Air pollution

WHAT IS AIR POLLUTION?

Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that they can produce undesirable effects on man and his environment.

POLLUTION'S SUBSTANCES

Gases (SOx, NOx, CO, HCs, etc)

Particulate matter (smoke, dust, fumes, aerosols)

Radioactive materials and **Many others**.

Most of these substances are naturally present in the atmosphere in low (background) concentrations and are usually considered to be harmless.

WHEN THE SUBSTANCE IS CONSIDERED POLLUTANT

Thus, a particular substance can be considered as an air pollutant only when its concentration is relatively high compared with the back ground value and causes adverse effects.

Composition of clean, dry atmospheric air

Component	Concentration (ppm)	Estimated residence time
Nitrogen	$78.1x10^{4}$	Continuous
Oxygen	$21x10^{4}$	Continuous
Argon	$93x10^{2}$	Continuous
Carbon dioxide	3.2x102	2-4 years
Neon	18	Continuous
Helium	5.2	Up to 2 million years
Krypton	1	Continuous
Xenon	$8x10^{-2}$	Continuous
CO	0.1	0.5 years
Methane	1.2	4-7years
N_2O	$25x10^{-2}$	4 years
NO	$6x10^{-4}$	5 days
NH_3	$6x10^{-3}$	7 days
H_2S	$2x10^{-4}$	2 days
SO_2	$3x10^{-4}$	4 days
H	0.5	*
O_3	0.02	Up to 60 days

*little is known about residence time

IMPORTANCE OF AIR POLLUTION PROBLEM

It affects human, plant and animal health.

For example, there is good evidence that the health of 900 million urban people suffers daily because of high levels of ambient air **sulfur dioxide concentrations**.

Air pollution is one of the 6 most serious environmental problems in societies at all level of economic development.

Air pollution can also affect the properties of materials (such as rubber), visibility, and the quality of life in general.

Effect of industrial development

Industrial development has been associated with emission to air of large quantities of **gaseous** and **particulate** emissions from both **industrial production** and from **burning fossil fuels** for energy and transportation.

THE ROLE OF TECHNOLOGY

When technology was introduced to control air pollution by reducing emissions of particles, it was found that the gaseous emissions continued and caused problems of their own.

CURRENT EFFORTS

Currently efforts to control both particulate and gaseous emissions have been partially successful in much of the developed world, but there is recent evidence that air pollution is a health risk even under these relatively favorable conditions.

IN RAPIDLY DEVELOPING COUNTERIES

In societies that are rapidly developing sufficient resources may not be invested in air pollution control because of other economic and social priorities. The rapid expansion of the

industry in these countries has occurred at the same time as **increasing traffic** from automobiles and trucks, increasing demands for **power for the home**, and concentration of the population in large urban areas called **mega cities**. The result has been some of the worst air pollution problem in the world.

IN MANY TRADITIONAL AND DEVELOPED COUNTRIES

In many traditional societies, and societies where crude household energy sources are widely available, air pollution is a serious problem because of **inefficient and smoky fuels used to heat buildings and cook.**

This causes air pollution both **out door and indoors**. The result can be lung disease, eye problems, and increased risk of cancer. The quality of air indoors is a problem also in many developed countries because buildings were built to be airtight and energy efficient. Chemicals produced by heating and cooling systems, smoking and evaporation from buildings materials accumulate indoors and create a pollution problem.

In Ethiopia, like many traditional societies, the problem of indoors air pollutions resulted from in efficient and smoky fuels used to heat buildings and cook. In the rural households of Ethiopia, most of the children and women are staying in overcrowded condition of a one roomed /thatched roof / house that exposed them for the indoor air pollution. It is also known that mothers and children are spending more than 75% percent of their day time at home.

Identification of the problems of both at out doors and indoors air pollutions in the societies one has to make interventions to alleviate the health related problems and promote safe ventilation of air in the living and working areas. First, however, some basic science is needed to understand air pollution.

Definition of terms and scale convention

Air pollution: – concentration of foreign matter in air in excessive quantity which is harmful to the health of man. 1.4.2. **Indoor air pollutions:** - Pollutions from the housing made materials and living and working activities of the house, such as: natural radiation-radon, domestic combustion-coal gas, and human habitstobacco smoking.

Out door air pollution: - Pollutions from out door services and environmental mixings, such as: 11 transportation-automobiles, industries-refineries, atomic energy plant-nuclear, and community activities-cleaning of streets.

Acute effects: - with in twenty four hours of sudden exposure to polluted air illness would occur.

Delayed effect: – The cause and effect relationship of air pollution and chronic effects on health is in a way difficult to prove due to long time contact and accumulation effect. 1.4.6.

