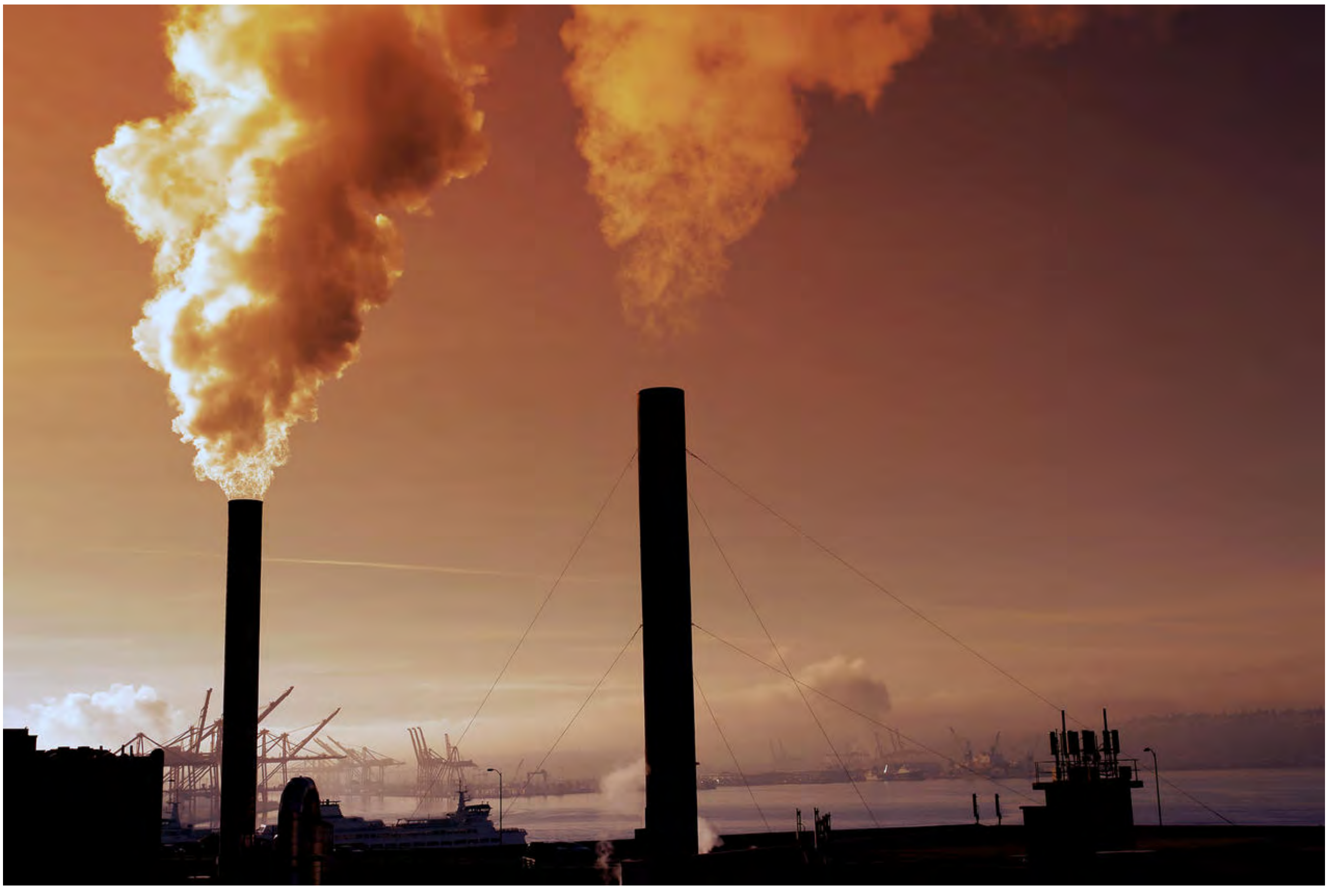

Air Pollution & Its Control

Effects of Air Pollution

Effects of Air Pollution

EFFECTS ON HUMAN HEALTH

The prime factors affecting human health are:

- Nature of the pollutants
- Concentration of the pollutants
- Duration of exposure
- State of health of the receptor
- Age group of the receptor

Generally speaking, susceptibility to the effects of air pollution is great among *infants*, the *elderly*, and the *infirm*. Those with chronic diseases of the lungs or heart are thought to be at great risk. Pre-school and school children appear to be both sensitive and specifically reactive to air pollution health effects. Another point to be noted is that the effect of air pollution on human health is worst during the winter season, when pollution levels reach a climax.

