

19.3 Environmental applications

19.3.1 Atmospheric chemistry terms (selected)

Note: Sentences which are preceded by the designation GB in this section were taken from the IUPAC Compendium of Chemical Terminology, Blackwell Sci. Publ. 1987 (the Gold Book).

Acid deposition

The acids deposited by transfer from the atmosphere either by precipitation (rain, fog, snow, etc.), called *wet deposition*, or by direct transfer to the surface of the earth induced by the flow of acid containing air masses over the earth's surface, called *dry deposition*.

Acid rain

Rain with pH values < about 5; commonly results from acids formed from pollutants. "Pure" rain water equilibrated with atmospheric CO₂ and naturally occurring acids in relatively clean air usually has a pH > 5.

Aerometer

Instrument used to measure the density of gases.

Aerometric measurements

Measurements of the temperature, pressure, air motion (velocity vectors), or other physical measurements to characterize an air mass.

Aerosol

Mixtures of small particles (solid, liquid, or a mixed variety) and the carrier gas (usually air); owing to their size, these particles (usually less than 100 μm and greater than 0.01 μm in diameter) have a comparatively low settling velocity and hence exhibit some degree of stability in the earth's gravitational field. An aerosol may be characterized by its chemical composition, its radioactivity, particle size distribution, electrical charge and optical properties. If the dispersed particles are solid, one speaks of "aerosols of solid particles", if they are liquid of "aerosols of liquid particles". The use of the terms "solid aerosol" and "liquid aerosol" is discouraged. An aerosol is neither "solid" nor "liquid", but if anything, gaseous.

Air, composition of pure

The composition of air is variable with respect to several of its components (e.g., CH₄, CO₂, H₂O) so "pure" air has no precise meaning; it is commonly considered to be air which is free of dust, aerosols, and reactive gaseous contaminants of anthropogenic origin. The composition of the major components in dry air is relatively constant (percent by volume given): nitrogen, 78.084; oxygen, 20.946; argon, 0.934; carbon dioxide, 0.033; neon, 0.0018; helium, 0.000524; methane, 0.00016, krypton, 0.000114; hydrogen 0.00005; nitrous oxide, 0.00003; xenon, 0.0000087. The concentration of carbon dioxide, methane, nitrous oxide, the chlorofluorocarbons, and some other species of anthropogenic origin are increasing measurably with time. Relative clean air which is free of most reactive anthropogenic contamination (NO, NO₂, SO₂, non-methane hydrocarbons, etc.), often used as a reference sample in the calibration and operation of instruments, may be purchased under the designation *zero air*.

Air pollutant

A substance, gaseous material or aerosol which has been introduced into the air (either by human activity or by natural processes) in sufficient concentration to produce a measurable effect on humans, animals, vegetation, or materials (monuments, etc.): for example SO₂, NO₂, H₂S, CO, hydrocarbons, etc.

Air pollution

Usually the presence of substances in the atmosphere, resulting either from human activity or natural processes, present in sufficient concentration, for a sufficient time and under circumstances such as to interfere with the comfort, health or welfare of persons or with the environment.

Air pollution index or air quality index

A mathematical combination of the concentrations of air pollutants (weighted in some fashion to reflect the estimated health impact of the specific pollutant) which gives an approximate numerical measure of the quality of the air at a given time. These indices have little scientific basis but have been used to inform the public (in a qualitative fashion) of the degree of pollution present at a given time. It is recommended that the actual measured pollutant concentrations be used by all information services when possible with simultaneous reference given to the corresponding concentrations which are considered by health authorities to be hazardous to human health.

Air pollution survey

A study of the concentrations and geographical distribution of specified air pollutants in a given area and an assessment of the damage, if any, which the pollutants have caused.

Air quality characteristic

One of the quantifiable properties relating to an air sample: concentration of a constituent, wind speed, temperature, etc. The quantity of air quality characteristic is the true value of the characteristic being investigated; it is recognized that in practice, this value can only be approximated by existing methods.

Air sampling network

A number of air sampling stations which are established in a given geographical region at which measurements of both pollutant concentrations and meteorological quantities (wind speed, direction, rain fall, humidity, etc.) are made to determine the extent and the nature of the air pollution and to establish trends in the concentrations of the air pollutants with time.

Aitken particles

Aerosol particles below 0.1 μm in diameter. These generally are the most numerous among all particles in the air. Their concentrations can be determined with the Aitken counter which measures total particle number density. Owing to their small size, Aitken particles contribute little to the total *mass* concentration of all aerosol particles: this is determined primarily by particles of diameter $>0.1 \mu\text{m}$.

Alert levels

Designated concentrations of certain key pollutants at which some degree of danger to public health is expected. In many areas in which a relatively high level of pollution is often encountered, several levels of alert are often established. For example, a first alert may signify a potential problem exists; a second alert becomes a signal for the curtailment of certain significant emission sources; the third alert signifies the need for some specified emergency action which must be taken to ensure the public safety.

Ambient air

The outdoor air in the particular location.

Ash

The solid residue which remains after the combustion of a fuel such as coal. Ash consists largely of heat treated mineral matter, but it may contain some products of the incomplete combustion of the fuel as well.

