

Lecture 3

Environmental Engineering

Global Warming

1.0 Introduction

Global warming is the term used to describe a gradual increase in the average temperature of the Earth's atmosphere and its oceans. Increase in greenhouse gases is responsible for rising global temperatures, known as global warming. It is believed that the change is permanently changing the Earth's climate.

2.0 Greenhouse Gases

Greenhouse gases are gases in the atmosphere which hold in heat. Without these gases, the Earth's surface temperature would drop. The gases which trap heat make up less than 1% of the atmosphere. They are called the 'greenhouse gases'. The main greenhouse gases are:

2.1 Carbon Dioxide

Carbon dioxide is considered as the most dominant factor responsible for the greenhouse effect. The troposphere contains only 0.0375% carbon dioxide by volume and its amount is controlled by carbon cycle.

The four major pools or reservoirs of carbon are:

- a. Fossil fuels
- b. The atmosphere
- c. Biosphere and
- d. Oceans.

Burning fossil fuels releases the carbon dioxide. Electricity from coal burning power plants releases enormous amounts of carbon dioxide into the atmosphere.

Carbon dioxide plays a crucial role in maintaining the stability of Earth's atmosphere. If carbon dioxide were removed, the terrestrial greenhouse effect would collapse, and Earth's surface temperature would drop significantly, by approximately 33°C.

Carbon dioxide is non pollutant gas in the atmosphere and a minor constituent, but it is of serious concern for the environment for its ability to change the global climate.

2.2 Chloro fluoro Carbon [CFCs]

The main sources of CFCs are:

- a. Leaking air conditioners and refrigerators.
- b. Evaporation of industrial solvents.
- c. Production of plastic foams.
- d. Aerosols.
- e. Propellants [CFC-11], etc.

Concentrations of CFCs rises nearly 5% per year. CFCs are responsible for 14 – 24 % global warming.

2.3 Methane

Methane is another extremely potent greenhouse gas, ranking right behind carbon dioxide.

Methane is produced in a number of ways including:

- The action of anaerobic bacteria on vegetation.
- Decomposing of organic matter.
- Incomplete combustion of vegetation.
- Natural gas pipeline leaks.
- Burning of biomass during production and
- Uses of oil and natural gas and petroleum oil.

2.4 Nitrous Oxide

Nitrous oxide is released from nylon products, from burning of biomass and fuels especially coal. From breakdown of fertilizers in soil, livestock wastes and nitrated contaminated groundwater, nylon products etc. It is responsible for about 6% of global warming. Besides trapping heat in the troposphere, it also depletes ozone in the stratosphere.

Nitrous oxide is emitted during agricultural, land use, industrial activities, combustion of fossil fuels and solid waste, as well as during treatment of wastewater.

2.5 Ozone

It comes mostly from hydrocarbons and nitrogen oxides. It causes irritation to eyes and respiratory organs. It decreases the resistance power to infections and aggravates illness. Absorption of infrared and ultraviolet radiation.

2.6 Other Causes of Global Warming

Other Green House Gases are:

- a. **Hydrofluorocarbons** - HFCs were developed as alternatives to ozone depleting substances that are being phased-out under the Montreal Protocol.
- b. **Perfluorocarbons;** - the most important perfluorocarbons are perfluoro-methane [PFM] and Perfluoro-methane [PFE]. The perfluorocarbon molecules are strong absorbers of infrared radiation, and are therefore powerful greenhouse gases.
- c. **Water Vapour** - Water vapour is the most important greenhouse gas.
- d. **Sulphur Hexafluoride;** [or SF_6] is a colourless and odor greenhouse gas and has a high global warming potential, and its concentration in the earth atmosphere is rapidly increasing.

2.7 Proportions of Greenhouse Gases

In average, the following are proportions of greenhouse gases.

- | | |
|------------------------------|-----|
| a. Carbon Dioxide | 50% |
| b. Methane - | 19% |
| c. Chlorofluorocarbons [CFC] | 17% |
| d. Ozone - | 8% |
| e. Nitrous oxide | 4% |
| f. Water Vapour | 2% |

3.0 Impact of Global Warming

a. Climatic change

The changes in environmental conditions of an area over long period of time is called climatic change. These changes effect the agriculture, migration of animals, hydrological cycle, thermal gradient between the poles and equator, wind pattern, distribution of rainfall, etc.

Climate change is changing water availability, making it scarcer in more regions. Global warming exacerbates water shortages in already water-stressed regions and is leading to an increased risk of agricultural droughts affecting crops, and ecological droughts increasing the vulnerability of ecosystems.

b. Effects on sea levels

Rising temperature will cause glaciers to melt and the polar ice caps to shrink. As a result, sea level may rise by 0.2 – 1.5 m over the next 50 – 100 years. It is proved that sea level has already risen by 10 – 25 cm. Low lying areas may be submerged and it is possible to destroy 20% - 80% of the coastal wetland. Rising sea levels are detrimental to coral reef species, which grow at a precise depth with optimum temperature and water movement.

c. Reduction of biodiversity

Increased temperatures and changes in the pattern of distribution of many species over a long period of time are likely to cause reduction in biodiversity in aquatic and terrestrial ecosystem.

d. Ecological disturbance

Global warming increases the desert. It increases temperature giving rise to changes of hurricanes, cyclones and floods, etc.

e. Effect on Agriculture

Shortages in water supply are likely to threaten food production, Climate change is expected to have the most severe impact on water supplies. With rise in temperature soil moisture will decrease and evapotranspiration and pest growth will increase. This will affect some crops.

f. Effect on human health

The global warming will lead to changes in the rainfall pattern in many areas, thereby effecting the distribution of vector borne diseases like malaria, elephant ties, etc. warmer temperature and more water stagnation would favour the breeding of mosquitoes, snails etc., which are vectors of such diseases. Higher temperature will increase respiratory diseases.

g. Disappearance of coral reefs

Coral populations will decrease due to increased temperatures and acidification.

h. Ecological disturbance

Global warming increases the desert. Changes of hurricanes, cyclones and floods will be more

4.0 Measures to Check Global Warming

The measures which can be taken to check global warming include:

- a. Planting more trees.
- b. Controlling population growth.
- c. Cutting down the current rate of CFCs.
- d. Using non-conventional source of energy.
- e. Reducing carbon dioxide emissions from automobiles.
- f. Shifting from coal to natural gas.
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- h. Trapping and using methane as a fuel.
- i. Reducing beef production.
- j. Using photosynthetic algae to remove atmosphere carbon dioxide.
- k. Adopting sustainable agriculture.
- l. Using energy more efficiently.