Al-Mustaqbal University
Department of Fuel and Energy Engineering Techniques
Second stage
Subject: Pollution
Lecturer: Dr. Malik Mustafa
Second semester

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Global air pollution problems

The main global pollution problems are:

1. Greenhouse effect and global warming,
2. Ozone depletion,
3. Acid rain.

1) Greenhouse Effect and global warming

Greenhouse Effect:

The solar energy coming from the sun passes through the atmosphere gases to reach the Earth's surface. Roughly one-third of this radiation is reflected directly back to the space. The remaining two-thirds are absorbed by the earth's surface and warm it. A long wave infrared (IR) radiation (heat) emitted from the Earth's surface. Some of IR radiation passes through the atmosphere into the space and some of it is absorbed by certain gases in the atmosphere, called greenhouse gases and re-emitted in all direction. The effect of this is to warm the Earth's surface and the lower atmosphere. This phenomenon is called the greenhouse effect. Fig.8 explains this phenomenon.

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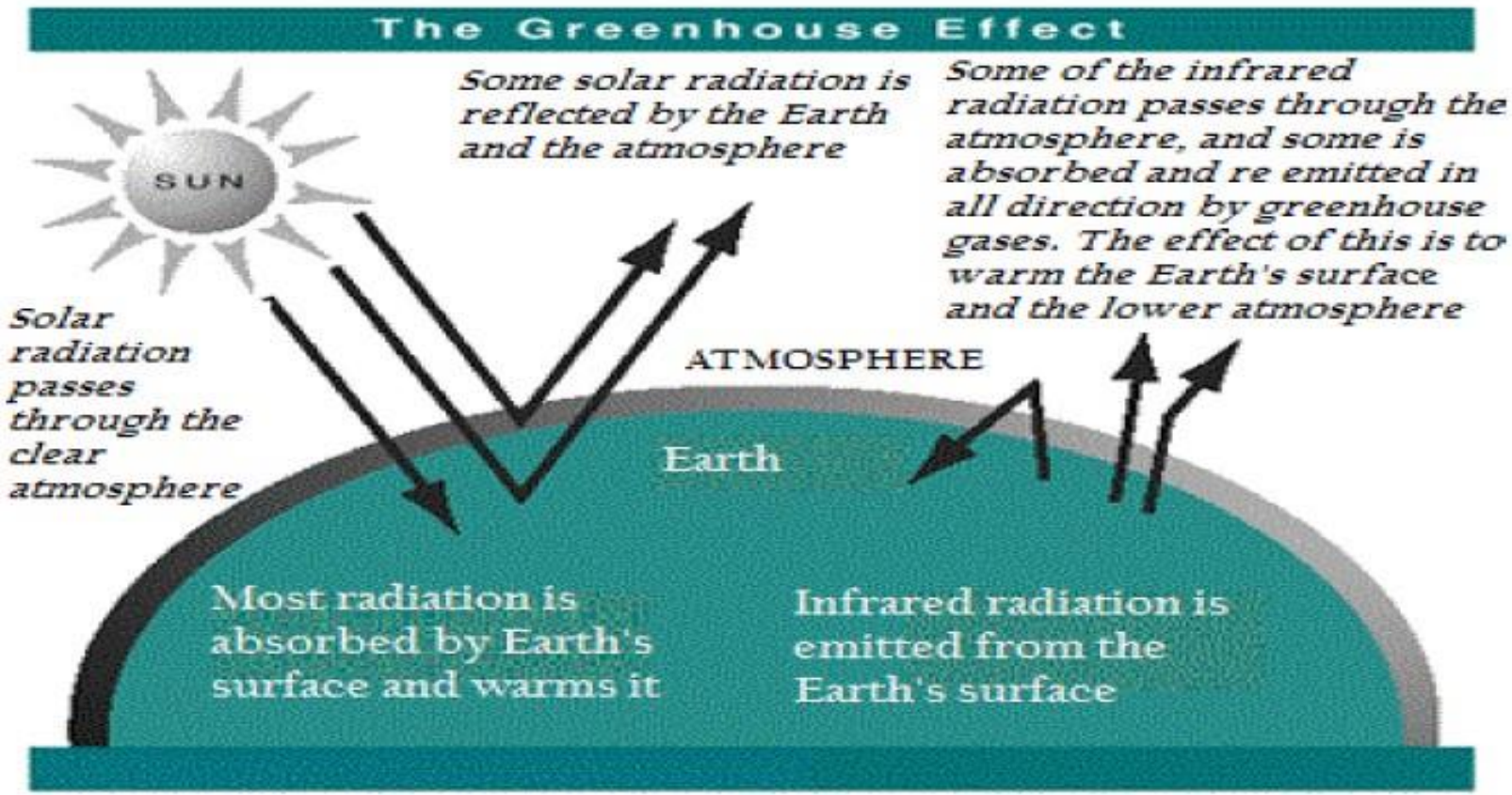