Atmosphere (of the earth)

The entire mass of air surrounding the earth which is composed largely of nitrogen, oxygen, water vapour, clouds (liquid or solid water), carbon dioxide, together with trace gases and aerosols; see *air, composition of pure*.

Arrester

Equipment designed to remove particles from a gaseous medium.

Aspirator

Any apparatus that produces a movement of a fluid by suction (e.g., a squeeze bulb, pump, Venturi, etc.)

Anthropogenic

Produced by human activities.

Background concentration (level)

Synonymous with baseline concentration. The concentration of a given species in a pristine air mass in which anthropogenic impurities of a relatively short lifetime are not present. The background concentrations of relatively long-lived molecules, methane, carbon dioxide, halocarbons (CF₃Cl, CF₂Cl₂, etc.), and some other species continue to rise due to anthropogenic input, so the composition of background air is undergoing continual change. Background concentration of a given species is sometimes considered to be the concentration of that impurity in a given air mass when the contribution from anthropogenic sources under study is absent.

Biosphere

That part of the globe that encompasses all forms of life on the earth. It extends from the

ocean depths to a few thousand meters of altitude in the atmosphere, and includes life forms at the earth's surface, in soils, and constituents which exchange materials with atmosphere, oceans, or surfaces.

Calibration gas mixture

A gas mixture of known composition, generally comprising one or more calibration components and a complimentary gas.

Calibration gas mixture, methods of preparation of

a) Gravimetric method: A method in which each component of a mixture is successively added to a gas cylinder which is weighed first empty and then after each addition. The concentration of each component is expressed as a mass ratio or mole ratio.

b) Manometric method: A method in which each component of a mixture is added successively to a gas cylinder previously emptied and where the pressure is measured after each addition. The mole ratio can only be calculated from the pressure data if the deviation from ideality of the particular system is known.

c) Static volumetric method: A method in which a mixture is prepared by combining two or more gases, contained in two or more separate calibrated volumes, all at known temperatures and pressures. The volume ratio of a component in the resulting mixture may be calculated from the known ratios of the calibrated volumes. The calculated volume ratio may differ from the mole ratio if the mixture does not behave ideally.

d) Dynamic volumetric method: A method in which two or more gas streams, flowing at known volume flow rates under specified conditions are combined into a single stream. The volume ratio of any component in the resulting mixture is calculated from the ratio of the volume flow rates. Deviations from ideality of the mixture must be known in order to calculate the mole ratio unless the flow rates are measured in mass flow per unit time for all gases; in this case the mass or mole ratio can be directly calculated.

e) Saturation method: A method in which a stream of gas is passed over or through a substance capable of evaporation or sublimation held at a fixed temperature. At equilibrium the concentration of the substance in the stream of gas will be determined by the vapour pressure of the substance at the temperature given.

f) Permeation method: A method in which a stream of gas is passed over a porous or permeable tube or vessel containing a volatile substance usually present as the liquid and saturated vapour phases. The permeation rate of the substance through the walls of the tube should be constant at any given temperature as long as sufficient liquid and its vapour remain in the tube. The concentration of the substance in the stream of gas is determined by the rate of flow of the gas stream and the permeation rate of the substance. If the gas

flow is measured in terms of mass per unit time and the permeation rate is known in the same units, then the mass ratio or the mole ratio can be calculated.

g) Diffusion method: A method in which a gas or vapour diffuses through a restriction into a stream of gas flowing at constant rate. If the temperature and pressure of the diffusing species remain constant at the inlet to and within the restriction, the mass rate of flow of the diffusing species will remain constant.

h) Comparison method: A method in which the concentration of a component in a mixture is measured by comparison with another mixture or other mixtures containing the same component at known concentrations.

Ceramic filter

A component of a stack sampling system which is suitable for high temperature use; also known as a *ceramic thimble*.

Charcoal

A carbonaceous solid residue which is formed in the destructive distillation of wood. It has a very high surface area per unit weight which makes it especially useful as an absorber of various gases and vapours.

Chemiluminescence analyzer

Instrument consisting of a reaction chamber with separate inlets for the sample and reagent gas, an optical filter, a photomultiplier and a signal processing device. The reactive gas is introduced in excess. The quantity of light produced is proportional to the sample flow rate and the concentration of the measured substance in the sample under specified temperature and pressure conditions. The filter limits the wavelength to the region of interest and helps to eliminate interferences.

COH, coefficient of haze

One technique of measurement of the amount of filterable particulate matter suspended in air which has been used in the past depends upon drawing a measured sample of air (usually 1000 linear feet) through a paper or membrane filter. A measurement is made of the intensity of light transmitted through the dust spot formed relative to that transmitted through an identical clean filter. The dirtiness of the air is reported in terms of the COH unit. This relates to the quantity of particulate material which produces an optical density, $\lg(I_0/I)$, of 0.01 when measured by light transmission at 400 nm and relative to the transmission of an identical dust-free filter taken as 100%. Thus a filter which transmitted

50% relative to the clean filter has an absorbance of 0.301 or 30.1 COH units. This is not a recommended measure of filterable particulate matter since the size, colour and other properties of the aerosol and the air in which it is suspended affect the results.

