Air sampling

The components of an air pollution monitoring system include the collection or sampling of pollutants, the analysis or measurement of the pollutant concentrations, and the reporting and use of the information collected.

Particulate monitoring uses gravimetric principles. In gravimetric analysis, a filter-based high-volume sampler (a vacuum- type device that draws air through a filter or absorbing substrate) retains atmospheric pollutants for future laboratory weighing and chemical analysis. Particles are trapped or collected in filters, and the filters are weighed to determine the volume of the pollutant. The weight of the filter with collected pollutants minus the weight of a clean filter gives the amount of particulate matter in a given volume of air. Chemical analysis can be done by Atomic Absorption Spectrometry (AAS), Atomic Fluorescence Spectrometry (AFS), Inductively Couple Plasma (ICP), spectroscopy, and X-ray Fluorescence (XRF) spectroscopy.

Some of the most common techniques to analyse gaseous pollutants include spectrophotometry, chemiluminescence, Gas Chromatography-Flame Ionization Detector (GC-FID), Gas Chromatography-Mass Spectrometry (GC-MS), and Fourier Transform Infrared Spectroscopy (FTIR).

Spectrophotometry is one of the most useful and widely used tools available for quantitative analysis. It relies on colorimetric principles. Chemiluminescence methods are highly sensitive means for determining atmospheric pollutants such as ozone, oxides of nitrogen, and sulphur compounds.

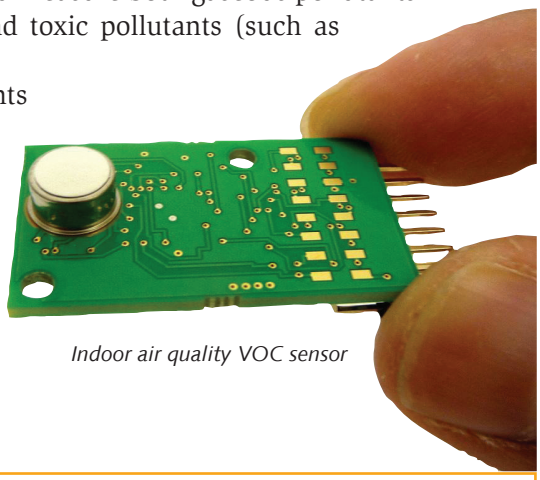
GLOSSARY

device: instrument, mechanism
to draw (drew-drawn): to take, to catch
to retain: to keep
to rely on: to be based on
sampling: to take a part of something to be examined
trapped: intercepted
to weigh: to measure how heavy something is

Unexpected glimpses

Klaus Lackner from Columbia University is working with Global Research Technologies to create artificial trees that will pull carbon dioxide from the air, just as real trees do. His air capture machines are like giant filters that trap the carbon dioxide that will be later freed and converted into a liquid: syngas, synthetic gas that can be used as a fuel stock. Alternatively, it could be disposed of through geologic and mineral sequestration.

Gas Chromatography (GC) coupled with a Flame Ionization Detector (FID) is employed for qualitative identification and quantitative determination of volatile organic compounds (VOCs).
Gas Chromatography-Mass Spectrometry (GC-MS) instruments have also been used for identification of VOCs.
Fourier Transform Infrared Spectroscopy (FTIR) can detect and measure both gaseous pollutants (such as carbon monoxide, sulphur dioxide, and ozone) and toxic pollutants (such as toluene, benzene, and methanol) in air.
All the data collected through the measurement of pollutants in the air we breathe and from emissions sources is used to develop emission inventories. An emissions inventory is a quantitative list of the amounts and types of pollutants that enter the air from all sources within a certain area. The fundamental elements in an emission inventory are the characteristics and locations of the sources, as well as the amounts and types of pollutants emitted.



Indoor air quality VOC sensor

1 *Use the following analytical techniques to complete the table which summarizes the air pollutants monitoring methods described in the reading passage.*

AAS (Atomic absorption spectrometry) – Chemiluminescence – Fourier Transform Infrared Spectroscopy (FTIR) – Gas chromatography (GC) – Flame ionization detector (FID) – Gas chromatography-mass spectrometry (GC-MS) – Gravimetric analysis – Spectrophotometry

METHODS OF MEASURING AND ANALYZING AIR POLLUTANTS

METHOD	VARIABLE MEASURED	PRINCIPLE
	PM_{10}, $PM_{2.5}$	Particles are trapped or collected in filters, and the filters are weighed to determine the volume of the pollutant.
	more than 60 metals or metalloid elements (e.g. Pb, Hg, Zn)	This technique operates/works by measuring energy changes in the atomic state of the analyte. Emitted radiation is a function of atoms present in the sample.
	SO_2, O_3	Measure the amount of light that a sample absorbs. The amount of light absorbed indicates the amount of analyte present in the sample.
	NO_2, O_3	Based upon the emission spectrum of an excited species that is formed in the course of a chemical reaction.
	VOC	Responds in proportion to the number of carbon atoms in a gas sample.
	VOC	Mass spectrometers use the difference in mass-to-charge ratio (m/z) of ionized atoms or molecules to separate them from each other.
	CO, VOC, CH_4	Sample absorbs infrared radiation and the difference in absorption is measured.

2 *Working in groups, describe the techniques you have used in your laboratories to measure and analyse air pollutants.*

3 **Class challenge.** *As you have read in the passage, an Emission Inventory is an account of all air pollution emissions from sources within an area, over a specific time interval. Here is an example of an* Air Emission Inventory *form containing formulas and acronyms for some common air pollutants. See who is the first to match those formulas and acronyms with the substances listed below.*

a.	Ammonia	NH_3	**g.**	Nitrogen Oxides	
b.	Carbon Dioxide		**h.**	Nitrous Oxide	
c.	Carbon Monoxide		**i.**	Perfluorocarbon	
d.	Hazardous Air Pollutant		**j.**	Sulphur Hexafluoride	
e.	Hydrofluorocarbon		**k.**	Sulphur Oxides	
f.	Methane		**l.**	Volatile Organic Compound	

AIR EMISSION INVENTORY
GENERAL INFORMATION

Plant Name .....

Plant Location (Address) .....

Phone number .....

Email address .....

EMISSIONS STATEMENT
Total Plant Emissions (Tons Per Year)

CO	NH_3	NO_x	Lead	PM_{10}	$PM_{2.5}$	SO_x	VOC	Greatest single HAP	Other HAPs

Total Plant Greenhouse Gas Emissions (Tons Per Year)

CO_2	N_2O	CH_4	PCFs	HFCs	SF_6

Chargeable Emissions (Tons)

NO_x	Lead	PM10	SO_x	VOC	Greatest single HAP	Other HAPs

CERTIFICATION OF TRUTH, ACCURACY AND COMPLETENESS

I certify under penalty of law that, based on information and belief formed after reasonable inquiry, the statements and information contained in this inventory are true, accurate, and complete.

Signature of Responsible Official	Name & Title	Date
.....	.....	.....