Indraprastha Institute of Information Technology Delhi

ESC 205 A Environment Science

End Semester Examination

December 09, 2024

MM 30 Time : 2 hrs

Attempt all the questions

1(i). Describe the following air control equipments :

(a). ESP

(b). Scrubbers

(c).Fabric filter

(ii). What are wind rose diagrams (3+2)

(a).Electrostatic precipitators (ESPs)

Works on the principle of electrical charging of particulate Matter (-ve) and collecting it in a +ve charged surface.

99% efficiency.

Can remove particle size range of 0.1 μm to 1 μm.

(b). Fabric Filter

Flue gas is allowed to pass through a woven Fabric, which filters out Particulate matter.

Small particles are retained on the fabric.

Remove particles up to 1 μm.

Its efficiency up to 99%.

(c). Scrubbers

Particulate matters are incorporated into liquid droplets and removed from the gas stream.

Different types of scrubbers are-

Spray tower

Venturi scrubber

Cyclone scrubber

Flue gas made to push up against a down falling water current.

Particulate matter mix up with water thus falls down and gets removed..

A venturi scrubber is designed to effectively use the energy from a high-velocity inlet gas stream to atomize the liquid being used to scrub the gas stream.

Wind rose diagrams

Wind rose diagrams : Wind roses are graphical charts that characterize the speed and direction of winds at a location. Presented in a circular format, the length of each "spoke" around the circle indicates the amount of time that the wind blows from a particular direction. Colors along the spokes indicate categories of wind speed.

Some may show wind rose diagrams also (Please refer to the Internet).

.2.(i), What are domestic hazardous wastes?

Domestic hazardous wastes include the following items : discarded paint drums, pesticide cans, compact fluorescent light bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, phenols, used needles and syringes and contaminated gauge, etc generated.

(ii). Describe the 4 methods of treatment of hazardous wastes.
(2+3)

1. Chemical treatment – e.g., Neutralization, Precipitation, Ion exchange, Reduction or Oxidation

2. Thermal treatment – e.g., incineration

Among thermal methods is high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.

3. Biological treatment – e.g., landfarming; Microbial degradation and aerobic or anaerobic treatments.

4. Physical treatment – e.g., solidification, flotation, sedimentation, evaporation, or filtration.

3. (i). What are the key objectives of environment impact assessment ?

Ensure environmental considerations are explicitly addressed and incorporated into the decision-making process

Anticipate and avoid, minimise and offset the adverse significant biophysical, social and other relevant effects of development proposals

Protect the productivity and capacity of natural systems and the ecological processes which maintain their functions

Promote development that is sustainable and optimises resource use and management opportunities.

(ii). What is the effective EIA system ? (2+3)

Adequate institutional /organization / industry arrangement (policy, law understanding & organization).

The quality of an environmental impact statement (EIS) and environment management programme/ plan (EMP).are being implemented optimally –

TOR (Terms of Reference)

SOP(Standard operating procedure)

Detailed review will address-quality of field work ,primary and secondary survey data collection & interpretation and ground validation and leadingto better EIS & EMP.

Project description

Description of environment – before, during and after closure of project.

4. Write short notes on the following topics :

(a) Types of environmental risks

There are the following 4 types of environment risks :

Grade 1- Low risk - Rare, occurs less than 0.1% of the time/cases

Grade 2- Low to medium risk - May happen, occurs between 0.1% and 1% of the time/cases

Grade 3- Medium to high risk - Quite often, occurs between 1% and 10% of the time/cases

Grade 4- High risk - Very often, occurs more frequently than 10% of the time/cases

(ii). HIRA and ALOHA

HIRA

Hazard identification and risk assessment (HIRA) study offers the systematic approach to assess hazards and their associated risks that may offer an objective measure of an identified hazard as well as provide a technique to manage the risk.

ALOHA

ALOHA Software. ALOHA stands for Areal Locations of Hazardous Atmospheres. ALOHA is the hazard modeling software program for the CAMEO software suite, which is used widely to plan for and respond to chemical/hazardous materials emergencies.

(iii). Environment modeling (1+2+2)

Environmental modelling is the creation and use of mathematical models of the environment. Environmental modelling may be used purely for research purposes, and improved understanding of environmental systems, or for providing an interdisciplinary analysis that can inform decision making and policy.

Types of Models

Numerical Model :

Input - Algorithms- Output.

Excel Model – Excel sheets are obtained. Algorithms and Equations can be seen.

Black Box Model- Algorithms cannot be seen.