Fig,8 The greenhouse effect

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Important of greenhouse effect:

The important of greenhouse effect is:

1. To maintain the average temperature of world\
2. To maintain the sea level.
3. The polar ice caps remain intact.

Global warming and Climate Change

Global warming is increase in global average temperature near the Earth's surface as a result of increasing in concentration of greenhouse gases in the atmosphere from human activities. If more greenhouse gases are added to the atmosphere, these gases will absorb more of infrared radiation reflected by the Earth's surface then the surface and the lower atmosphere will warm further. This extra warming is called the global warming.

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Greenhouse Gas	% Responsible for Global Warming
Carbon Dioxide, CO_2	50 – 55
Chlorofluorocarbons, CFCs	25
Methane, CH_4	12
Nitrous Oxide, N_2O	6

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Effects of global warming

The following effects will results from the global warming (rising temperature):

1- Thermal expansion of the water and melting of polar ice caps would cause sea level to rise.

2- Could lead to changes in regional wind systems which would influence global rainfall distribution and lead to redistribution and frequently of flood, draught, and forest fires.

3- Growth in insect population: Climate change would create favorable conditions for growth in insect population, which this have bad effect on agriculture and human health.

4- Disrupts the Water supply and draughts would be more common.

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Controlling global warming

1- Reduce deforestation and develop way to sustainable agriculture.

2- Use of technologies to absorb CO_2 from emission.

3- Increased absorption of CO_2 by planting more trees.

4- Sequester CO_2 in deep Ocean.

5- Increased dependence on renewable energy source.

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2) The Ozone Layer and Ozone Layer Depletion

The Ozone Layer

The ozone layer in the stratosphere serves as a shield, protecting the earth's surface from the suns' ultraviolet radiation (UV). Ozone layer absorbs 97-99% of the UV radiation. As the ozone absorbs UV-radiation, it is broken into oxygen molecule and oxygen radical. The oxygen and the oxygen radical then recombine to form new ozone molecule, available to absorb more UV-radiation.

$$O_3 \xrightarrow{UV} O_2 + O^*$$

$$O_2 + O^* \longrightarrow O_3$$

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Ozone layer depletion

The ozone layer depletion occurs as results of releasing of chemicals such as chlorofluorocarbons (CFCs). CFCs when first used in air conditioning and refrigeration systems valued for their non-toxic and stable properties. CFCs introduced in the lower troposphere pass through the ozone without any change and reach the stratosphere. Here, they impact by the UV-radiation and release destructive chlorine atoms:

$$CFCl_3 \xrightarrow{UV} CFCl_2 + Cl$$

(CFC-11)

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$$CF_2Cl_2 \xrightarrow{UV} CF_2Cl + Cl$$

(CFC-12)

The chlorine atom quickly reacts with the ozone molecule breaking it into oxygen:

$$Cl + O_3 \rightarrow ClO + O_2$$

The ClO produced reacts with oxygen radical forming more chlorine atom that can react with more ozone

$$ClO + O^* \rightarrow Cl + O_2$$

The above reaction also removes the oxygen radial thus preventing it from recombined with the oxygen to form an ozone molecule. The overall effect is a decrease in the amount of ozone that leads to ozone removal from stratosphere.

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Source of ozone layer depletion

The facts the ozone layer depletion was discovered in the mid of 1980. The main source of ozone layer depletion is

1- Chlorofluorocarbon, CFCs: CFCs are cause damage to ozone layer. When CFCs reach the upper atmosphere they are degraded by UV radiation to produce chlorine atom. This atom breaks up ozone molecules to form oxygen and ozone then disappear and depleted.

2- Nitrous oxide: It produces from the microbial action on the nitrogenous fertilizers, which cause depletion of the ozone layer.

3- Nuclear test: Nuclear explosions release high quantity of various gases and other materials which damage the ozone layer.