Collection efficiency

A term which characterizes an entire sampling pretreatment procedure, usually represented as a percentage of the original amount of the analyte which is left for measurement (signal formation) after having passed through this procedure. This term also applies to the efficiency of collection of an air pollutant by an arrestment plant. For particulates, the collection efficiency is size related.

Collector

A device for removing and retaining contaminants from air or other gases. Term which is often applied to cleaning devices in exhaust systems. Also used to designate a device for removing and retaining samples from media in different environmental compartments to be investigated. A collector is sometimes used to describe a *scavenger*. GB: A solid substance added to or formed within a solution to collect a micro- or macro-component.

Combustion gases

Gases and vapours produced in furnaces, combustion chambers or in open burning.

Concentration, ground level

The concentration of a chemical species, normally a pollutant, in air; usually measured at a specific height above the ground.

Concentration, particle

Commonly expressed in several ways: mass concentration (usually as $\mu\text{g m}^{-3}$) or number concentration (number of particles cm^{-3}); modern instrumentation allows measurement of the number of particles as a function of size as well as the total number present in a given air volume. For atmospheric aerosols, this is a complex distribution for which diameters range from below 0.01 to above 100 μm ; the particles making the highest contribution to the total number density are in the size range below 0.1 μm , those contributing most to the total surface area are in the 0.1 to 1.0 μm range, while those with the highest contribution to the volume or mass of the aerosol come from both the 0.1 to 1.0 and 1.0 to 100 μm ranges.

Contaminant, air

A substance, gaseous material or aerosol, which is present in an air mass at levels greater than in clean air. An air contaminant has been added commonly by anthropogenic activity; see also *air pollutant*.

Continuous air monitoring program (CAMP)

In the United States the CAMP program represents a series of monitoring stations which were established near large cities for the continuous monitoring of gaseous pollutants, SO₂, NO, NO₂, CO, hydrocarbons, and O₃.

Controlled atmosphere

A synthetic gaseous sample of pure air which may contain carefully determined amounts of certain contaminants; this may be used as a standard for the calibration of analytical techniques, as a simulated environment for the study of biological responses, or for other purposes.

Denuder system (tube or assembly)

An apparatus used to separate gases and aerosols (over a given diameter) which is based upon the difference in diffusion velocity between gases and aerosol particles. Usually a tube containing a selective internal wall coating which removes the gaseous compounds at the wall.

Deposition

Deposition is normally considered to be one of two types: *dry deposition* is the process by which aerosols and gases in the air are deposited on the surface of the earth (soil, water, rock, plants, etc.); this is termed "dry" deposition even when the receptor surface is moist. *Wet deposition* is that process which involves the transport of chemicals to the surface of the earth by water droplets or snow crystals which scavenge pollutants as they form and fall through the atmosphere.

Deposition velocity

The ratio of flux density (often given in units of $\text{g cm}^{-2} \text{s}^{-1}$) of a substance at a sink surface to its concentration in the atmosphere (corresponding units of g cm^{-3}). While the units of this ratio are clearly those of velocity (in this case cm s^{-1}), the ratio is not a flow velocity in

the normal sense of the word. (Thus "linear velocity".)

Diameter, equivalent

The diameter of a spherical particle which will give identical geometric, optical, electrical or aerodynamic behaviour to that of the particle (non-spherical) being examined; sometimes referred to as the Stokes diameter for particles in non-turbulent flows.

Diffuser

A porous plate or tube, commonly made of carborundum, alundum, or silica sand, through which air is forced and divided into minute bubbles for diffusion in liquids.

Diffusion battery

An aerosol sizing instrument for particles with diameters below 0.2 μm . The fractionation is based on different diffusivities of the small particles and their deposition on the walls of the long parallel or circular channels, formed by equally spaced plates, bundles of small bore parallel tubes or sets of stainless wire screens.

Discomfort threshold

The lowest value (e.g., concentration of an impurity, etc.) at which a sensation of discomfort is perceived; a measure which varies from person to person.

Dispersion

The dilution of a pollutant by spreading in the atmosphere due to diffusion or turbulent action (eddy diffusion).

Diurnal variation

Indicates variations which follow a distinctive pattern which recurs with a daily cycle.

Dobson unit

Unit sometimes used in the description of the total ozone in a column of air overhead. It is

given as the thickness (in units of 10^{-3} cm or 10^{-5} m) of that layer which would be formed by the total ozone in a column reduced to the pressure of 760 Torr and temperature of 0°C .

Dosage

As applied to an air pollutant in an exposure chamber, dosage is commonly defined as the concentration of the pollutant times the duration of exposure.

Droplet

A small liquid particle. The size of droplets encountered in the atmosphere extends over a wide range; e.g., liquid aerosol solutions which make up the fine particle fraction of continental tropospheric aerosol are usually $< 2\ \mu\text{m}$ in diameter. Cloud water droplets usually have diameters in the range of 5 to 70 μm , while rain droplets commonly have diameters ranging from 0.1 to 3 mm.

