EFFECTS OF AIR POLLUTION

Effects of Specific agents :

A. PARTICULATES :-

The effects of particulates are treated as those effects contributed to airborne particles in general without generic identification, but some specific types of particles are covered. The physical effects are those with the soundest basis; some of the chemical and biological effects attributed to particulates are debatable.

1. Physical Effects ;- The important physical effects or particulates are reduction in visibility and isolation, increase in rainfall and dirtiness.

a. Visibility Reduction :

Visibility is limited by light scatter and absorption of gaseous molecules and supended particles (Midscatter). Visibility is the mean greatest visual range that persists over 50% of the horizon, visual range being the maximum distance at which a large black object against light background can be seen sufficiently for identification.

b. Other physical effects :

(i) Insulation reduction
(ii) Effect on rainfall.

2. Chemical Effects :- Particles in ambient air are quite small and have a large surface area - to - mass ratio. This property results in many of the chemical effects attributable to particles. Small particles are more soluble than large particles, more combustible and more mobile in renewing surface reactants by means other than diffusion.

Flash fires and explosions are caused by dense suspensions of combustible dusts. Such problems are limited mostly to enclosed spaces. The most notorious being grain elevators and coal mines. However, rather rapid oxidations of small particles occur in the atmosphere without the particle density being sufficient to support flame propagation.

Particles usually react with suffaces only in prosence of moisture, however, significant capillary condensation occurs under particles when the relative humidity is far below saturation, and some of the most damaging particles are hygroscapic and take up moistrue from the surrounding and dissolve at atmospheric humidities.

3. Biological Effects :- Particles may be classified into three categories according to their biological action : inert particles such as limestons, carbon and tale; irritating shapes such as fibres of glass, rockwool and bagasse and chemically active partcles such as silca, beryllium and asbestos.

Dusts deposit on plants and may interfere with the reception of sunlight or with plant functions such as respiration and transpiration. Inort dusts result in the stunted growth of plants that receive large amounts of such dust. Soluble particles and mists often react with plants and cause biochemical damage and emen plant deaths; for example sulphuric acid mist is an effective defoliant.

The biological effects of inort dusts on people and other animals may be classed as mechanical blockage. The lung-cleaning mechanism can be overwhelmed or made ineffectual causing a build of dusts deposited in the lungs during respiration. Under normal cicumstanoes inert dusts can be respired with apparent impurity.

Irritating dusts may cause problems because of their shape chemical composition, radioactivity, or combination or these factors. The most irritating shapes are fibres such as rockwool and fibreglass. Parttcles that cause the most concern chemically are probably silica and beryllium. Asbostos is an irritating shape and material, Radiactive particles may deliver large dosages of radintion to small areas. The highly active particles that would result if a nuclear spacecraft were destroyed in the atmosphere have been the subject of considerable research.

a. Asbestos : The linkage of asbestor with some lung cancers (mesothaliomas) has resulted in a rapid increqe in the number of publications on the subject. Apparently certain polycyclic hydrocarbons must be present for the formation of such cancors and the asbestos may just potentiate the effects of hydrocarbons. Before the indictmen of asbostos as carcinogonic, the concern was for asbestosis, a preumoconiosis with fibrotic manifestation.

b. Beryllium : It can cause berylliosis a morbid condition of the lungs characterized by the formation of granulomas.

4. INERT DUSTS : The Air Qunlity Criteria of the National Air Pllution Control Administration (NAPCA) recommend maximum ambicnt levels of $80ug/m^3$ suspended particulates as an annual mean for health reasons.

B. CARBON MONOXIDE : The important effects of CO are biologioal effects on people and animal. CO does not appear to have any serious effect on the plant at normal pollution level. In this can nection it may be mentioned that there a number of other substances which are relatively unimportant because they are unlikely to be found in atmosphere in sufficiont concentration to be

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toxic to vegetation, except perhaps accidentally.

Many of the physiogolical studies on CO have involved the uptake and release kinetisa and the amounts of Hb inactivated by various concentrations. CO reacts with Hb to give Carboxyhemoglobin (COHb). Not only is the Hb unavailable for oxygen transport but also the dissociation of oxygen from the other Hb molecules is shifted to slower rate.

Sometimes present COHb is assumed equal to 1/6 times the CO concentratopm in parts per million by volume.