An objectionable odour, visibility reduction, eye irritation or vegetation damage are useful guides to the likelihood or severity of health effects. A grey pall over a city or an industrial area can have a depressing effect and impair the enjoyment of life. There is no doubt, however, that the urgency with which steps are taken to improve air quality will depend very much on how serious the risk of ill health from air pollution is thought to be.

Health Effects

- Eye Irritation.
- Nose and throat irritation.
- Irritation of the respiratory tract.
- Gases like hydrogen sulphide, ammonia and mercaptans cause odour nuisance even at low concentrations.
- Increase in mortality rate and morbidity rate.
- A variety of participates particularly pollens, initiate asthmatic attacks.
- Chronic pulmonary diseases like bronchitis and asthma, are aggravated by a high concentration of SO_2, NO_2, particulate matter and photochemical smog.
- Carbon monoxide combines with the haemoglobin in the blood and consequently increases stress on those suffering from cardiovascular and pulmonary diseases.
- Hydrogen fluoride causes diseases of the bone (fluorosis), and mottling of teeth.
- Carcinogenic agents cause cancer.

- Dust particles cause respiratory diseases. Diseases like silicosis, asbestosis, etc., result from specific dusts.
- Certain heavy metals like lead may enter the body through the lungs and cause poisoning.

Effect of Radioactive Fallout

The biological effect of radiation may be somatic or genetic damage. In somatic damage, the exposed individual is affected, while in genetic damage the future generations become the victims.

Radioactive fallout from testing of nuclear weapons causes:

- Cancer
- Shortening of life span
- Genetic effects or mutation

One significant point we have to note about the effect of radioactive fallout is, it causes long range effects affecting the future of man and hence we future of our civilization.

Effect of Sulphur Dioxide (SO_2)

Sulphur dioxide is an irritant gas which affects the mucous membranes when inhaled. Under certain conditions, some of the air-borne sulphur dioxide gas is oxidised to sulphur trioxide. Each of these two gases, in the presence of water vapour or water, forms sulphurous and sulphuric acid respectively. Sulphur trioxide is a very strong irritant, much stronger than sulphur dioxide, causing severe bronchospasms at relatively low levels of concentration.

Effect of Carbon Monoxide

Carbon monoxide has a strong affinity for combining with the haemoglobin of the blood to form carboxyhaemoglobin, COHb. This reduces the ability of the haemoglobin to carry oxygen to the body tissues. CO has about two hundred times the affinity of oxygen for attaching itself to the haemoglobin, so that low levels of CO can still result in high levels of COHb. Carbon-monoxide also affects the central nervous system. It is also responsible for heart attacks and a high mortality rate.

Effect of Oxides of Nitrogen

Of the seven oxides of nitrogen known to exist in the ambient air, only two are thought to affect human health. These are nitric oxide (NO) and nitrogen dioxide (NO_2). While some questions remain about haemoglobin reactions with oxides of nitrogen, there is no positive evidence that nitric oxide exposure is a health hazard associated with community air pollution.

Nitrogen dioxide is known to cause occupational disease. Among occupations with NO_2 hazards are the manufacture of nitric acid, exposures of farmers to silage that has had high nitrate fertilisation, electric arc welding, and mining utilising nitrogen compounds as explosives. It is estimated that eye and nasal irritation will be observed after exposure to about 15 ppm of nitrogen dioxide and pulmonary discomfort after brief exposures to 25 ppm of nitrogen dioxide.

