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Internal Assessment Test 1 – Sept. 2017

Sub:	AIR POLLUTION AND CONTROL					Sub Code:	10CV765	Branch:	CIVIL
Date:	21-09-17	Duration:	90 min's	Max Marks:	50	Sem/Sec:	VII		OBE

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1	Explain the classification of air pollutants in detail.	[10]	CIV710.1	L2
2	Explain photo chemical smog and coal induced smog.	[10]	CIV710.1	L2
3	Briefly explain primary and secondary air pollutants with examples.	[10]	CIV710.1	L2
4	Explain briefly on air pollution episodes of London smog and Bhopal gas tragedy	[10]	CIV710.1	L2
5	Explain the effects of air pollution on plants.	[10]	CIV710.1	L2
6	Explain the effects of air pollution on materials	[10]	CIV710.1	L2

IAT 1 SOLUTION

AIR POLLUTION AND CONTROL (10CV765)

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.

Based on chemical composition

Organic Compounds- Compounds with Carbon and hydrogen

Eg: Hydrocarbons, Aldehydes, Ketones,Carboxylic acid, Alcohol etc…

Inorganic Compounds- eg: Sulphur oxides, Carbon monoxide, Hydrogen chloride, Nitrogen oxides, Hydrogen fluoride etc

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 SO_2 and Fog. Suspended droplets of H_2SO_4 were formed from SO_2 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. Based on orgin of pollutants

a. Primary pollutantsare those thatareemittedfrom i d e n t i f i a b l e sources,typical pollutantsareparticulatemattersuchasash,smoke,dust,fumes,mistandspray;inorganicgasessuchasSO_2,H_2S, nitricoxide,ammonia,CO,CO_2,hydrogenfluoride,andalsoradioactivecomponents.

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 and meteorological forces.

4. **a. London smog:**

London, situated in Thanes valley, experienced its worst air pollution episode due to fog from December 5 to December 9,1952. The killer smog began on December 4 as a high pressure area created a subsidence inversion over southern England. A white smog was formed in London area. Because of extensive use of coal (sulphur content 1.5%) as fuel for space heating and electricity production, the particulate and sulphur dioxide levels in the atmosphere increased. The white smog became a black fog. Smoke concentrations during the fog were found to be five times greater than those found at other times. The average concentration of sulphur dioxide in the atmosphere during the episode was about six times the usual level. The symptoms were cough, nasal discharge, sore throat, irritation of eyes and bronchi and vomiting. Most of people who died were old and those who had histories of chronic bronchitis, asthma, broncho-pneumonia and other lung or heart disease. This London disaster of 1952 caused 4000 deaths

b. BHOPALGASTRAGEDY

ModernTechnologicaldevelopmentshavemultipliedthehazardstowhichhumanbeingsareexposed .

Nearly5millionchemicalshavebeensynthesizedintheworldduringthelast40yearsandsome50,000to70,000chemicalsareusedextensivelyinmillionsofdifferentcommercialproductswithoutthe availabilityof properinformationonthemajorityofthechemicals.

Onthefatefulnighton2-12-1984,andintheearlyhoursof3-12-1984morethan1millionresidentsofBhopal,capitalofM.PIndiareportedirritationofeyesthatquicklybecame

unbearable,followedbythedeathdancingintheirresidences.Acloudofpoisonousgaswasreleased from theUnion Carbide Factory. Theplant was a pesticidemanufacturingunit ownedbyUnionCarbideIndiaLtd,asubsidiaryofUnionCarbide,aleadingcompanybasedintheUSA.The factorywaslicensedtoproduceMethylIsocyanite(MIC)i.eCH_3NCO,anextremelyhazardouschemicalwhic hisusedinthemanufactureofseveralpesticides.The carbide plant has three storage tanks for MIC, each capable of holding 45 tonnes. The Union Carbide manual on standard operating procedure warns that if water leaks into the system, it results in the evolution of a lot of gas and liberation of heat. This is precisely what had happened on the fateful day of 2nd December1984.

5.EFFECTSONVEGETATION

EFFECTOFAIR POLLUTIONONPLANTS:

Theprimaryfactor whichcontrolsgasabsorptionbytheleavesisthedegreeoftheopeningof thestomata.Whenthestomataarewideopenabsorptionismaximumandviceversa.Consequentlysomeconditi onsthatenhancetheabsorptionofthegas[CO_2forphotosynthesis]predisposetheplanttoinjury[byabsorptiona pollutantlikeSO_2]conditionsthatcausethestomatatoopenare

1) HighLightintensity[morninghours]
2) Highrelativehumidity
3) Adequatemoisturesupplytotherootsoftheplants.
4) Moderatetemperatures

LISTOFAIRPOLLUTANTSAFFECTINGPLANTS

i) SO_2
ii) Fluoridecompounds
iii) Ozone
iv) Chlorine
v) HydrogenChloride
vi) Nitrogenoxides[NO,NO_2…….]
vii) Ammonia
viii) HydrogenSulphide
ix) HydrogenCyanide
x) Mercury
xi) Ethylene
xii) PAN
xiii) Herbicides

xiv) Smog

FORMSOFDAMAGETOLEAVES

Damagetoleavestakesseveralforms

1) NECROSIS: Necrosisisthekillingorcollapseoftissue.