Physiological symptoms have not been proved for less than 10% COHb therefore current efforts mostly indicate physiological change for low levels. It has been reported that about 2% COHb affects the ability to judge time and space intervals and 5% impairs ability to perform designated psychomotor activities. Heavy smokers ofter have levels above 5%.

At high levels of concentration, CO, more that any other air pollution has been identified as a participant in synergestic reactions For example, the combined effect of CO in the presence of H2S Nitrogen Diexide is more severe than the sum of the effects of each of the gases.

SULPHUR DIOXIDE : Sulphur occur in trace quantities as an elemont in the atmosphere, and in its reduced form as unpleasant smelling hydrogen sulphide and mercaptans. Most of the sulphur in the atmosphere is in an oxidised form; SO2 is probably the most widespread of the man-made air pollutants and is the one most intensively studied.

OXIDES OF SULPHUR : Oxides of Sulphur, primarily SO2, are produced by the combustion of sulphur containing fuels, such as coal and fuel oils, in sulphuric acid plants and in metallurgical processes involving ores that contain sulphur. The burning of wood and solid wastes such as paper, cardboard and rubber tyres also add SO2 to the atmosphere.

Reactions : In the combustion of Sulphur containing materials, most of the sulphur is converted to sulphur dioxidd and a small percentage is oxidised further to the trioxide stage. The formation of sulphur trioxide may be increased by using excess oxygen and by the catalytic action of ash constituents specially iron oxides. Sulphur trioxides react rapidly with water vapour to become sulphuric acid, resulting in an irritant mist. This conversion often is the change of the bluish white emitted in industrial and power plant operation.

When gases, including oxides of sulphur leave a stack,

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turbulent diffusion usually lowers the SO2 concentration rapidly. Only a few parts per million several hundred feet away and further oxidation to SO_3 proceeds on a slow rate.

Effects : SO2 can injure man, plants and materials and can interfere with visibilty. At sufficiently high concentrations, SO2 irritates the upper respiratory tract of human beings because of its high solubility in body fluids. At low concentration the main potential effect of SO2 is to make breathing more difficult bu causing the finer air tubes of the lung to constitute.

The toxic effects of SO2 appear to be greator when the gas combin with aersoll than when it is . The effect of Sulphuric acid mist is greatly influenced by the size of the mist particles; those of intermedidate size (about 1 u in mean dia) appear to be most injurious.

SO2 causes both acute and chronic injury to the leaves of plants. It is absorbad through the stomata and at a very low concentration (below. 4p:pm) the SO2 tends to be oxidised to sulphate in the cells as rapidly as it is absorbed. In such cases, there may be temporary partial inhibition of photosynthesis while the gas is present, but the leaves are not permanently damaged, the normal level of photosynthesis is rapidly regained after the fumigation has stopped. At higher levels of exposure the cells die, interveinal tissues collapse and take a water soaked appearance, and drying and bleaching occurs later. It seems clear that the oxidation-reduction properties of SI2 , rather than its acidity, are responsible for its toxic effects on plants.

High light intonsity, high relative humidty, adequate moisture and moderate temp cause the stomato to open and the leaf therefore absorbs more SO2. The stomata of most plants are therefore much more resistant to SO2 during that time.

Different species of plants and even different varities of a species may vary con sidenably in their susceptibility to SO2. These differencew soan to be caused primarily by variatiouns in the rate of absorption of the gas by the leaves. Plants with their leaves of high physiological activity, such as alfafa, grains, cotton, grapes, are generally sensitive. Plants with flashy leaves or needles (such as citrus and pine) tond to be resistant except when the leaves are newly formed.

Both SO3 and H2SO4 are responsible for accelerating the corrosion and deterioration of certain materials. They also attack building

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materials, particularly limestone, marble, roofing slate and mortar, all of which contain carbonates that are converted to relatively soluble sulphates that can be leached away by rain water. SO2 is responsible for the formation of that familiar greenish coating on copper and copper alloys which acts as a pretective coating; but when formed as electrical contacts made of copper. They increase the electrical resistance of the contacts.

The small amounts of metallic impurities in paper accelerate the conversion, in the presence of moisture, of absorbed SO2 to H2SO4 acid, which makes the paper extremely brittle. SO2 also causes leather to lose much of its strength and to eventually disintegrate, and brings about deterioration of a number of natural and synthetic fibres used in textiles partcularly cotton and wool. Nylon is also attacked by it.