Aerosols: - Small solid or liquid particles (fine drops or droplets) that are suspended in air.

Dust: – aerosols consist of particles in the solid phase. 1.4.8. **Smoke:** - aerosols consist of particles in the solidand sometimes also liquid-phase and the associated gases that result from combustion.

Ash: - aerosols of the solid phase of smoke, particularly after it settles into a fine dust.

Particulates: - Small particles, that travel in air and settles or lands on something.

Fumes: - are polydispersed fine aerosols consisting of solid particles that often aggregate together, so that many little particulates may form one big particle.

Inhalable fraction: - Particles less than 100 µm that can be inhaled into the respiratory throat (trachea). 1.4.13. **Thoracic fraction:** - Those particles below 20 µm, that can penetrate into the lungs.

Respirable range: - the greatest penetration and retention of particles is in the range 10.0 to 0.1 µm. 1.4.15. **Mist:** - A cloud or dense collection of droplets suspended in air. **Vapour:** - The evaporated compound in the gas phase. **Troposphere:** - The first and lowest of the atmospheric layers is called the “troposphere”.

Stratosphere: - The second layer of air is called the “stratosphere”.

Q `1 Ionosphere: - Above the stratosphere is the "ionosphere" the top of which is the border line space. 1.4.20. **Thermosphere:**- This is a region of highly ionized gases, extending to about 1600 km.

Mesosphere: - Above the stratosphere, or the middle layer.
Wind: - Is simply air in motion

Units and measurements

Unit of measurement Concentrations of air pollutants are commonly expressed as the mass of pollutant per Unit volume of air mixture, as mg/m^3 , $\mu g/m^3$, ng /m^3

Concentration of gaseous pollutants may also be expressed as volume of pollutant per million volumes of the air plus pollutant mixture (ppm) where 1ppm= 0.0001 % by volume. It is sometimes necessary to convert from volumetric units to mass per unit volume and vice versa. The relationship between ppm and mg/m3 depends on the gas density, which in turn depends on: □ Temperature □ Pressure □ Molecular weight of the pollutant The following expression can be uses to convert of between ppm and mg/m3 at any temperature or pressure

$$mg/m^3 = \frac{273 \text{ X PPM X molecular wt. X pressure}}{22.4 \text{ X temperature}}$$

Simply multiply the calculated value of mg/m^3 by 1000 to obtain $\mu g/m^3$ The constant 22.4 is the volume in liter occupied by 1

mole of an ideal gas at standard concentration (0.0 c and 1 atm.). One mole of any substance is a quantity of that substance whose mass in grams numerically equals its molecular weight \

Energy transfer in the atmosphere

Importance

The physical &chemical characteristics of the atmosphere and the critical heat balance of the earth are determined by energy and mass transfer processes in the atmosphere.

Sun light scattering

Incoming solar energy is largely in the visible region of the spectrum (400-700nm). The shorter wavelength blue solar light is scattered relatively more strongly by molecules and particles in the upper atmosphere, which is why the sky is blue as it is viewed by scattered light. Similarly, light that has been transmitted through scattering atmospheres appears red, particularly around the sun set and sun rise, and under circumstances in which the atmosphere contains a high level of particles.

Sun energy outside the earth

Radiation from the sun arrives just outside the earth's atmosphere with average annual intensity; called the solar constant (**isolation**) S, currently equal about 1370 W/m^2 . If

all this energy reached the earth's surface and was retained, the planet would have vaporized long ago

Reflected solar energy

Some of the incoming solar energy that hits the earth is reflected back in to the space; such reflected energy is not absorbed by the earth or its atmosphere and does not contribute their heating. The fraction of incoming solar radiation that is a reflected is called **albedo**, and for the earth, the global annual mean value is now estimated to be about 31 percent.

Public Health importance of Air

Air pollution is a very complicated physical and chemical system. It can be thought of as a variety of constituents that are dissolved or suspended in air, many of which interact with one another and many of which acts together to produce their effects.

Pollution is variable

The constituents of air pollution change with the season, with industrial activity, with changes in traffic, and with the prevailing winds, to name just a few relevant factors.

The composition of air pollution is, therefore, not constant from day to day or even week to week on an average, but

trends to cycle. Average levels go up and down fairly consistently depending on the time of year but the actual levels are highly variable from one year to the next.

Air serves as a vehicle

Therefore poor ventilation of air and overcrowding conditions are creating more favorable situation to the transmission of pollutants.

Example

In Ethiopia rural household conditions, where there are more family members, without having enough number of doors and windows and staying at home significant proportion of the day time are highly victims for indoor air pollutions.