Dust

Small, dry, solid particles projected into the air by natural forces, such as wind, volcanic eruption, and by mechanical or manmade processes such as crushing, grinding, milling, drilling, demolition, shovelling, conveying, screening, bagging, and sweeping. Dust particles are usually in the size range from about 1 to 100 μm in diameter, and they settle slowly under the influence of gravity.

Dust collector

A device for monitoring dust emissions. Also the equipment used to remove and collect dust from process exhaust gases; this may employ simply sedimentation (dustfall jars, coated slides, papers, etc.), inertial separation (cyclones, impactors, impingers, etc.), precipitation (thermal and electrostatic) or filtration.

Dust fall

Solid particles in the air which fall to the ground under the influence of gravity.

Effluent

Any spent liquors or other waste material which are emitted by a source (waste from plating shops, pickling tanks, sewage treatment plants, chemical manufacturing plants, etc.)

Elutriation

The process of separating the lighter particles of a powder from the heavier ones by means of an upward directed stream of fluid (gas or liquid).

Emission

The total rate at which a solid, liquid, or gaseous pollutant is emitted into the atmosphere from a given source; usually expressed as mass per unit time. *Primary emissions* are those substances which are emitted directly to the atmosphere (e.g., NO, SO₂, etc.), while *secondary emissions* are formed from the primary emissions through thermal or photochemical reactions (e.g., ozone, aldehydes, ketones, sulphuric acid, nitric acid, etc.).

The point or area from which the discharge takes place is called the *source*; the area in which the emission or its transformed products (e.g., in the case of aerosols, acidic deposition, etc.) may be deposited is called the *receptor area* or *sink*. *Emission* may be applied to noise, heat, etc., as well as pollutants.

Emission flux

The emission per unit area of the appropriate surface of an emitting source.

Emission source

Several types of emission sources exist: *Point* sources of emission include: power plants, incinerators, refineries, steel mills, chemical plants, etc. Often the emissions for these sources are released from elevated stacks. *Mobile* sources of emission include: automobiles, trucks, buses, ships, airplanes, etc.

Explosivity limits (or explosion limits); flammable limits

The concentration limits, usually of a substance in air, between which combustion will be self-sustaining.

Exposure

Subjecting a person, animal, plant, or material to an environment containing a significant concentration of an air pollutant.

Fallout

A measurement of air contamination consisting of the mass rate at which solid particles deposit from the atmosphere. See *dust fall*.

Filter

A porous material on which solid particles present in air or other fluid which flows through it are largely caught and retained. Filters are made with a variety of materials: cellulose and derivatives, glass fibre, ceramic, synthetic plastics and fibres. Filters may be naturally porous or be made so by mechanical or other means. Membrane/ceramic filters are prepared with highly controlled pore size in a sheet of suitable material such as polyfluoroethylene, polycarbonate, or cellulose esters. Nylon mesh is sometimes used for reinforcement. The pores constitute 80-85% of the filter volume commonly, and several pore sizes are available for air sampling (0.45 to 0.8 μm are commonly employed).

Flowmeter

An instrument for measuring the rate of flow of a fluid moving through a tube, pipe or duct system. The instrument is calibrated to furnish volume or mass rate of flow. Several types of flowmeters are in use:

Variable area flowmeter - A flowmeter consisting of a tapered tube and a float. The gas enters at the bottom of the tube. The inner diameter of the tube increases from the bottom to the top, and the float is supported in the tube at a height which is a function of the rate of flow and the nature of the gas in the tube; this is sometimes referred to as a "rotameter" which is derived from a trademark.

Soap film flowmeter - A flowmeter in which a soap film is generated on a cross section of a graduated tube (sometimes a calibrated buret is employed) in which the gas to be measured passes. The film moves along the tube at the same rate as the gas flow. The measured time required for the film to sweep through a measured volume can be used to calculate the gas flow rate. This is often employed in gas chromatography work.

Critical orifice flowmeter - A device consisting of a plate having an orifice of small diameter and placed in a gas stream such that the total flow passing through the orifice has a velocity at least equal to the sonic velocity. A pressure measuring device is attached upstream of the orifice. The flow is proportional to the upstream pressure and independent from the downstream pressure.

Spirometer - An absolute flow measuring device consisting of two cylinders each sealed at one end and having slightly different diameters. The smaller is inverted into the larger which is filled with a confining liquid. The inverted cylinder is suspended with counterweights so that it moves freely within the larger cylinder. Gas may either be displaced from the smaller cylinder or admitted to it. The dimensions of the smaller cylinder must be known. The rate of rise or fall of the

inverted cylinder can be used to calculate the rate of flow of gas either into or out of the spirometer. The device is used principally for calibrating other devices.

Other types of flow meters also are in wide use today (e.g., the Hastings-type mass flowmeter).

Flue gas

Waste gas from the combustion process.

Fly ash

Finely divided particles of ash entrained in flue gases resulting from the combustion of fuel.

Fog

A general term applied to a suspension of droplets in a gas. In meteorology, it refers to a suspension of water droplets resulting in a visibility of less than 1 km. GB: An *aerosol* of liquid particles, in particular a low cloud.