Other sulphur compounds : Mercaptans and hydrogen sulphides are produce in large quantitiesin the processing of petroleum, in the cooking of coals, and in the operating of paper pulp mills using Kraft process. They also are produced in certain other chomical procasses.

Effects : H2S and mercaptans are objectionable because of their distinct and unpleasani odour even at very low concentrations.

Ag & cu tarnish rapidly in the presence of H2S. Any meterial containing lead, be it lead based white paint or plumbing fixtures darkens in presence of H2S.

The air pollution problem that results from harm to the above materials. It is unusual to find levels in the atmosphere that are high enough to cause damage to vegetation, irritation of the eyes and respiratory systems, systamic effects, or death.

CARBON DIOXIDE :

CO2 is not normally considered an air pollutant because (i) the uncontaminated atmosphere has a concontration of approx. 300 ppm, (ii) it is essential for animal and plant life, and (iii) thore must be atleast 5000 ppm in the air befor man's respiration is adversely affected.

However, since about the middle of 19th centurt, worldwide atmospheric concerntrations of CO2 have been rising steadily because of the increasing dependance of our industrial era on fossil fuels. Huge quantities of CO2 are emitted each day into city air. CO2 concentrations over heavily

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industrialised areas are at times as high as 100 ppm.

Local Effects : The principal undervable effect of atmospheric CO2 is deterioration of building stones in particular, carbonate rock such as limestone. In the presonce of moisture , CO2 produces carbonic acid, which converts calcium carbonate to the water soluble bicarbonate that is the leached away. CO2 is also responsible in part for the atmospheric corrosion of magnesium and perhaps of other structural metals.

implicatans : The extra amount of atmospheric CO2 that are derived from Globastuib of fossil fuel may have possible effect on the climate of the cole earth.

The temparature of the earth is controlled by the balance between energy received from the sun and that lost back into space. Light passes through the atmospher to the surface of the earth. There some of it is absorbed, heating the ground , thi energy is then reradiated as infrared rediation, The atmosphere is kept warm because there substances in its upper layers absorb some of this infrared radiation from the earth. In the order of importance, they are water vapour, CO2 and O3. Those subatances act like the glass. Human activities have changed the CO2 concentration. Some socientists believe that the slight rise of average temp. Over the cntire in atmospheric CO_2.

EFFECTS OF SPECIFIC AGENTS

Oxides of Bitrogen (NO_x) . : Oxidem of Nitrogen are one of the most important groups of atmospheric contaminants. They are produced during the high temp. combustion of Coal. Oil, Gas or Gasolipe in power plants and internal combustionengines (auto-exhaust). The combustion fixes atmospheric Nitrogen to produce the oxides . At this temps nitric oxides form first and in the atmosphere it reacts with oxygen and is converted to nitrogen diexde (NO_2) . While this oxidation is rapid at high concentrations, the rate is much slower at low conecntrations. In sunlight especially in the presonce of organic material, the conversion of NO to NO2 is gratly accolerated.

Effects : The hazards associated with NO are (i) a direct noxious effect on and well being of people and (ii) photochemical oxidation of organic material, which is an indirect effect. In the concentrations normally found in community air pollution, the effects that arise from photochemical reactions are more objectionable.

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NO2 is coniderable more toxic than NO and acts as an acitely irritating substance. In equal concentrations, it is more injurious than CO. NO2, at levels found in air pollution, are only potentially irritating and potentially rolated to chronic pulmonary fibrosis.

SO2 can react with the water vapour in the air or with rain drops to produce HNO3, small concentrations in the atmosphere can change considerable corrosion to metal surfaces in the immediate vicinity of the souros. NO2 absorba light in the visible region of the spectrum, mestly in the blue region. it is an yellow-brown gas. Because it is visible, substantial concentration reduce visibility even without the presence of acrosol particles.

Plant damage by NOx is rare.

PHOTOCHEMICAL AIR POLLUTION (SMOG).

The term 'Smog' was orginally conied to denote smoke and fog conditions in urban and industrial areas out the term is now more generally used to refer to a special air pollution problem which is characterised by its composition and effects. Smog causes plant damage, eye irritation, cracking of stressed rubber and a decrease in visibility. The annoying components in this pollution were products formed in a photochomical reaction between oxides of nitrogen and many types of organies in the prosence of sunlight. This system can also oxidis. SO2 SO3 with the haze formation.)

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