Effct of Radioactive Isotopes

The important radioactive isotopes that may reach ambient air are Iodine 131, Phosphorous 32, Cobalt 60, Strontium 90, Radium 226, Carbon 14, Sulphur 35, Calcium 45 and Uranium. The major sources of radioactive air pollutants are:

- Nuclear reactors
- Experimental accelerators
- Scientific and medical use of radioactive isotopes
- Agricultural and industrial use of radioactive isotopes as tracers, and
- Testing of nuclear bombs in the atmosphere.

The serious health effects are anaemia, leukaemia and cancer. Radioactive isotopes also cause genetic defects and sterility, as well as embryo defects and congenital malformations. It also shortens the life span of an individual.

EFFECTS OF AIR POLLUTION ON ANIMALS

The process by which farm animals get poisoned is entirely different from that by which human beings exposed to polluted atmospheres are poisoned. In case of farm animals it is a two-step process:

- Accumulation of the air-borne contaminant in the vegetation and forage
- Subsequent poisoning of the animals when they eat the contaminated vegetation

In case of human beings working in polluted atmospheres in factories, the concern is for the harmful substances that are directly inhaled, whereas in the case of the farm animals, the danger obviously is not in inhaling the polluted air, but rather the ingestion of forage which has been contaminated with pollutants like fluorine from the air

The three pollutants responsible for most livestock damage are fluorine, arsenic and lead. These pollutants originate from industrial sources or from dusting and spraying.

EFFECTS OF AIR POLLUTION ON PLANTS

The primary factor which controls gas absorption by the leaves is the degree of opening of the stomata. When the stomata (*stomata are the entrances in the leaf bottom through which CO_2 enters to play its role in photosynthesis*) are wide open, absorption is maximum and vice versa. Consequently, the same conditions that enhance the absorption of the gas (CO_2 for photosynthesis), predispose the plant to injury (by absorbing a pollutant gas like SO_2). The conditions that cause the stomata to open are high light intensity (especially in the morning hours), high relative humidity, adequate moisture supply to the roots of the plant and moderate temperatures.

Most plants close their stomata at night and are therefore much more resistant at night than in the day time. But some plants like the potato, which do not close their stomata at night are as sensitive in the dark as in the light.

Air Pollutants Affecting Plants

- Sulphur dioxide
- Fluoride compounds (like hydrogen fluoride)
- Ozone
- Chlorine
- Hydrogen chloride
- Nitrogen oxides (NO, N02, etc.)
- Ammonia
- Hydrogen sulphide
- Hydrogen cyanide
- Mercury
- Ethylene
- PAN (peroxy acetyl nitrate)
- Herbicides (sprays of weed killers)
- Smog

The above pollutants interfere with plant growth and the phenomenon of photosynthesis. Smog, dust, etc., reduce the amount of light reaching the leaf and also by clogging the stomata may reduce carbon dioxide intake to some extent and thus interfere with photosynthesis.

Forms of Damage to Leaves

- **Necrosis** is the killing or collapse of tissue.
- **Chlorosis** is the loss or reduction of the green plant pigment, chlorophyll. The loss of chlorophyll usually results in a pale green or yellow pattern. Chlorosis generally indicates a deficiency of some nutrient required by the plant. In many respects, it is analogous to anaemia in animals.
- **Leaf abscission** is dropping of leaves.
- Leaf epinasty is a downward curvature of the leaf due to higher rate of growth on the upper surface.

Effect of Sulphur Dioxide on Plants

Sulphur dioxide produces two types of injury on the leaves of plants - acute and chronic, depending on the concentration and period of exposure. The acute injury is characterized by the killing of marginal or interveinal areas of the leaf. Immediately after fumigation these areas will get a dull, water-soaked appearance. Subsequently they dry up and usually bleach to an ivory colour, though some species finally assume a brown or reddish-brown colour. Chronic injury is caused by the slow, long-continued absorption of sub-lethal amounts of gas or by absorption of an amount of gas somewhat less than that necessary to cause acute injury.

Effect of Ozone

Ozone is phytotoxic in exposures of a few hours at about 0.2 ppm. Injury due to ozone is quite different from typical smog injury. The lesions are generally confined to the upper surface. The effects of ozone on plants in mild and severe doses is indicated in following table.

