1. Leak-check	1. Initially
2. One-point Flow Check	2. Weekly
3. Sample Inlet Tube	3. Clean Every Two Weeks
4. Impactor Well	4. Clean Weekly
5. Water Collection Bottle	5. Empty Weekly
6. Examine O-rings	6. Clean or Replace Month
7. Electronic Timer	7. Inspect Each Use
8. Filter Tape	8. Inspect Each Use

Typical QA/QC Activities For Real-time Gas Monitors

1. Leak-check	1. Initially
2. Five-point Calibration Check	2. Initially and Weekly
3. Two-point Calibration Check (Zero/Upscale)	3. Daily (Automated)
4. Flow Check	4. Initially and Weekly
5. Data Acquisition System	5. Initially and Weekly
6. Electronic Timer	6. Inspect Each Use
7. Calibration Gases Certification/Pressures	7. Inspect Each Use
8. Environmental Control	8. Inspect Each Use

Typical QA/QC Activities For Meteorological Monitoring

1. Wind Speed	1. +/- 0.5 m/sec
2. Wind Direction	2. + or – 5 º
3. Ambient Temperature	3. + or – 0.5 ºC
4. Delta Temp. (Wind Stability)	4. + or – 0.1 ºC
5. Precipitation	5. + or – 0.5 mm
6. Barometric Pressure	6. + or – 0.2 " Hg
7. Time	7. + or – 5 minutes
8. Evaluated	8. Initially and Annual

Measurement of Pollutant Emissions

Why Monitor Emissions at the Source Level?

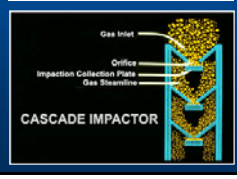
- Determine compliance with air pollution regulations
- Determine effectiveness of air pollution control technology
- Evaluate production efficiencies
- Support scientific research

Goal of Testing

1. The gas being sampled from a source should represent either the total or a known portion of the emissions from the source.
2. Samples of the emissions collected for analysis must be representative of the gas stream being sampled.
3. The volume of the gas sample withdrawn for analysis must be measured accurately in order to calculate the concentration of the analyzed constituents in the sampled gas stream.
4. The gas flow rate from the source must be determined in order to calculate emission rates for the various constituents.

Monitoring Particulate Matter Options

- Sampling Particulate Matter Options
  - TSP
  - PM-10
  - PM-2.5
- Sampling Technique Options
  - Filtration
  - Impaction
- Monitoring Interval Options
  - Time-Integrated
  - Real-time



Typical Cost For Various Monitoring Options

TSP Sampler	$ 1,650
TSP Mass Flow	$ 2,600
PM-10 (Time Integrated)	$ 5,200
PM-10 (Real-Time)	$ 10,500
PM-2.5 (Time Integrated)	$ 7,400
PM-2.5 (Real-Time)	$ 15,500
Portable TSP Sampler	$ 2,500

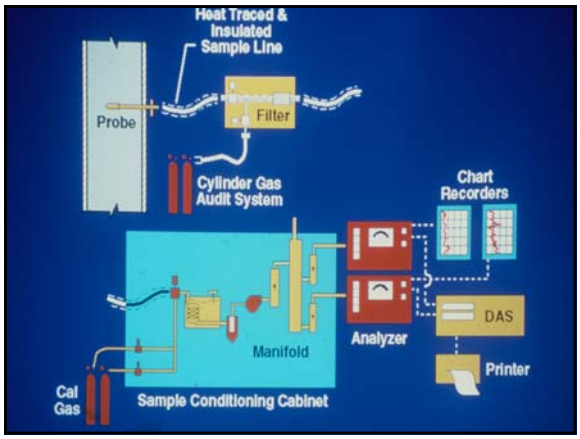
EPA Reference Methods and Equivalents

The U.S. EPA has developed Federal Reference Methods and Federal Equivalent Methods for sampling and analysis of pollutants in the ambient air and from emission sources.

- http://www.epa.gov/ttn/amtic

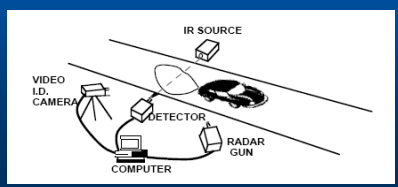
Continuous Emission Monitoring

- "Continuous " measures the emissions on an ongoing bases for a period of time (i.e., hours, days, weeks, months, and years…)
- Less time-consuming and labor-intensive than manual source testing
- May provide a more representative picture of emissions than one-time source testing.



Roadside Monitoring

- Another type of monitoring that can be performed is roadside monitoring, where pollutant levels in a vehicle's exhaust are measured while the vehicle is traveling down the road.



Roles and Responsibilities

- It is important to identify clear roles and responsibilities to ensure all monitoring tasks are maintained.

Regulatory Requirements for Ambient and Source Monitoring in South Africa

Chapter Review

- Air quality monitoring is carried out to assess the extent of pollution, ensure compliance with national legislation, evaluate control options, and provide data for air quality modeling.
- The measurement of both type and quantity of air pollutant emissions from a source is an important part of obtaining the data needed to implement a meaningful control program.
- There are a number of different methods to measure any given pollutant, varying in complexity, reliability, and detail of data.

Classroom Demonstration and Hands-on with Continuous Emission Monitoring Systems

Opacity CEM
Gas CEM

AQM Planning Tool Activity