

Review Paper on Effect of Refrigerants on Green House and Their Implication on HVAC

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Abstract— The greenhouse effect is tangible and aids to legalize the hotness of our earth. It is crucial for lifecycle on Ground and is one of Earth's natural progressions. The green house effects took its appellation from the manners of green house. A conservatory's glass consents shortwave emission to arrive nevertheless prohibits departing long wave radiation from withdrawing, warm air in greenhouse. Pollutants of the Refrigerants which are used in Refrigeration and Air Conditioning will produce the green house effect. All the Refrigerants which are used in Refrigeration and Air Conditioning will not affect the greenhouse, some of the Refrigerants will affect the greenhouse and some will not effect, based upon the physical and chemical properties of the Refrigerants used in Refrigeration and Air Conditioning plants.

Keywords: Refrigerants, chemical and physical properties, greenhouse effect, global warming effect.

I. INTRODUCTION

Because of human activity, there are now more greenhouse gases in the air. The atmosphere and earth's surface both experienced significant warming as a result, which had a negative impact on the natural ecosystem [1,2]. The GWP of a particular greenhouse gas measures how much of an impact it has on global warming (Global Warming Potential). The mass of CO₂ that would have the same overall effect on global warming as releasing one kilogramme (kg) of the specified atmospheric component is known as the global warming potential (GWP) [3-7]. In accordance UNFCCC the Kyoto Protocol [8] establishes legally binding targets for greenhouse gas emissions.

taxation in various nations. Even stricter measures have recently been suggested or approved at the local level (national, regional, and municipal). The transition to a future internet of refrigerants with ODP and GWP limitations is being forced by these constraints [9]. The European Parliament has previously established a regulation for the phase-out of F-Gases [10] that prohibits the use of refrigerants with GWPs greater than 150 in the context of mobile refrigeration systems. This law has been in effect until 2011 [11].

Stronger storms, the relocation of agricultural zones, the development of tropical illnesses, the thawing of glaciers and ice caps, higher pollution levels, the submerging of more land, etc. are some effects of global warming.

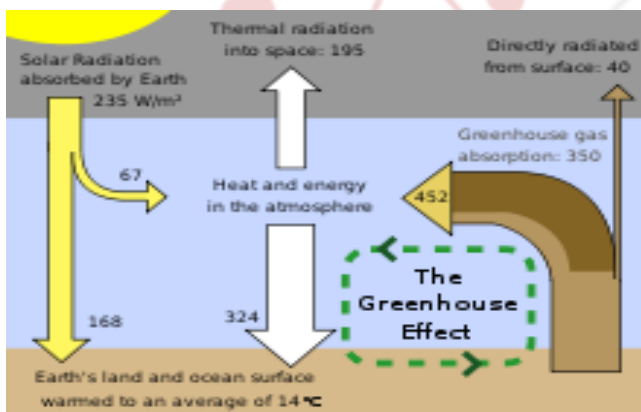


Figure 1: Green House Effect

(Image Courtesy: <http://www.atmo.arizona.edu/students/courselinks/spring04/atmo451b/pdf/RadiationBudget.pdf>)

The Kyoto Protocol is being implemented through various national laws and regulations, but they all generally forbid unnecessary emissions of HFC and PFC chlorofluorocarbons. Their use is subject to regulation and/or

II. IMPACT OF GLOBAL WARMING

The two main adverse effects on the environment which are of serious concern are Global Warming and Ozone Depletion. Unfortunately most of the refrigerants used till date contributes significantly to one or both of these effects. It is difficult and cumbersome to quantify the contribution of a specific working fluid to these effects. Global Warming Potential (GWP), Ozone Depletion Potential (ODP) or Total Equivalent Warming Impact (TEWI) gives numerical values. However, there may be many numerical values for the same substance because of different definitions and reference states. The computations are quite involved and require considerable analytical, experimental and empirical data inputs. This will most probably continue due to the development of more advanced and sophisticated models. Depending on these, the values may change from one source to another. Moreover, the values are being continually updated and upgraded as and when more data are available.

A. Ozone Depletion Effect

The ozone depleting effect has received great attention since the harmful UV radioactivity's which forte else reached the apparent of the earth? This harmful radiation could have serious damaging effects on germinating crops and on the photo-plankton of the oceans. All life on earth directly or indirectly depends on these minute organisms. Another serious consequence is that increased doses of UV light can increase the incidence of skin cancer and cataracts and impair the body's immune system.

Both CFCs and halons are stable chemicals which persist for many years to decades in the troposphere. They in the long run cut down the stratosphere emancipating halogens: chlorine in the case of CFC and bromine in the case of halons. Chlorine and bromine can break down ozone but are not themselves destroyed during this process. Thus, one halogen atom can break down thousands of molecules of ozone before it is washed out of the atmosphere. This knack of a biological to abolish ozone be contingent up-on the halogen type (Cl₂ and Br₂), the amount of halogens glimmers it proclamations, and its dwelling time in the troposphere. Respectively chemical dismiss be allocated a number conferring to its Ozone Depletion layer.

It is computed from global photochemical models after reaching steady state.

$$ODP = \frac{[\Delta]O_3x (\%)Ex (kt/a)]}{[\Delta]O_3,CFC11(\%)ECFC11(kt/a)]}$$

The emissions are chosen in such a way that the computed ozone depletion is about 1%.