Pollutant	**Dose**	**Effect**
Sulphur dioxide	Mild	Interveinal chlorotic bleaching of leaves
	Severe	Necrosis in interveinal areas and skeletonized leaves
Ozone	Mild	Flecks on upper surfaces, premature aging and suppressed growth
	Severe	Collapse of leaf, necrosis and bleaching
Fluorides	Cumulative effect	Necrosis at leaf tip
Nitrogen dioxide	Mild	Suppressed growth, leaf bleaching

Effect of Chlorine

Apart from the fluorides, halogens and their compounds are relatively unimportant air pollutants which might cause injury to vegetation. However, chlorine is more toxic to vegetation than sulphur dioxide by a factor of two or three. Lesions are generally marginal and interveinal. Damage to vegetation caused by chlorine is rare, and most of the reported cases are due to accidents or excessive use of gas for sterilising.

Time-Concentration Equations

The effect of concentration versus lime is an important variable in assessing damage. A high dose for a short time may cause an acute injury, whereas" the same total dose over a longer time may cause no visible effects at all.

The concentration-time equation may be expressed as,

$$t(C - C_0) = K$$

where,

t = time in hours to produce a certain effect on a certain species

C = concentration of a specific gas in ppm

C_0 = threshold concentration of the gas (ppm) to cause injury

K = experimentally determined constant

Leaf Destruction in Relation to the Yield

Many industries that emit phytotoxic gases are located near valuable agricultural lands. If damage is done to nearby crops, the farmer is legally entitled to recover his losses (especially in countries where air pollution control legislation is in force). Therefore, an objective method is required for determining the extent of losses. Many studies have shown that for sulphur dioxide, the reduction in the yield of the crop is proportional to the percentage of leaf area destroyed. The equation is of the form

$$y = a - bx$$

where,

y = yield expressed as the percentage of full yield

x = percentage of leaf area destroyed

a = constant (about 100%)

b = Slope of yield-leaf destruction curve.

EFFECTS ON MATERIALS

Air pollution has long been a significant source of economic loss in urban areas. Damage to non-living materials may be exhibited in many ways, such as corrosion of metals, rubber cracking, soiling and eroding of building surfaces, deterioration of works of art, and fading of dyed materials. Much of this damage is due to the conversion of sulphur oxides to highly reactive sulphuric acid. Suspended particulate matter also plays a significant role in metal corrosion. Deposition of dust and soot on building materials not only significantly reduces the aesthetic appeal of structures, but also, either alone or in combination with other environmental factors result in direct chemical attack (NAS, 1977). It has been pointed out that it is quite difficult to predict corrosion rates separately for sulphur dioxide and particulate matter since they frequently co-exist at high levels. Paints are usually applied on materials to enhance the beauty of the surface and to protect the underlying surface from weathering. Air pollutants may limit both these functions by damaging the protective coating and thereby exposing the underlying surface to be attacked by pollutants.

Some of the most common pollutants that can cause much damage are sulphur dioxide, hydrogen sulphide, tarry and greasy aerosols, and metal salts.

Mechanism of Deterioration

Air pollutants damage materials by five mechanisms:

- **Abrasion**. Solid particles of sufficient size and travelling at high velocities can cause destructive abrasion. Large, sharp-edged particles imbedded in fabrics can accelerate wear.
- **Deposition and removal.** Solid and liquid particles deposited on a surface may not damage or change the material itself except, perhaps to spoil its appearance. However, the removal of these particles may cause some deterioration. Although a single washing or cleaning may not cause noticeable deterioration, frequent cleaning ultimately does.
- **Direct chemical effect**. Some air pollutants react irreversibly and directly with materials to cause deterioration: for example, the tarnishing of silver by hydrogen sulphide and the etching of a metallic surface by an acid mist.
- **Indirect chemical effect**. Certain materials absorb pollutants and are damaged when the pollutants undergo chemical changes. Sulphur dioxide absorbed by leather, for instance, is converted to sulphuric acid which deteriorates the leather.
- **Electrochemical corrosion**. Most of the atmospheric deterioration of ferrous metals is by an electrochemical process. Numerous small electrochemical cells form on ferrous metal surfaces exposed to the atmosphere. Anodes and cathodes result from the local chemical or physical differences on the metal surfaces. The distance between the anodes and cathodes is usually small. The difference in potential between the anode and cathode is the driving force for the corrosive action. If the metal is clean and dry, no current flows and no corrosion appears. If water is present even as a molecular layer on a surface that appears to be dry current flows. If the water is then contaminated with air pollutants, it is very likely to have more electrical conductivity, and corrosion will proceed faster.

