humidity.

CHLOROFLUOROCARBONS (CFCs)

Chlorofluorocarbons (CFCs) are a class of compounds initially developed in 1930 to replace the toxic and inflammable refrigerants such as methyl chloride, ethyl chloride, propane and sulphur dioxide. Infact, chlorofluorocarbons have some desirable properties that make them particularly useful in a number of applications. These properties include low viscosity, low surface tension, low boiling points, least chemical and biological reactivity etc. These properties account for their non toxic and non-flammable nature. Taking advantage of these properties, chlorofluorocarbons have widely been used as refrigerants, solvents for cleaning electronic and other components and blowing agents for polymer foams.

Later on, when low pressure valves were developed, fluorocarbons became the standard propellants for dispersing aerosols. A series of chlorofluorocarbons were developed by **Du Pont in 1940** to serve refrigeration and air conditioning. These CFCs were non toxic, inexpensive, efficient and easy to handle. In 1950, they were widely used as aerosol-propellants, cleaning solvents, plastic foams, in fast food packaging, in dry cleaning industries, for sterilizing surgical instruments in medicinal and oral inhalation products and for cleaning and degreasing electronic equipments.

Since 1955, their rate of production has increased progressively reaching a staggering figure of 1·7 billion pounds in 1973. The huge amount of these products being used and released to atmosphere are probably causing an irreparable damage to our environment. The boiling point constitutes the important factor for the selection of a CFC for a particular application. Generally CFCs lie in boiling points ranging from 48°C (CFC – 113) to –39°C (CFC–115).

Bromine containing **halons** were developed by the US Army Corps of Engineers during second world war as a means of fire fighting in tanks and armoured personal carriers. Halons are gaseous halogen compounds which are 3 to 10 times more damaging to the ozone layer than chlorofluorocarbons. Let us first consider the nomenclature of CFCs.

C F C

a b c

where a = number of carbon atoms –1 (usually omitted if a = 0)

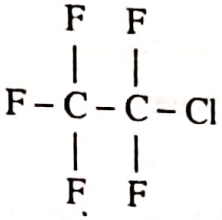
b = number of H atoms +1

c = number of F atoms

The balance of atoms required for a saturated carbon is then made up of chlorine. There is another simple way of determining the chemical formula of a specific CFC from the numerical symbol. Suppose we have to derive chemical formula of CFC-115. Add 90 to this number. The modified three digit number then gives the number of carbons, hydrogens and fluorines in sequence. Thus,

$$115 + 90 = 205.$$

The number 205 shows that there are 2 carbons, 0 hydrogens, and 5 fluorines. The remaining one atom for carbon saturation is chlorine. Thus chemical formula of CFC-115 is CF_3CF_2Cl.



(CFC – 115)

Postscript letters are used to show different structural isomers. For example, CFC-114a is $CFCl_2CF_3$ in order to distinguish it from $CF_2Cl.CF_2Cl$.

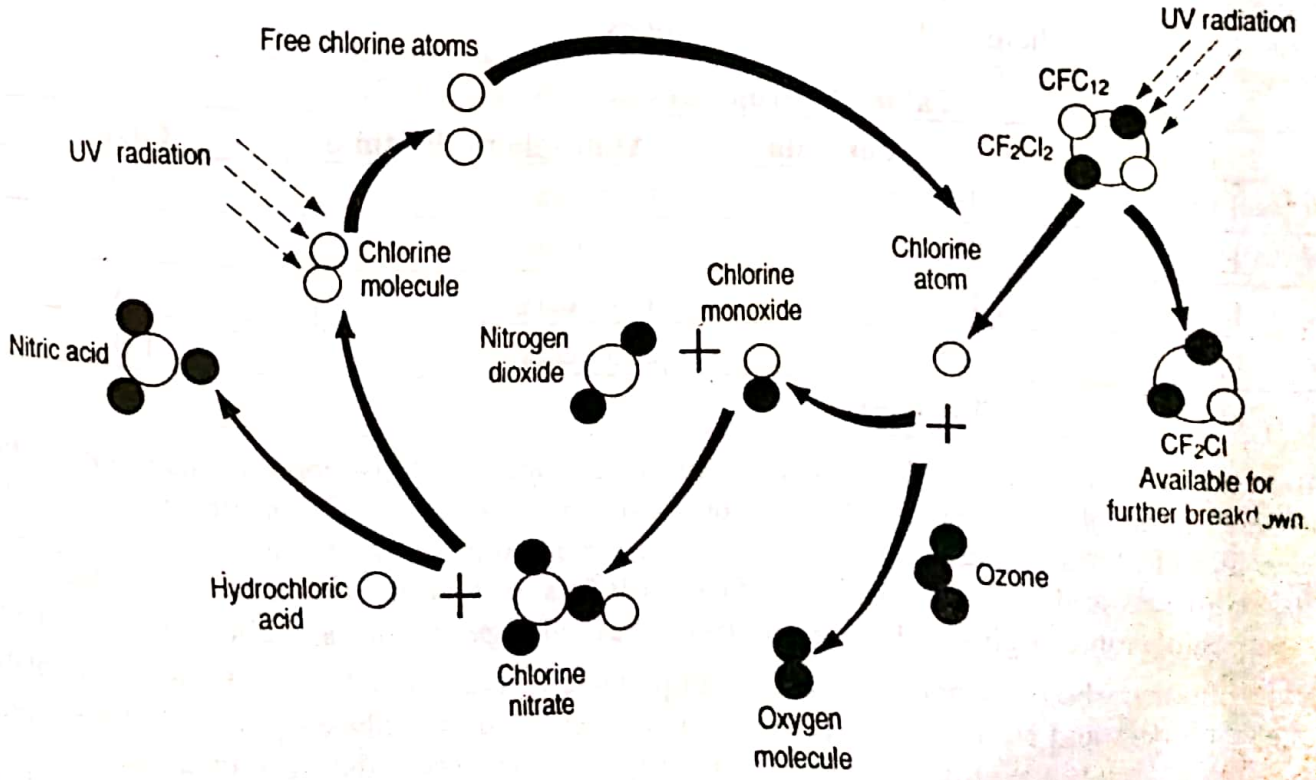


Fig. 4. How breakdown products of CFCs attack atmospheric ozone molecules.

The **ozone depletion potential (ODP)** is defined as the ratio of the impact on ozone from