Fume

Fine solid particles (aerosol), predominantly less than 1 μm in diameter, which results from the condensation of vapour from some types of chemical reaction. Usually this is formed from the gaseous state generally after volatilization from melted substances and often accompanied by chemical reactions such as oxidation.

Fumes

In popular usage, a term often taken to mean airborne effluents, unpleasant and malodorous, which might arise from chemical processes; see *smoke*.

Gas analysis installation

Assembly for the purpose of determining one or more components in a gaseous mixture. It generally comprises the following elements: sample probe, region of primary treatment of the gases, region of secondary treatment of gases, points for venting to the atmosphere and for calibration sample injection, transfer line, and the analytical unit.

Greenhouse effect

Heating effect produced by certain gases (e.g., CO₂, O₃, etc.), which by virtue of their characteristic infrared absorption, lower the earth to space transmission of long wavelength radiation but allow transmission of shorter wavelength radiation inward from the sun to the earth.

Grit

Airborne solid particles in the atmosphere which are of natural or manmade origin and which remain in suspension for some time; in the United Kingdom the size of the grit particles is defined as greater than 75 µm in diameter (retained on a 200 mesh British Standard sieve).

Ground level inversion

The inversion of the normal temperature gradient in the atmosphere; the temperature of the air increases with increasing height of the air above the ground. This leads to poor mixing of gases released below the inversion.

Halocarbons/halogenated hydrocarbons

The substitution of one or more of the hydrogen atoms in an alkane or alkene by halogen atoms (chlorine, fluorine, bromine, or iodine) generates useful compounds for use in many fields. Those hydrocarbons in which all of the hydrogen atoms are replaced by halogens are designated as halocarbons. These have been used extensively in refrigeration, "aerosol" spray cans, manufacture of insulation, etc. Two common anthropogenic halocarbons are: trichlorofluoromethane (CCl₃F) designated by the DuPont Company as Freon-11; dichlorodifluoromethane (CCl₂F₂), designated by the DuPont Company as Freon-12. Several other halocarbons and alkyl halides are used commercially and also appear as trace gases in the atmosphere: tetrachloromethane (or carbon tetrachloride, CCl₄), 1,1,1-trichloroethane (or methyl chloroform, CCl₃CH₃), trichloroethene (or trichloroethylene, CCl₂=CCHCl), tetrachloroethene (or perchloroethylene, CCl₂=CCl₂), dichloromethane (CH₂Cl₂). The lifetimes of many of the chlorofluorocarbons (e.g., CClF₃, CCl₂F₂, etc.) are very long in the atmosphere, and the major destruction of these species occurs in the stratosphere where photodecomposition of the halocarbons produces Cl-atoms which are involved in pathways to stratospheric ozone destruction. International agreements are anticipated to control the manufacture and release of the very long-lived halocarbons, and replacement of these by species which are destroyed within the troposphere is anticipated.

Haze

A state of reduced visibility (1-2 km) resulting from the increased light scatter due to the presence of fine dust or aerosol particles (H_2SO_4 , NH_4HSO_4 , products of the ozone-terpene reactions, etc.).

Hydrosphere

The gaseous, liquid, and solid water of the earth (oceans, icecaps, lakes, rivers, etc.) as distinguished from the *lithosphere* and the *atmosphere*.

Hygrometry and moisture analysis

The measurement or indication of the water content of the ambient air or of a sample of gas.

Hygrometer

Instrument used to measure the water vapour content of the atmosphere. The designs and operations of the various instruments now employed are very different. See the following types:

Hygrometer, capacitance - Hygrometer using the capacitance variations of a capacitor whose dielectric medium consists of the gas or of a material in contact with this gas.

Hygrometer, dew point (cooled surface condensation) - Instrument in which the sample is passed over a cooled surface. The temperature at which dew forms on the cooled surface is a function of the water content of the gas passing over the surface.

Hygrometer, electrical - A hygrometer whose sensitive element has electrical properties which vary with the humidity of the gas which traverses the hygrometer.

Hygrometer, electrolytic - Hygrometer using a hygroscopic substance (for example, diphosphorous pentoxide, P_2O_5) which is transformed into an electrolyte (phosphoric acid, H_3PO_4) in contact with the moisture in the gas. The electrolyte (phosphoric acid) is electrolysed continuously and the electrolysis current is measured. At a constant flow of the gas to be analyzed, the electrolysis current is a linear function of the water concentration.

Hygrometer, frost point - Instrument in which the sample is passed over a cooled surface. The temperature at which frost forms on it is a function of the water

content of the gas passing over the surface.

Hygrometer, mechanical - An apparatus containing an element (hair, goldbeater's skin, carbon-film) whose dimension or mass varies as a function of its water content.

Hygrometer, psychrometric - Instrument by which the relative humidity of the atmosphere may be determined. It is generally composed of two temperature sensors, one of which measures the temperature of the air; the other sensor is moistened with water and senses the cooling due to evaporation of water. The temperature difference between the two sensors is a function of relative humidity; sometimes referred to as a "wet- and dry-bulb" hygrometer.