Because the above definition normally does not consider the typical situation in Polar Regions which causes the formation of the ozone hole, and because some substances are fully decomposed only well above the stratosphere, the Chlorine Loading Potential (CLP) is introduced. CLP describes the maximum chlorine transported in to the stratosphere in relation to the same for CFC11 and is defined as :

$$CLP = \frac{[tx /tcfc11][mcf11/mx][nx/3]}$$

Where the lifetime t, molecular weight m and the number of chlorine atoms n. Table 1 gives the ODP and CLP values for some substances.

B. Global Warming Effect

The greenhouse upshot is begun by immersion of lengthy wave radiation from earth's shallow by various gases in the earth's troposphere which covers up to about 15 km over the surface. Short wave(high frequency) radiation since the sun warmth the outward of the earth and the seas. These surfaces give off long wave (low frequency) radiation which is trapped by variety of gases which act like an insulting blanked. There is thus a tendency to increase the earth's temperature causing the global warming effect.

Table 1: ODP and CLP Values for some substances.

Fluid	T years	ODP	CLP
CFC11	69.0	1	1
HFC123	1.53	0.0123	0.0131
HFC124	7.04	0.0173	0.0337
HCFC134a	15.68	0.008	-
HCFC141b	8.54	0.0739	0.0952
HCFC142b	24.16	0.050	0.1596
HFC152	1.72	0.0007	-

However, it should be emphasized that this effect is the basis of life on earth. For instance, the natural concentrations of CO₂ and H₂O in the atmosphere are essential without which the average temperature on earth would be as low as about -18 °C. Hence, the objective is to keep the global warming effect in balance rather than decreasing or eliminating it.

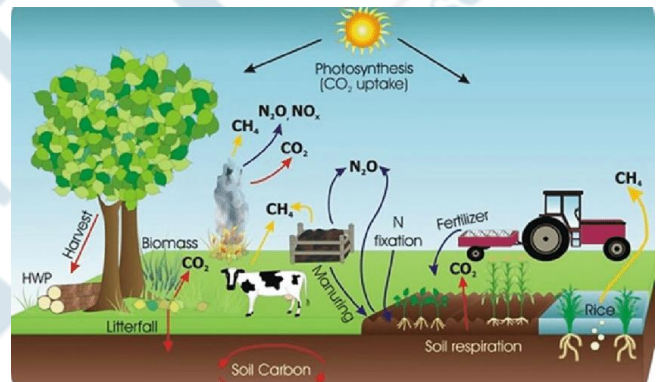


Figure 2: Global Warming (Image Courtesy: FAO 2014b)

The ecological systems of the world are very critically dependent on the temperature. The fractions of a degree change in average temperature can radically influence the distribution of crops and animals. Unpredictable changes may occur in the weather and wind flow patterns. If such a heating tendency is not suppressed, mean sea levels will increase, causing at least many low lying islands to vanish.

From the point of view of the refrigeration, it may be noted that each molecule of a CFC is thousands of times more potent in causing global warming than the molecule of the most widely recognized green house chemical namely, carbon dioxide.

Normally, the reference gas for GWP is CO₂ so that there is a common base for comparing the impacts of different gases. However, particularly in the case of refrigerants, R11 is used sometimes as the reference gas because it also has the ODP=1. Hence, it is important to mention the reference gas in listing of GWPs.

GWP depends on the length of the time which elapses from the release of the gas until it is purged from the atmosphere and the infrared energy absorption properties of the gas. It is

thus important to mention the integration time horizon considered in computing the GWP. Different gases are purged from the atmosphere at different rates. For instance, if CO₂ and a typical HFC are released today to atmosphere, after 100 years basically all the HFC would be lost from atmosphere whereas still 41% of CO₂ would be intact. It is stipulated that even after 500 years, about 14% of CO₂ would be existing in the atmosphere. Thus, for R134a which 'has a lifetime of 16 years, GWP based on 100 years is 1200 whereas that based on 500 years is 420. If only infrared absorption properties are considered without taking into account time horizons for comparison with CO₂ GWP of R134a will be as high as 4130.

III. OZONE DEPLETION SUBSTANCES AND REGULATION

An ozone-depleting substance (ODS) is a chemical substance, generally consisting of some grouping of chlorine, fluorine, or bromine plus carbon, like chloro fluoro carbons (CFC) and hydro-chlorofluorocarbons (HCFC) that devours publicized to rescind stratospheric ozone. These substances are normally found in aerosol products, foams, fire-extinguishers and are used as refrigerants or blowing agents in refrigeration and in air-conditioning units. Regulations regarding production and importing/exporting, usage etc, of ozone depleting substances are found in ODS rules 2000 issued by Ministry of Environment and Forests, Govt of India.



Figure 3: Sources of Stratospheric Chlorine
(Image Courtesy: https://commons.wikimedia.org/wiki/File:Sources_of_stratospheric_chlorine.svg)

IV. REPLACEMENT OF REFRIGERANTS

It is acclaimed to that the Inventive Tackle Manufacturer be communicated apropos the optional refrigerant auxiliary. However in our country the alternate refrigerants used by most appliance manufacturers are from Hydro-carbons or HFC group of refrigerants.

V. CONCLUSIONS

The properties of Refrigerant HFC-152 and HFC-123 are having less harmful effect on earth atmosphere by comparing to other Refrigerants physical, chemical properties and Ozone. The refrigerant HFC-152 and HFC-123 or their blends are suitable to be used in Refrigeration and Air Conditioning plants.

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ABBREVIATIONS:

- ODP - Ozone Depletion Potential
- CLP - Chlorine Loading Potential
- CFC - Chloro Fluoro Carbon
- HFC - Hydro Fluoro Carbon
- UV - Ultra Voilet

GWP - Global Warming Potential
TEWI - Total Equivalent Warming Impact
ODS - Ozone Depleting Substances