5. What is global warming and climate change ? (5)

Global warming refers only to the Earth's rising surface temperature, while climate change includes warming and the “side effects” of warming.

Average Temperature on earth is around 13.9 Degree C.

The current rise in global average temperature is more rapid than previous changes, and is primarily caused by humans burning fossil fuels.

Fossil fuel use, deforestation, and some agricultural and industrial practices increase greenhouse gases like carbon dioxide and methane.

The following gases are the main contributors of the greenhouse effect : carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and ozone in the lower atmosphere. Their concentration is rising in the loweer atmosphere.

Cattle also give out methane.

Higher temperatures are also causing more intense storms, droughts, and other weather .

Rapid environmental change in mountains, coral reefs and the Arctic is forcing many species to relocate or become extinct.

Climate change threatens people with food and water scarcity, increased flooding, extreme heat, more disease and economic loss. Human migration and conflict can also be a result.

Many of these impacts are already felt at the current 1.2 °C (2.2 °F) level of warming. Additional warming will increase these impacts and may trigger tipping points, such as the melting of the Greenland ice sheet.

Under the 2015 Paris Agreement, nations collectively agreed to keep warming "well under 2 °C".

However, with pledges made under the Agreement, global warming would still reach about 2.7 °C (4.9 °F) by the end of the century

Limiting warming to 1.5 °C will require halving emissions by 2030 and achieving net-zero emissions by 2050.

Electricity generated from non-carbon-emitting sources will need to replace fossil fuels for powering transportation, heating buildings, and operating industrial facilities.

Carbon can also be removed from the atmosphere, for instance by increasing forest cover and by farming with methods that capture carbon in soil.

While communities may adapt to climate change through efforts like better coastline protection, they cannot avert the risk of severe, widespread, and permanent impacts.

6.(i). In a wastewater settling tank the length of the tank is 1.5 meters , width is 4.5 meters and the depth is 5 meters, and the flow rate is 1.3 m3 /min. Calculate the terminal velocity v (t) of the critical particle. (1)

Solution : v (t) = Q/LxW= 1.3/1.5x4.5 = 0.192 m /min.

(ii). (a). Calculate the sludge volume index (SVI) when the sludge volume after settling for 30 min., (mi/litre) is 25 and MLSS (Mixed Liquor Suspended Solids) concentration is 125 mg/litre.

(b). Calculate the Maximum Return Sludge Concentration also. (1)

Solution:

SVI= SV/MLSS x 1000= 25/125= 1/5 x 1000= 200 ml/g.

Return Sludge Concentration = 106/SVI = 106 / 200 = 5000 g/ml.

(iii). Estimate the tons of carbon in the atmosphere corresponding to a concentration of 360 ppm of CO_2. Assume the total mass of air equals

5.1 x 10 raised to the power 18 kg i.e., 10^{18}. The density of air at the standard temperature and pressure (STP, 0 degree C and 1 atm.) is 1.29 kg/m^3. (2)

Solution CO2 = (360/1x10 raised to the power 6) X (44/22.4) X 1000 =

0.707 g/m3.

Carbon = (0.707X 12X 5.1X10 raised to the power 18) / (44X1.29) = (45.65/ 56.76) X 1018 = 7.62X10 raised to power 17

0.762 X 10 raised to the power 18 g OK up to this.

Other Answers could also be :

= 762 X 10raised to power 9 tons . OK

= 762 giga tons. OK

(iv). If the utilities generate electricity using 33 % efficient coal fired power plant. As a carbon reducing measure if electric water heater that convert heat into electricity at 100 % efficiency are replaced with a gas water heaters with a 76 % conversion efficiency. By what fraction the (and percentage) carbon emission would be reduced.

Emission factor for coal is 25.2 x 10^6 ton. C/ quad

Emission factor for gas is 14.5 x10^6 tons/quad. (1)

You may Assume 1 quad of electricity is being delivered to electric heaters.

Solution :

PLEASE CHANGE THE VALUE OF EFFICIENCY BY 76 % AND FOLLOW THE NEW CALCULATIONS BY FOLLOWING THE FORMULA GIVEN IN THE SLIDES OR BELOW WHERE VALUE IS 75.

Emissions from coal burning = 3 X 25.2 X 10^6 tons carbon/quad. 75.6 X 106 ton carbon..

Heat input by using gas = 1 quad / 0.75 = 1.33 quad.

Emission from gas burning = 1.33X14.5 X 10^6 ton carbon/quad

= 19.28 10^6 ton carbon.

Reduction = 75.6 - 19.28 = 56.32 which is 74.49 % Reduction in carbon Emissions by using gas instead of coal..

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