Immission

A Germanic term, pronounced in English, "eye-mission"; the transfer of pollutants from the atmosphere to a "receptor"; for example, pollutants retained by the lungs. It does not have the same meaning as ground level concentration, but is the opposite in meaning to emission. This term has not been used commonly in the English language.

Immission dose

The integral of the immission flow into the receptor over the exposure period.

Immission flux

The immission rate divided by the unit surface area of the receptor.

Immission rate

The mass (or other physical quantity) of pollutant transferring per unit time into a receptor.

Impaction

A forcible contact of particles of matter with a surface.

Impactor, cascade

An instrument used for the classification of aerosols according to size and for possible subsequent chemical analysis. Air is drawn through a series of orifices of decreasing size; the air flow is normal to collecting surfaces on which aerosols are collected by inertial impaction. The particles, separated stepwise by their momentum differences into a number of size ranges, are collected simultaneously.

Impingement

Equivalent to *impaction*; often refers to impaction on a liquid surface.

Impinger

A sampling instrument employing impingement for the collection of particulate matter. Common types are: a) the midget impinger employing impingement in 1-10 cm³ water, b) the standard impinger employing impingement in 75 cm³ water, and c) dry impingers. Impingers are also suitable for sampling certain gases and vapours.

Inertial separator

Any dry type collector which utilizes the relatively greater inertia of particles to effect their removal from a gas stream; e.g., cyclonic and impingement separators, gravity settling chambers, and high-velocity gas reversal chambers.

Infrared gas analyzer

Instruments with various degrees of sophistication are employed to monitor certain species with characteristic infrared absorption bands. E.g., relatively simple systems are employed to detect carbon monoxide (CO) in air; these are built with matching cells, one containing a reference CO sample with the air to be tested in the other. Filtered infrared light which lies largely within the CO absorption region is passed through both cells. In one use of the instrument, the pressure difference which results from the preferential heating of the cell with the higher CO concentration is measured. The signal can be calibrated to yield the CO concentration. Sophisticated infrared systems involving Fourier transform spectrometers or infrared laser diodes are employed to detect particular molecular species of interest in atmospheric chemistry (NO₂, H₂O₂, CH₂O, CO, HNO₃, etc.) and to study their reactions in the real atmosphere or in simulated atmospheres in the laboratory. Long path lengths for the infrared beam are required to detect the small concentrations of most species.

Instantaneous (spot) sampling

Obtaining a sample of the atmosphere in a period which is short compared with the duration

of the sampling exercise. Such samples are often called "grab" samples, a term not recommended. These are useful for the analysis of hydrocarbons and other complicated mixtures of trace gases which are relatively stable in a stainless steel canister or tank and can be transported back to the laboratory for chromatographic or other analysis which cannot be done satisfactorily in the field. The use of plastic bags (constructed of Mylar, FEP Teflon, Tedlar (PVC) or other films) to collect instantaneous samples and to store them for analysis is not recommended. It is very difficult to eliminate pinholes, the reproducibility of heat seals used in constructing the bags is not easy to achieve, gases can permeate through the bag walls, and impurities can be introduced through off-gassing of the bag walls.

Isobar

Lines on a plot joining points of equal barometric pressure in the atmosphere.

Isokinetic line

A line in a given surface connecting points with equal wind speed; also called *isotach* or *isovel*.

Isokinetic sampling

A technique for collecting airborne particulate in which the sampling device has a collection efficiency of unity for all sizes of particles in sampled air, regardless of wind velocity and direction of the instrument. The air stream entering the collector has a velocity (speed and direction) equal to that of the air in the gas stream just ahead of the sampling port of the collector.

Isotherm

Lines joining points of equal temperature in the atmosphere.

Lapse rate

The variation of an atmospheric variable with height; unless otherwise stated the variable is temperature.

Lapse rate, temperature

The rate of change of temperature with altitude (dT/dz). The rate of temperature decrease with increase in altitude which is expected to occur in an unperturbed dry air mass is

$9.8 \times 10^{-3} \text{ }^\circ\text{C m}^{-1}$. This is called the *dry adiabatic lapse rate*. The lapse rate is taken as positive when temperature decreases with increasing height. For air saturated with H_2O , the lapse rate is less because of the release of the latent heat of water as it condenses. The average tropospheric lapse rate is about $6.5 \times 10^{-3} \text{ }^\circ\text{C m}^{-1}$. The lapse rate has a negative value within an inversion layer.

LIDAR

An acronym for Light Detection And Ranging. It is a real time remote sensing technique for the determination of aerosol and trace gas concentrations in air by measurement of scattered laser radiation.

Lithosphere

The crust of the earth, usually thought of as a discrete form and in contact with the hydrosphere and the atmosphere.

Maximum allowable concentration

The maximum concentration of a pollutant which is considered harmless to healthy adults during their working hours, assuming they breathe uncontaminated air at all other times.

Maximum emission concentration

Standards for maximum concentration of air pollutant emission from stationary or mobile sources.

Mist

A qualitative term applied to a suspension of droplets in a gas. In the atmosphere a mist produces a generally thin, greyish veil over the landscape. It reduces visibility to a lesser extent than fog but somewhat more than haze (visibility of less than 2 km but greater than 1 km).

