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Improvement Test

Sub:	AIR POLLUTION AND CONTROL							Code:	10CV765
Date:	21 / 11 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	VII	Branch:	CIVIL

Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1	Explain the classification and properties of air pollutants.	[10]	CO1	L2
2	Distinguish between photochemical smog and coal induced smog.	[10]	CO1	L2
3	With a neat sketch, explain the principle and operation of an electrostatic precipitator.	[10]	CO3	L2
4	Explain the meteorological parameters that influence the dispersion of pollutants in atmosphere.	[10]	CO2	L2
5	Discuss salient features of air pollution (Prevention) Act,1986.	[10]	CO5	L2
6 (a)	Explain Water quality standards.	[05]	CO5	L2
(b)	Explain Air pollution Index.	[05]	CO5	L2

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AIR POLLUTION AND CONTROL (10CV765)

IAT 3 SOLUTION- 2017

1. Based on orgin of pollutants

a. Primary pollutants are those that are emitted from identifiable sources, typical pollutants are particulate matter such as ash, smoke, dust, fumes, mist and spray; inorganic gases such as SO_2, H_2S, nitric oxide, ammonia, CO, CO_2, hydrogen fluoride, and also radioactive components.

b. Secondary pollutants are those formed in the atmosphere by chemical reactions between primary pollutants and normal atmospheric constituents. Pollutants such as SO_3,NO_2, peroxy acetyl nitrate (PAN), ozone, aldehydes, ketones and various sulphate and nitrate salts are included in this category Secondary pollutants as formed from the chemical and photo chemical reaction in the atmosphere. The reaction mechanisms are influenced by concentration of reactants, the amount of moisture contents, degree of photo activation, Meteorological forces and local photography.

Based on Source

a. Natural sources include wind blow dust, pollen grains, volcanic gas and ash, smoking and trace gases from forest fires.

b. Anthropogenic sources: Power plants, industrial boilers, diesel generations, municipal and industrial incineration refuse.

STATIONARY AND MOBILE SOURCES

Stationary source- Industrial instillations, asphaltic plants and cement manufacturing unit

Mobile source- Automobiles

PROPERTIES OF AIR POLLUTANTS

(1)PARTICULATE MATTER – In general the term particulate refers to all atmospheric substances that are not gases. They are ranging in size from 100µ down to 0.1µ and less.

DUST: It contains particles of size ranging from 1µ to 200µ. These are formed by natural disintegration of rock and soil by the mechanical processes of grinding and spraying. They have large settling velocities and removed from the air by gravity and other inertial processes. Fine dust particles act as centres of – catalysis for many of the chemical reactions taking place in the atmosphere.

SMOKE: It contains fire particles of the size less than 1µ, which are formed by combustion, smoke may have different colours depending on nature of materials burned

FUME: These are solid particles of the size ranging from 0.1µ to 1µ and are normally released from chemical or metallurgical processes

AEROSOL: All air borne suspensions either solid or liquid.

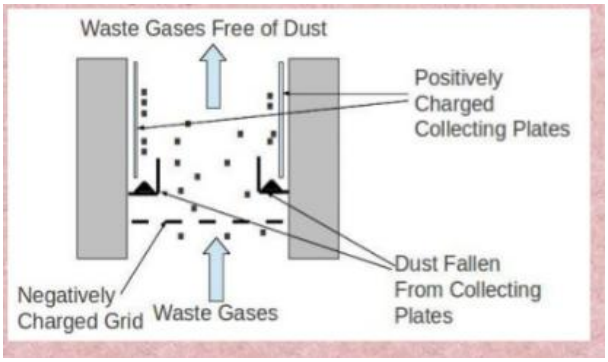
OXIDES OF SULPHUR : SO_2 is a colourless gas with a characteristic, pungent odour. It is moderately soluble in water, forming weak acidic sulphurous acid (H_2SO_3). It is oxidized slowly in clean air to sulphur trioxide (SO_3).