Factors That Influence Deterioration

Some of the more important factors that influence the deterioration rate of damaging pollutants include moisture, temperature, sunlight and air movement:

- **Moisture**. Without moisture in the atmosphere, there would be little if any, atmospheric corrosion even in the most severely polluted environments. Visible wetting of surfaces is not required for corrosion to take place. For several metals, there seems to be a critical atmospheric humidity, which when exceeded, produces a sharp rise in the rate of corrosion.
- **Temperature**. The most obvious influence of temperature is on the rate of the chemical reaction resulting in deterioration. Lowered surface temperature, however, may increase the chance for damage, because objects exposed during a radiation temperature inversion loose heat rapidly and usually cool to temperatures below that of the ambient air. If their surface temperature fail below the dew point, the surface becomes moist and, in the presence of corrosive pollutants whose concentrations are

increasing under the stable influence of the temperature inversion, conductive to certain types of damage to materials.

- **Sunlight**. In addition to producing agents such as ozone through a series of complex photochemical reactions in the atmosphere, sunlight can cause direct deterioration of certain materials. In case of rubber cracking or fading of certain dyes, direct sunlight damage cannot always be distinguished from that caused by ozone.
- **Air movement**. Wind speed is significant in determining whether solid and liquid agents impact on vertical surfaces, settle on horizontal surfaces, or produce abrasion. Where deterioration is caused by pollutants released nearby, wind direction is a most important variable. Air movement where leather bound books are stored is a critical factor when the air is contaminated by sulphur dioxide. The air movement continually supplies sulphur dioxide contaminated atmosphere to the leather surface of the books.

Effect on Building Materials/Properties

Air pollutants cause great damage to the historical monuments. The marble temples of Acropolis in Athens (Greece), the Cleopatra's Needle and Lincolon Memorial in United States of America, Madonna in Milan's Cathedral (Italy) are some of the ancient monuments that have already suffered varying amounts of corrosion, spoilage, disfigurement, cancer or discolouration. The famous Humayun's Tomb in Nizammuddin (Delhi has been adversely affected by the fumes generated from the Indraprastha Thermal Power Station). The historic Taj Mahal of Agra is sick and getting corroded because of the growing air /pollution in the Taj Trapezium.

Building materials are corroded and disfigured by air pollution in a number of ways in addition to the normal weathering processes. Smoke and Tarry, sticky aerosols adhere to stone and other building surfaces to produce unsightly coatings. Rain may remove some of these materials, but streaking at window sills, for example, shows that rain removal is only a partial process.

Under conditions of high wind speed, larger particles can be re-entertained in the wind stream and actually produce a slow erosion of building surfaces similar to sandblasting. This is a much more subtle damage than that caused by reactive chemical pollutants. Acidic gases such as sulphur dioxide in the presence of moisture can react with limestone ($CaCO_3$) to form calcium sulphate ($CaSO_4$) and gypsum ($CaSO_4.2H_2O$), both of which are rather soluble in water. Carbon dioxide in the presence of moisture produces carbonic acid, the acid converts the limestone into a water soluble bicarbonate, which is then leached away.

Protection of Materials from Adverse Effects

Addition of a small amount of certain elements, especially copper, improves the corrosion resistance of mild steel. American society for testing of materials (ASTM) has established this fact in an extensive series of exposure tests. Copper steel and Chromium, Silicon, Copper alloy steel used in an industrial environment for 10 years were more resistant to corrosion than carbon steel.