2) CHLOROSIS Itisalossorreductionofthegreenplantpigment [chlorophyll]

Thelossofchlorophyllusuallyresultsinapalegreenoryellowpattern.Chlorosisgenerallyindicates adeficiencyofsomenutrientrequiredbytheplant.

Inmanyrespectsitisanalogoustoanaemiainanimals.

3) ABSCISSION Leafabscissionisdroppingofleaves.

4) EPINASTY Leafepinastyisthedownwardcurvaturedofaleaf duetohigherrategrowthontheuppersurface.

KINDSOFINJURYTOPLANTS

1) **ACUTEINJURY:**Itresultsfromshorttimeexposurestorelativelyhighconcentrations,suchasmighttoccurunderfumigationconditions. Theeffects arenotedwithinafewhourstofewdaysandmayresultinvisiblemarkingsontheleavesduetocollapseanddeathofcells.Thisleadstonarcoticpatternsi.e.areasofdeadtissues.

2) **CHRONICINJURY :**Itresultsfromlongtermlowlevelexposureandusuallycauseschlorosis(or)leafabscission.

3) **GROWTHORYIELDRETARDATION**:Theinjuryisintheformofaneffectongrowthwithoutvisiblemarkings[invisibleinjuries].Usuallyasuppressionofgrowthoryieldoccurs.

EFFECTSOFAIRPOLLUTANTSONPLANTS

POLLUTANT	DOSE	EFFECTS
Sulphurdioxide	a)Mild	Interveinalchloroticbleachingofleaves
	b)Severe	Necrosisin interveinalareasandskeletonizedleaves
Ozone	a)Mild	Flecksonuppersurfaces,prematureagingandsuppressed growth.
	b)Severe	Collapseofleaf,necrosisandbleaching
Fluorides	Cumulativeeffects	Necrosisatleaftip.

6.

EFFECTSONMATERIALSMECHANISMOFDETERIORATION

Airpollutioncausedamagetomaterialsby5mechanisms

1. **ABRASION:**Solidparticlesofsufficientsizeandtravellingathighvelocitiescancauseabrasiveaction.

2. **DEPOSITIONANDREMOVAL:**Solidandliquidparticlesdepositedonasurfacemaynotdamagethematerialitselfbutitmayspoilitsappearance
3. **DIRECTCHEMICALATTACK:**Someairpollutantsreactdirectlyandirreversiblywithmaterials tocausedeterioration.
   Eg:Thebleachingofmarblebyso2,tarnishingofsilverbyH2S,etchingofmetallicsurfacebyanacidmist
4. **INDIRECTCHEMICALATTACK:**Certainmaterialsabsorbsomepollutantsandgetdamagedwhenthepollutantsundergochemicalchanges.
5. **CORROSION:**Theatmosphericdeteriorationofmetalsisby anelectrochemicalprocessi.e.corrosion.Thisisduetotheactionofairpollutantsfacilitatedbythepresenceofmoisture

FACTORSINFLUENCINGATMOSPHERICDETERIORATION:

1. **MOISTURE:**Thepresenceofmoistureintheatmospheregreatlyhelpstheprocessofcorrosion.IncaseofSO2andvariousparticulars,therateofcorrosionofmetalswillincreaseasrelativehumidityintheair increases.
2. **TEMPERATURE:**Affectstherateofchemicalreactionandconsequentlyaffectstherateofdeterioration.
3. **SUNLIGHT:**Inadditiontoproducingdamagingagentssuchasozone,PANthroughaseriesofcomplexphotochemicalreactions,sunlightcancausedirectdeteriorationofcertainmaterials.
4. **AIRMOVEMENT:**Winddirectionisanimportantfactortobeconsideredinplaceswheredeteriorationiscausedbypollutantsreleasedfromnearbyfactories.Similarlywindspeedisalsoanimportantfact

orindeterminingtheimpactofairpollutantsonthereceivingsurfaces.

AIRPOLLUTIONDAMAGETOVARIOUSMATERIALS

MATERIALS	PRINCIPALAIRPOLLUTANTS	EFFECTS
1.Metal	SO_2, AcidGases	Corrosion, loss of metal,spoilageofsurface,tarnishing
2.BuildingMaterials	SO_2,Acidgases, particulates	Discoloration,leaching
3.Paint	SO_2,H_2S,Particulates	Discoloration
4.TextilesandTextiledyes	SO_2,Acidgases,NO_2,ozone	Deteriorationreducedtextilestrengthandfading
5.Rubber	Oxidants,ozone	Cracking,weakening
6.Leather	SO_2,acidgases	Disintegration, powdered surface
7.Paper	SO_2,acidgases	Embrittlement
8.Ceramics	Acidgases	Changeinsurfaceappearance