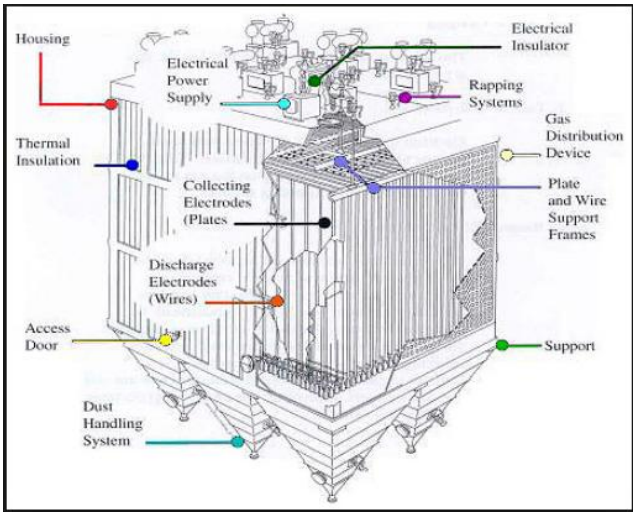
2. PHOTO-CHEMICAL SMOG : Photochemical Smog was first observed in Los Angeles, USA in the Mid1940's and since then the phenomenon has been detected in most major metropolitan cities of the world. The conditions for the formation of Photo chemical Smog are air stagnation, abundant sunlight and high concentration of hydrocarbons and NOx in the atmosphere. It occurs under adverse Meteorological conditions when the air movement is restricted in highly motorized areas and is caused by the interaction of some hydro carbons and oxidants under the influence of sunlight giving rise to dangerous PEROXYACETYL NITRATE [PAN]. Its main constituents are Nox, PANS, hydrocarbons, CO and Ozone. It reduces visibility, causes eye irritation, damage to vegetation and cracking of rubber.

Smog arises from photochemical reactions in the lower atmosphere by the interaction of hydrocarbons and NOx released by the exhaust of automobiles and some stationary sources. This interaction results in a series of complex reactions producing secondary pollutants such as ozone, aldehydes, ketones and peroxyacetyl Nitrate [PAN].

COAL INDUCED SMOG : Another Form of smog is called industrial smog. This smog is created by burning coal and heavy oil that contains sulphur impurities in power plants, industrial plants, etc. The smog consists mostly of a mixture of SO2 and Fog. Suspended droplets of H2SO4 were formed from SO2 and a variety of suspended particulate matter. This smog is common during the winter in cities such as London [Dee 1952], Chicago, Pitts burg, when the cities burned large amounts of coal and heavy oil without control over the emissions, large scale problems were witnessed. In 1952, London, 4000 people died as a result of this type of smog. Today heavy oil and coal are burned only in large boilers and with reasonably good control or tall Chimneys so that industrial smog is less of a problem. However come countries such as China, Poland, Czechoslovakia and some other Eastern European countries still burn large quantities of coal without using adequate controlling measures.

3.Electrostatic precipitator: The electrostatic precipitator (ESP) operate on the principle of electrostatic attraction. A high negative voltage , 20,000 to 100,000 volts, applied to the discharge electrodes, produces a strong electric field between the discharge and collector electrodes. Particles in the gas stream acquire a negative charge as they pass through the electrical field. Because of their charge, the particles are then attracted to collector electrode. The efficiency of an ESP is a function of the flue gas characteristics (especially temperature and moisture) and the electrical resistivity of the particles.





ELECTROSTATIC PRECIPITATOR : Consists of six major components,

i) A source of high voltage
ii) Discharge electrodes and collecting electrodes
iii) Inlet and outlet for the gas
iv) An electric cleaning system
v) 'Hopper' for collection and disposal of particulates
vi) An outer casing [called shell] to form an enclosure around the electrodes.

APPLICATIONS

1) Cement factories : Cleaning of flue gas from cement kilns, recovery of cement dust from kilns.
2) Pulp and paper : Soda-Fume recovery in kraft pulp mills.
3) Steel plants : Cleaning blast furnace gas, cleaning open hearth and electric furnace gases.
4) Chemical Industries – Collection of SO_x, Phosphoric Acid mist, cleaning various types of gases i.e., hydrogen, CO_2, SO_2, Removing dust from elemental phosphorus in the vapor state.
5) Petroleum industry:- Recovery of catalyst.
6) Carbon black industry :- Agglomeration and collection of carbon black.
7) Thermal Power plants:- Collecting Fly ash from coal fired boilers.