For the protection of underlying surface low permeability coating is needed. Chlorinated rubber is advantageous for use on concrete and building materials, an application it shares with styreneacrylic.

DISEASES CAUSED BY AIR POLLUTION

Asthma

Asthma is a disease that may be caused by air pollution. Asthma is a chronic, occasionally debilitating inflammatory disease of the airways that may be caused by air pollution from cars, factories or power plants. Air pollutants are common triggers of asthma: ground level ozone, sulfur dioxide, fine particulate matter and nitrogen oxide. Another important trigger for asthma attacks is environmental or second hand tobacco smoke. The CDC suggests that parents, friends and relatives of children with asthma should attempt to quit smoking and should never smoke in proximity to a child or person with asthma, as this could cause an asthma attack.

Lung Cancer

Lung cancer is a disease that may be caused by air pollution. Lung cancer is characterized by the uncontrolled growth of abnormal cells in one or both lungs. Over time, the abnormal cells can develop into tumours and impair the lung’s primary function: to supply the blood, and therefore the body, with oxygen. Long-term exposure to combustion-generated fine particulate matter poses a significant risk for cardiopulmoary and lung cancer mortality. Urban air pollution boosts lung cancer risk, and that motor vehicle emissions may be particularly problematic.

SULPHUR CYCLE

Human production of sulfur from fossil fuel and ore smelting has caused an observable impact on the regional scale (hundreds of kilometres). Considerable evidence suggests that long-range transport of SO_2 occurs in the troposphere. In transit quantities of SO_2 are converted to sulphate, with eventual deposition by dry or wet processes on the surface far from the original source of SO_2 Sulphate deposition plays the principal role in acid deposition which results in lowering the pH of freshwater lakes and alters the composition of some soils. These changes affect the viability of some plant and aquatic species. The long-range transport of SO_2 and the presence of sulphates as fine particulate matter play a significant role in reduction of visibility in the atmosphere.

Sulfur is present in most fossil fuels, usually higher in coal than in crude oil. Prehistoric plant life is the source for most fossil fuels. Most plants contain S as a nutrient and as the plants become fossilized a fraction of the sulfur volatilizes (i.e. becomes a vapor) and is released. However, some sulfur remains in the fossil fuel and can be concentrated because much of the carbonaceous matter is driven off. Thus, the S-content of the coal is available to react with oxygen when the fossil fuel is combusted. In fact, the S-content of coal is an important characteristic in its economic worth; the higher the S-content the less it is worth. So, the lower the sulfur content and volatile constituents and the higher the carbon content makes for a more valuable coal. Since combustion is the combination of a substance (fuel) with molecular oxygen (O_2) in the presence of heat, the reaction for complete or efficient combustion of a hydrocarbon results in the formation of carbon dioxide and water:

$$(CH)_x + O_2 = CO_2 + H_2O$$

However, the fossil fuel contains other elements, including sulfur, so the side reaction forms oxides of sulfur.

$$S + O_2 = SO_2$$

Actually, many other oxidized forms of sulfur can form during combustion, so air pollution experts refer to them collectively as SO_x which is commonly seen in the literature.

NITROGEN CYCLE

Likewise, nitrogen compounds also form during combustion, but their sources are very different from those of sulfur compounds. In fact, the atmosphere itself is the source of much of the nitrogen leading to the formation of oxides of nitrogen (NO_x). Molecular nitrogen (N_2) makes up most of the gases in the earth's atmosphere (79% by volume). Because N_2 is relatively nonreactive under most atmospheric conditions, it seldom enters into chemical reactions, but under pressure and at very high temperatures, it will react with O_2:

$$N_2 + O_2 = 2NO$$

Approximately, 90-95% of the nitrogen oxides generated in combustion processes are in the form of nitric oxide (NO), but like the oxides of sulfur, other nitrogen oxides can form, especially nitrogen dioxide (NO_2), so air pollution experts refer to NO and NO_2 collectively as NO_x. In fact, in the atmosphere the emitted NO is quickly converted photochemically to nitrogen dioxide (NO_2). Such high temperature/high pressure conditions exist in internal combustion engines, like those in automobiles (known as "mobile sources"). Thus, NO_x is one of the major mobile source air pollutants. These conditions of high temperature and pressure can also exist in boilers such as those in power plants, so NO_x is also commonly found in high concentrations leaving fossil fuel power generating stations.

