Environmental Chemistry - 2

II. Acid Rains

* Acid rains are obtained due to oxides of nitrogen & sulphur.
* Acid rain may have a pH of 4-5
* Acid rains corrode monuments, buildings, statues, bridges & marble stones.
* They destroy forest and crops affecting the fertility of soil and reduce the agriculture productivity

$$H_2O_{(1)} + CO_{2(g)} \rightarrow H_2CO_{3(aq)}$$

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO_2 + O_3 \rightarrow NO_3 + O_2$$

$$NO_2 + NO_3 \rightarrow N_2O_5$$

$$N_2O_5 + H_2O \rightarrow 2HNO_3$$

$$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 \xrightarrow{+H_2O} H_2SO_4$$

$$SO_2 + \frac{1}{2}O_2 + H_2O \xrightarrow[\text{metal or soot particulars}]{NO} H_2SO_4$$

Green House Effect

* The progressive heating up of surface of the earth is called green house effect or global warming
* CO_2 & H_2O Block a part of the heat (IR) emitted by the earth & reflects back. Due to this earth surface gets heated up.
* 50% in CO_2 content of air can increase the surface temperature of the earth by 3^0C
* In addition to CO_2, the other green-house gases are $CFC's$ (17%), $O_3(18\%)$, $NO(4\%)$, water vapour (2%)
* Unseasonal rains, cyclones, & hurricanes occur due to increase of rate of evaporation of water. The level of ground water decreases and agriculture sector will be badly affected.
* Global warming can be prevented by increasing the number of sinks of CO_2 (like plants)

Depletion of Ozone Layer

* The process of destroying the existence of ozone molecule in the stratosphere is termed as depletion of ozone. Ozone absorbs U.V. Radiation coming from the sun and gives visible region to the earth.

* CFC's when released into air, enter stratosphere and carry the changes.

$$CFCl_3 \xrightarrow[UV]{h\nu} C^*FCl_2 + Cl^*$$

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

$$ClO^* + (O) \rightarrow Cl^* + O_2 \text{ etc}$$

* In stratosphere nitric oxide reacts with ozone as follows:

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO_2 + O_3 \rightarrow NO + 2O_2$$

* Cl_2 and HCl gases will be produced from volcanos. They also react with ozone in stratosphere.

$$Cl_2 + O_3 \rightarrow ClO^* + O_2$$

$$ClO^* + O_3 \rightarrow Cl^* + 2O_2$$

Photochemical Smog

* O_3 and NO_2 being strong oxidizing agents react with hydrocarbons producing chemicals formaldehyde, acrolein and peroxy acetyl nitrate (PAN) which are harmful ingredients of photochemical smog.

$$3CH_4 + 2O_3 \rightarrow 3HCHO + 3H_2O$$

$$CH_2 = CH_2 - CHO \xrightarrow{O_3, NO_2} CH_3 - \underset{\underset{O}{\|}}{C} - OONO_2$$

(Peroxyacetyl nitrate or PAN)

* Causes asthma & bronchitis
* Causes cracking of rubber and extensive damage of plant life
* Reduces the visibility & causes corrosion of metals, stones, & building material, paper, leather & painted surface.

Green Chemistry

* "It involves not producing green house gases that are responsible for green house effect."
* According to green chemistry the process should be $A + B \rightarrow C$ such that byproducts are not generated. (A, B are reactants, C is wanted product)
* In dry cleaning of clothes the solvent tetrachloroethylene was used. This is Carcinogenic. Liquefied CO_2 is a better substitute than tetrachloroethene.