4. Important meteorological parameters that influences air pollution can be classified into

1. Primary parameters and
2. Secondary parameters

1. **PRIMARY PARAMETERS** are
   a) Wind direction and speed
   b) Temperature
   c) Atmospheric stability
   d) Mixing height
2. **SECONDARY PARAMETERS** are
   a) Precipitation
   b) Humidity
   c) Solar radiation
   d) Visibility

WIND DIRECTION AND SPEED: The direction and speed of surface winds governs the drift and diffusion of air pollutants, discharged near the ground level. The higher the wind speed at or near the point of discharge of pollution, the more rapidly are the pollutants carried away from the source. The pollutants so dispersed will not exist at the same concentration but will rapidly be diluted, on the other hand when wind speeds are low, pollutants tend to be concentrated near the area of discharge.

ATMOSPHERIC STABILITY AND TEMPERATURE INVERSIONS:

In well mixed air, for every 300m increase in altitude, the temperature decreases by about 1.8^{o} C. This vertical temperature gradient is known as dry adiabatic lapse rate (DALR). Ambient and adiabatic lapse rates are a measure of atmospheric stability.

MAXIMUM MIXING DEPTH (MMD)

Height above earths surface, upto which pollutants extend, under the action of turbulence.
PRECIPITATION: Precipitation exerts a two fold cleansing action on the pollutants discharged into the atmosphere . It accelerates the deposition of particular matter on the ground and hence its removal from the atmosphere.

HUMIDITY: The moisture content of the atmosphere influences the corrosive action of the air pollutants and indicates the potentiality for fog formation in relation to the degree of air pollution

RADIATION: Depending on the location, solar radiation can have a pronounced effect on the type and rate of chemical reactions in the atmosphere

5. Salient features of air pollution (Prevention) Act,1986.

ENVIRONMENTAL (PROTECTION) ACT, 1986

The Environment (Protection) Act, 1986 was introduced as an umbrella legislation that provides a holistic framework for the protection and improvement of the environment. In terms of responsibilities, the Act and the associated Rules obtained environmental clearances for specific types of new projects (addressed under Environmental Impact Assessment Notification, 1994) and for submission of an environmental statement to the State Pollution Control Board annually. Environmental clearance is not applicable to hydro projects also. SJVNL undertakes Environmental Impact Assessment for all projects as standard management procedure has laid down in The Environment (Protection) Act, 1986 and also functions within permissible standards of ambient air quality and noise levels as prescribed by national laws and international regulations.

Under the Act, the Central Government may frame rules with respect to the following:

(i) The stands of quality of air, water or soil for various areas and purposes.

(ii) The maximum allowable limit of concentration of various environmental pollutants (including noise) for different areas.

(iii) The procedures and safeguards for the handling of hazardous substances.

(iv) The prohibition and restrictions on the location on the industries and the carrying on of processes and operations in different areas.

(v) The prohibition and restrictions on the handling of hazardous substances in different areas.

(vi) The procedures and safeguards for the prevention of accidents which may cause environmental pollution and for providing for remedial measures for such accidents.

6.a.