In addition to the atmospheric nitrogen, other sources exist, particularly the nitrogen in fossil fuels. Nitrogen oxides can also be released from nitric acid processing plants and other types of industrial processes involving the generation and/or use of nitric acid (HNO_3).

Both NO and NO_2 are harmful and toxic to humans, although atmospheric concentrations of nitrogen oxides are usually well below the concentrations expected to lead to adverse health effects. The low concentrations owe to the moderately rapid reactions that occur when NO and NO_2 are emitted into the atmosphere. Much of the concern for regulating NO_x emissions is to suppress the reactions in the atmosphere that generate the highly reactive molecule ozone (O_3).

ACCUMULATION OF POLLUTANTS IN HUMAN BODY

The human body and other biological systems have a tremendous capacity to take in all types of chemicals and either utilize them to support some bodily function or eliminate them. As analytical capabilities have improved, lower and lower concentrations of chemicals have been observed in various parts of the body. Some of these chemicals enter the body by inhalation.

The concept of *total body burden* refers to the way a trace material *accumulates* in the human system. The components of the body that can store these materials are the blood, urine, soft tissue, hair, teeth, and bone. The blood and urine allow more rapid removal of trace materials than the soft tissue, hair, and bone, Accumulation results when trace materials are stored more rapidly than they can be eliminated. It can be reversed when the source of the material is reduced. The body may eliminate the trace material over a period of a few hours to days, or may take much longer - often years.

Risk is an expression of the likelihood (statistical probability) that harm will occur when a receptor (e.g. human or a part of an ecosystem) is exposed to that hazard. An example of a toxic hazard is a carcinogen (a cancer-causing chemical). An example of a toxic risk is the likelihood that a certain population will have an incidence of a particular type of cancer after being exposed to that carcinogen. This is a way of describing the population risk; that is the risk of one person out of a million will develop lung cancer when exposed to a certain dose of a chemical carcinogen for a certain period of time.

The effect of accumulation in various systems depends greatly on the quantity of pollutants involved. Many pollutants can be detected at concentrations lower than those necessary to affect human health. For pollutants which are eliminated slowly, individuals can be monitored over long periods of time to detect trends in body burden.

Effects of various air pollutants on human beings have already been discussed.

FACTORS AFFECTING CHEMICAL ACCUMULATION IN HUMAN BODY

This simplified explanation does not take into account all of the many factors that affect the ability of chemicals to be *bioaccumulated*. Some chemicals *bind to specific sites* in the body, prolonging their stay, whereas others move freely in and out. The time between uptake and eventual elimination of a chemical directly affects bioaccumulation. Chemicals that are immediately eliminated, for example, do not bioaccumulate.

Similarly, the *duration of exposure* is also a factor in bioaccumulation. Most exposures to chemicals in the environment vary continually in concentration and duration, sometimes including periods of no exposure. In these cases, an equilibrium is never achieved and the accumulation is less than expected.

Chemical accumulation varies between individual organisms as well as between species. Large, fat, long-lived individuals or species with low rates of metabolism or excretion of a chemical will bioaccumulate more than small, thin, short-lived organisms.

AIR QUALITY INDEX (AQI)

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health .Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country.

How Does the AQI Work?

Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy-at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Understanding the AQI

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

Air Quality Index (AQI) Values	**Levels of Health Concern**
0 to 50	Good
51 to 100	Moderate
101 to 150	Unhealthy for Sensitive Groups
151 to 200	Unhealthy
201 to 300	Very Unhealthy
301 to 500	Hazardous

Each category corresponds to a different level of health concern. The six levels of health concern and what they mean are:

- "**Good**" AQI is 0 to 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
- "**Moderate**" AQI is 51 to 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
- "**Unhealthy for Sensitive Groups**" AQI is 101 to 150. Although general public is not likely to be affected at this AQI range, people with lung disease, older adults and

children are at a greater risk from exposure to ozone, whereas persons with heart and lung disease, older adults and children are at greater risk from the presence of particles in the air.