Monitoring (in atmospheric trace component analysis)

In a broad sense of the term, repeated measurements to follow changes over a period of time. In a restricted sense of the term, regular measurement of pollutant levels in relation to some standard or in order to assess the effectiveness of a system of regulation and control.

Monitoring systems (in atmospheric trace component analysis)

Automatic systems placed in a smokestack, a work place, or in the ambient atmosphere which measure and record the amounts of specified air pollutants which are present.

Monthly averages (with reference to atmospheric component analysis)

For reporting integrated analyses of ambient air on a monthly rate, an average value is calculated; i.e., it is given on the basis of a 30-day month.

Network, air sampling

A number of air sampling stations which are established in a given geographical region at which periodic measurements of both pollutant concentrations and meteorological quantities (wind speed, direction, rain fall, humidity, etc.) are made to determine the extent and the nature of the air pollution and to establish trends in the concentrations of the air pollutants with time.

Normal conditions

A qualitative term, dependent on the preference of the investigator; it often implies ambient pressure and room temperature. Preferably the variables of temperature and pressure should be quoted as values representative of the actual conditions (or range of conditions) employed in the study.

Nuisance threshold

That concentration of an air pollutant that is considered objectionable. In the case of a substance with an objectionable odour, it is the smallest concentration of the substance which can be detected by a human being (nose).

Odour threshold

The concentration of a compound which produces an odour which is detectable by a human being (nose). For certain compounds this threshold is very low (e.g., 1 part in 10^9 for certain sulfides).

Ozone hole

A region of the stratosphere over Antarctica in which a marked decrease in the concentration of ozone has been observed in the Antarctic spring in recent years. The origin of this phenomenon is not yet established, but several theories based on both physical (transport related) and chemical processes (involvement of the halocarbons and their products of oxidation) have been suggested. The latter explanation appears to be in better accord with recent findings.

Particle (atmospheric)

A small discrete mass of solid or liquid matter.

Particle counter

A device for measuring the number of suspended particles (in a certain size range) per volume unit of a gaseous or liquid medium.

Particle size

To describe the size of liquid or solid particles (aerosol) the average or equivalent diameter is used. For nonspherical particles collected in an impactor, for example, the aerodynamic diameter of a particle of arbitrary shape and density refers to the size of a spherical particle of unit density that would deposit on a given impactor surface.

Particle size distribution

The size of the liquid or solid particles in the atmosphere usually extends from 0.01 to 100 μm in diameter. In the earth's atmosphere the distribution function which describes the number of particles as a function of diameter, mass, or surface area of the aerosol can be determined reasonably well with modern instrumentation.

Particulate matter

A general term used to describe airborne solid or liquid particles of all sizes. The term aerosol is recommended for general use in describing airborne particulate matter.

Passive sampler

A device for preconcentration of trace substances from gaseous media based on molecular diffusion without controlled conveyance of the gas to be investigated (e.g., work place air).

Peak concentration (trace atmospheric component)

The highest concentration of a given trace component which was measured with a continuous analyzer during a specified sampling period.

Period of unattended operation

Period for which given values of performance characteristics of an instrument can be guaranteed to remain within 95% probability without servicing or adjustment.

Permeation tube

A device used for dynamic preparation of test gas mixtures by means of controlled permeation of a gaseous analyte out of a container through polymer material into a carrier gas stream. These devices containing certain condensable gases (e.g., NO₂, SO₂, etc.) when operated at closely controlled temperatures can be used as primary standards calibrated in terms of the weight loss per unit time.

Precipitation, in meteorology

Rain, snowfall, hail, etc.

Pressure gauges

Devices for measuring the pressure in a system.

Bourdon tube gauge - A device in which the responsive element is a blind, curved elastic tube, oval in cross section and open at one end to the systems of which the pressure is to be measured. The body of the gauge is at atmospheric or some other controlled pressure. Increasing pressure within the gauge causes the radius of curvature to increase, and this motion drives an indicator.

Capacitance gauge - A device in which a metal coated diaphragm serves as one plate of a capacitor. A reference pressure is applied to one side of the diaphragm and the

pressure to be measured is applied to the other. Changes in pressure, change the capacitance which is transformed to a pressure reading by the device. Such devices are highly sensitive and are available commercially for a wide range of pressures.

Dead weight piston gauge - An absolute pressure measuring device, usually used for calibration of other types of pressure measuring devices. It consists of a hydraulic system equipped with a cylinder and a piston of accurately known area. Pressure is applied to the hydraulic system and weights are added externally to the piston until the external force exerted by the piston equals the force exerted by the hydraulic system. The pressure exerted by the hydraulic system can be calculated from the combined weight of the piston and the added weights, and the area of the piston.

Pressure, static

The pressure of a fluid at rest, or in motion exerted perpendicularly to the direction of flow.

Primary pollutant

A pollutant emitted directly into the air from identifiable sources (e.g., SO₂, NO, hydrocarbons, etc.). *Secondary pollutants*, such as ozone, are generated within the atmosphere through chemical changes which occur in primary pollutants.