Table 1 Organoleptic and Physical Parameters

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 3025	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Colour, Hazen units, *Max*	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
ii)	Odour	Agreeable	Agreeable	Part 5	a) Test cold and when heated b) Test at several dilutions
iii)	*p*H value	6.5-8.5	No relaxation	Part 11	—
iv)	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
v)	Turbidity, NTU, *Max*	1	5	Part 10	—
vi)	Total dissolved solids, mg/l, *Max*	500	2 000	Part 16	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Aluminium (as Al), mg/l, *Max*	0.03	0.2	IS 3025 (Part 55)	—
ii)	Ammonia (as total ammonia-N), mg/l, *Max*	0.5	No relaxation	IS 3025 (Part 34)	—
iii)	Anionic detergents (as MBAS) mg/l, *Max*	0.2	1.0	Annex K of IS 13428	—
iv)	Barium (as Ba), mg/l, *Max*	0.7	No relaxation	Annex F of IS 13428* or IS 15302	—
v)	Boron (as B), mg/l, *Max*	0.5	1.0	IS 3025 (Part 57)	—
vi)	Calcium (as Ca), mg/l, *Max*	75	200	IS 3025 (Part 40)	—
vii)	Chloramines (as Cl_2), mg/l, *Max*	4.0	No relaxation	IS 3025 (Part 26)* or APHA 4500-Cl G	—
viii)	Chloride (as Cl), mg/l, *Max*	250	1 000	IS 3025 (Part 32)	—
ix)	Copper (as Cu), mg/l, *Max*	0.05	1.5	IS 3025 (Part 42)	—
x)	Fluoride (as F) mg/l, *Max*	1.0	1.5	IS 3025 (Part 60)	—
xi)	Free residual chlorine, mg/l, *Min*	0.2	1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
xii)	Iron (as Fe), mg/l, *Max*	0.3	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xiii)	Magnesium (as Mg), mg/l, *Max*	30	100	IS 3025 (Part 46)	—
xiv)	Manganese (as Mn), mg/l, *Max*	0.1	0.3	IS 3025 (Part 59)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xv)	Mineral oil, mg/l, *Max*	0.5	No relaxation	Clause 6 of IS 3025 (Part 39) Infrared partition method	—
xvi)	Nitrate (as NO_3), mg/l, *Max*	45	No relaxation	IS 3025 (Part 34)	—
xvii)	Phenolic compounds (as C_6H_5OH), mg/l, *Max*	0.001	0.002	IS 3025 (Part 43)	—
xviii)	Selenium (as Se), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 56) or IS 15303*	—
xix)	Silver (as Ag), mg/l, *Max*	0.1	No relaxation	Annex J of IS 13428	—
xx)	Sulphate (as SO_4) mg/l, *Max*	200	400	IS 3025 (Part 24)	May be extended to 400 provided that Magnesium does not exceed 30
xxi)	Sulphide (as H_2S), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 29)	—
xxii)	Total alkalinity as calcium carbonate, mg/l, *Max*	200	600	IS 3025 (Part 23)	—
xxiii)	Total hardness (as $CaCO_3$), mg/l, *Max*	200	600	IS 3025 (Part 21)	—
xxiv)	Zinc (as Zn), mg/l, *Max*	5	15	IS 3025 (Part 49)	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

6.b. Air pollution Index: Scheme that transforms values of air pollution related parameters, eg sulphur dioxide concentration or suspended particulate matter, into single set of numbers. It helps in informing public about air pollution levels. It helps in comparing air pollution levels in cities. It helps to avoid severe episode of air pollution.

- Types of indices
- Short term indices- Inform daily changes in air pollution levels. They are used by local and state air pollution control agencies
- Long term indices –Evaluate changes in air pollution over a period of several years. They help in assessing the effectiveness of enforcement policies and improving air quality

Air Pollution parameters are Suspended particulate matter, sulphur dioxide, carbon monoxide, nitrogen dioxide and hydrocarbons.

- Criteria for standardised index
- Easily understood

- Include major pollutants
- Calculated in simple manner
- Exhibit day to day variation
- Relate to air quality standards and goals

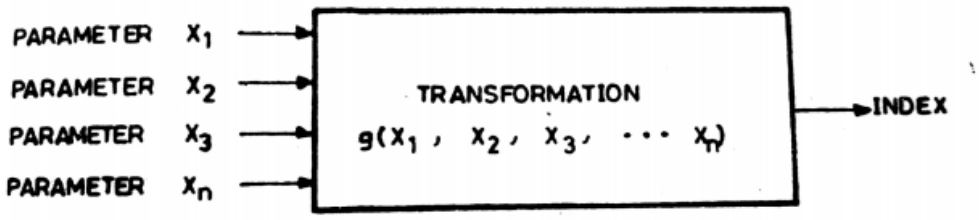


Fig. 20.1 *Index calculation*