- "**Unhealthy**" AQI is 151 to 200. Everyone may begin to experience some adverse health effects, and members of the sensitive groups may experience more serious effects.
- "**Very Unhealthy**" AQI is 201 to 300. This would trigger a health alert signifying that everyone may experience more serious health effects.
- "**Hazardous**" AQI greater than 300. This would trigger a health warnings of emergency conditions. The entire population is more likely to be affected.

EPA has assigned a **specific color** to each AQI category to make it easier for people to understand quickly whether air pollution is reaching unhealthy levels in their communities. For example, the color orange means that conditions are "unhealthy for sensitive groups," while red means that conditions may be "unhealthy for everyone," and so on.

AIR POLLUTION AND CLIMATE CHANGE

Air pollution changes our planet's climate, but not all types of air pollution have the same effect. There are many different types of air pollution. Some types cause global warming to speed up. Others cause global warming to slow down by creating a temporary cooling effect for a few days or weeks.

Air pollution includes *greenhouse gases*. One of these is carbon dioxide, a common part of the exhaust from cars and trucks. Greenhouse gases cause global warming by trapping heat from the Sun in the Earth's atmosphere. Greenhouse gases are a natural part of Earth's atmosphere, but in the last 150 years or so, the amount in our atmosphere has increased. The increase comes from car exhaust and pollutants released from smokestacks at factories and power plants. The increase in greenhouses gases is the cause of most of the *global warming* that happened over the past century. Scientists predict that much more warming will likely happen during the next century.

Cars, trucks, and smokestacks also release tiny particles into the atmosphere. These tiny particles are called *aerosols*. They can be made of different things such as mineral dust, sulphates, sea salt, or carbon. Some of these particles get into the atmosphere naturally. They are dust lifted into the atmosphere from deserts, from evaporating droplets from the ocean, released by the smoke from wildfires, and erupting volcanoes. But air pollution released by humans by burning of fossil fuels also adds them to the atmosphere. Aerosols have an impact on climate. While different types of aerosols act differently in the atmosphere, the overall effect of aerosols is cooling.

Greenhouse gases stay in the atmosphere for years and cause warming around the world. Computer models indicate that, worldwide, the tiny aerosols cause about half as much cooling as greenhouse gases cause warming.

ASSIGNMENT

Q.1. (AMIE S11, 4 marks): Write a short note on effect of CO upon the human body.

Q.2. (AMIE S14, 6 marks): How SO_x and NO_x affect human health? Discuss.

Q.3. (AMIE S10, W10, 20 marks): Stating principal sources of dusts in the environment briefly, describe the effects of dusts in the workplace on personnel, machines, gadgets and instruments, properties.

Q.4. (AMIE S11, 4 marks): Discuss the effects of air pollution on vegetation.

Q.5. (AMIE S11, 6 marks): Briefly explain the effects of air pollution on the atmosphere.

Q.6. (AMIE S10, W11, 20 marks): Describe in detail about the adverse effects of air pollution on human health, vegetation and property.

Q.7. (AMIE W12, 8 marks): Briefly explain sulphur and nitrogen cycles at regional scale.

Q.8. (AMIE W12, 4 marks): What factors influence the accumulation of a chemical in the human body?

Q.9. (AMIE S13, 14, 5 marks): Write short note on effects of radioactive fall out on human health.

Q.10. (AMIE S14, 5 marks): Elaborate air pollution and effect on property.

Q.11. (AMIE S14, 8 marks): Name any two occupational diseases caused due to air pollutants and describe any one in detail.

Q.12. (AMIE S13, 5 marks): Write short note on air pollution indices.

Q.13. (AMIE W10, 5 marks): Write short note on climatic change due to air pollution.