Probe (in stack gas sampling)

A device, commonly in the form of a tube, used for sampling or measurement inside a duct, stack, volcano, vent, etc.

Psychrometry

The use of a wet-and-dry-bulb thermometer for measurement of atmospheric humidity.

Radiosonde

A miniature radio transmitter with instruments in a package that is carried aloft (e.g., by an unmanned balloon) for broadcasting every few seconds by means of precise tone signals or other suitable method, the humidity, temperature, pressure, or other parameter.

Relative humidity

The ratio, often expressed as a percentage, of the partial pressure of water in the atmosphere at some observed temperature, to the saturation vapour pressure of pure water at this temperature.

Remote sensing (in atmospheric sciences)

The determination of substances in the atmosphere, or in emissions, or of meteorological parameters in the atmosphere, by means of instruments not in immediate physical contact with the sample being examined.

Retention efficiency (in particle separation)

The ratio of the quantity of particles retained by a separator to the quantity entering it (generally expressed as a percentage).

Ringelmann chart

A chart which has been used in air pollution evaluation for assigning the degree of blackness of smoke emanating from a source. The observer compares the shades of grey (white to black) with a series of shade diagrams formed by horizontal and vertical black grid lines on a white background. A corresponding number, the Ringelmann number, is then assigned to describe the best match; numbers range from 0 (white) to 5 (black). This method of pollution evaluation, although relevant to the enforcement of legislation still in force in many countries, is not recommended for use today since more quantitative indicators of the efficiency of the combustion are now available.

Sample, air

A quantity of air (sometimes of known volume), which is assumed to be representative of the air mass under investigation, and which is examined for air quality characteristics.

Sample line

Line provided to remove a representative sample of the gas to be analyzed and to conduct it to the sample point. It may include devices such as filters, dryers, or condensers (primary and secondary treatments of gas) which are necessary to prepare the sample for analysis.

Sample point

Point in the gas analysis installation beyond which it is assumed that no alteration of the sample occurs and the sample can be considered representative.

Sample probe

Device inserted into the gas to be sampled and to which is connected a sample line or a container for collecting the sample.

Sampler

Same as *collector*.

Sampler, dichotomous

Device for dividing a polydispersed aerosol particle population into two size fractions during sampling. The fractionation is based on the momentum differences of the particles which allow the larger particles to pass through a zone of stagnant gas.

Sampling, cryogenic

The collection of trace compounds from gaseous media by co-condensation with a major constituent (e.g., water vapour, CO₂, N₂, Ar) of the matrix.

Sampling, grab

The taking of a sample (often in an evacuated bulb) in a very short time; preferred terms are *instantaneous sampling* or *spot sampling*.

Sampling train

The complete assemblage of equipment necessary to sample atmospheres.

Scavenging

The removal of pollutants from the atmosphere by natural processes, including scavenging by cloud water, rainout, and washout. This type of removal process is termed *precipitation scavenging*. Scavenging of airborne pollutants at surfaces of plant, soil, etc., is termed *dry*

deposition.

Scrubber

An apparatus used in sampling and in flue gas cleaning. The gas is passed through a space containing wetted "packing" or spray. In general, particles are collected in scrubbers by one or a combination of the following: impingement of particles on liquid medium; diffusion of the particles onto liquid medium; condensation of liquid medium vapours on the particles; partitioning of the gas into extremely small elements to allow collection of the particles by Brownian diffusion and gravitation settling on the gas-liquid interface. The devices include spray towers, jet scrubbers, Venturi scrubbers, cyclonic scrubbers, inertial scrubbers, mechanical scrubbers, and packed scrubbers. Normally the gas flow in the scrubber is counter to the liquid flow. Efficient scrubbers will collect particles as small as 1 to 2 μm in diameter.

Scrubbing

A process used in gas sampling or gas cleaning in which components in the gas stream are removed by contact with a liquid surface or a wetted packing, on spray drops, droplets, or in a bubbler, etc.

Secondary pollution (emissions)

The products of the primary pollutants which form through photochemical and thermal reactions in the atmosphere (O_3 , peroxyacetyl nitrate, etc.).

Sedimentation

In the atmospheric sciences, the process of removal of an airborne particle from the atmosphere due to the effect of gravity.

Smoke

A visible aerosol made up of small gas-borne particles resulting from the incomplete combustion of organic matter. It consists of carbon, carbon-rich products and all other dispersible product particles from the incomplete combustion. This does not include steam (condensed water vapour).

Source

In atmospheric chemistry, the place, places, or group of sites or areas where a pollutant is released into the atmosphere. Point sources, elevated sources, area sources, multiple sources are often identified.

Stack sampling

Collection of representative gaseous and particulate samples of matter flowing through a duct or stack. Acceptable performance should indicate a collection efficiency of 95 ± 5 percent. Samples should be taken under isokinetic conditions to obtain an accurate representation of the particle size distribution in the effluent.

Zero gas or zero sample

Substance or mixture of substances resembling, as closely as possible, the matrix of the actual air sample to be measured, but characterized by a value of the air quality characteristic which is not detectable by the method used.