ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.02370.3

REVIEW ON OZONE DEPLETION AND GLOBAL WARMING

Dr. S.R. Ali*

*Faculty of Engineering, Teerthanker Mahaveer University,
Moradabad, Uttar Pradesh, INDIA
Email id: drsrali.engineering@tmu.ac.in

ABSTRACT

Natural refrigerants are presented as the perfect, ecologically benign refrigerants and the final answer to ozone loss and global warming in this article. In refrigerated and air-conditioning systems, HFC refrigerants are presently the most common alternative for CFC and HCFC refrigerants. However, they are just as alien to nature as CFCs and HCFCs, providing a solid foundation about the need to embrace natural refrigerants as a substitute for halocarbon refrigerants. This study also looks at the possibilities of refrigerants and their uses in refrigerated and air-conditioning systems. Both oil used in R12 or poly-ol-ester oils in use in R134asystems are miscible with natural refrigerants, particularly hydrocarbons, and their combinations. They are also fully compatible with in all materials typically used in refrigeration systems, with the exception of ammonia. Finally, the results of this study show that natural refrigerants are the best long-term options in refrigerated and air-conditioning systems.

KEYWORDS: *Atmosphere, Carbon, Global warming, Ozone, Refrigerants.*

INTRODUCTION

Refrigeration technology is very essential in today's world. It not only offers pleasant and healthy living conditions, but it is also considered necessary for surviving harsh weather and storing food. Food preservation, in particular, is critical to global stability and economic growth. Food conservation is accomplished by delaying metabolic processes to limit bacterial growth. This is readily accomplished by chilling or freezing without the need of additional preservatives. Refrigeration technology provides the technological means to keep food cool along the cold chain, from manufacturing to transit through storage, sale, and storage in a refrigerator at the consumer's house[1].

Air-conditioning systems and industrial operations are examples of other applications. Air-conditioning systems aid in improving human comfort for both residential and commercial reasons, as well as maintaining health and increasing efficiency. However, rapid technological development and economic growth around the world over the last century have resulted in serious environmental issues, forcing us to acknowledge that while technological advancements may improve human comfort, they also pose a risk to the planet through atmospheric depletion and global warming. Ozone layer depletion & climate change are two significant environmental issues that have severe consequences for the refrigeration industry's future growth. Actions to prevent ozone depletion and climate change are now having an impact on the business. Ozone is a kind of oxygen that has three oxygen atoms in its molecule[2].

Ozone is a toxic gas that may be fatal if breathed. The stratosphere, which is approximately 11 kilometers above the earth's surface, is surrounded by an ozone layer. For this life-protecting layer, life on Earth has been protected for thousands of years. It serves as a barrier, shielding the planet from the sun's damaging UV radiation. By absorbing the majority of the sun's damaging ultraviolet B (UV-B) radiation, the ozone layer effectively screens all of the sun's harmful ultraviolet rays (Ultra-Violet A is allowed through while ultraviolet C is captured by oxygen). Because the ozone layer protects the ecosystem and life on Earth from damaging UV-B radiation, any disruption to it may have serious consequences. Increased UV-B radiation may cause eye damage (such as cataracts, lens deformation, and presbyopia), induce skin cancer, slow plant development, disrupt ecosystem balance, and raise illness risk[3].

Nobody imagined that human activities might endanger the ozone layer until the early 1970s. The most significant ozone depletion and greenhouse gas, halocarbons, are entirely due to human activity. Halocarbons are a class of chemicals that are mainly man-made gases that include both carbon and one or more halogens (fluorine, chlorine, iodine, and bromine). They're usually created in a lab for industrial reasons. They were created for the first time in 1928. They've been extensively utilized for a number of applications since then, including propellants in aerosol cans, the production of soft and hard foams, refrigeration and air conditioning, and cleaning solvents. Chlorofluorocarbons (CFCs), hydro chlorofluorocarbons (HCFCs), and hydro fluorocarbons (HFs) are all members of this category (HFCs)[4].

One chlorine atom may destroy 100,000 ozone molecules, according to research. The longer a compound's effect on the ozone layer lasts, the greater its chlorine concentration. Because CFCs contain more chlorine than HCFCs, they have a greater risk for ozone depletion. The effectiveness of ozone destruction is often evaluated using a comparison unit called Ozone -depleting potential (ODP), which would be based on the ODP of trichlorofluoromethane (CFC-11) being given a value of one. CFCs are thought to account for approximately 70% of all man-made ozone damaging compounds in the atmosphere. The creators of these refrigerants could not have predicted how damaging they would be to the ozone layer. They went out of their way to find refrigerants that had remarkable stability, which was enforced as one of the criteria of the perfect refrigerant they were asked to create.

Global warming is a positive thing in and of itself since it allows for the existence of life in all of its forms. Man's actions, it is feared, are increasing the density of greenhouse gases, increasing the quantity of absorbed infrared radiation, and resulting in higher atmospheric temperatures and long-term climatic changes[5]. The quantity of radiant energy absorbed by refrigerants is quantified by the Global Warming Potential index (GWP). GWP is the quantity of infrared light that a gas may absorb over a 100-year period when compared to carbon dioxide (which has a GWP of 1). Total Equivalent Warming Impact (TEWI) is a more accurate estimate of a refrigerant's impact to global warming (TEWI).

DISCUSSION

1. Refrigerants derived from nature:

Over the 160-year history of refrigeration, over 50 different compounds have been employed as working medium in some capacity. The majority of them will have been rejected as inappropriate for different reasons, but there are still a few options to adapt to varied application circumstances. Natural coolants such as water, ammonia, hydrocarbons, and carbon dioxide are among them. Natural refrigerants are an environmentally friendly alternative to CFC, HCFC, and HFC refrigerants. They are compatible with typical elastomer materials used in refrigerating systems and are soluble in standard mineral oils, in addition to having zero ozone depletion potential (ODP) and minimal or no greenhouse effect (GWP). Natural refrigerants do not react with water because they do not include chloride or fluorine atoms, and therefore do not produce the powerful acids that may cause early system failure. The following table examines the possibility of several of these refrigerants as viable replacements to ozone-depleting refrigerants and greenhouse gases[6].

1.1 Ammonia is used as a refrigerant:

For more than 120 years, ammonium is a very well refrigerant in large-scale industrial applications. Technology know-how is widely distributed, both in developed and developing nations. Thermodynamic and transport characteristics of ammonia are much better to those of CFCs, HCFCs, and HFCs. When compressor speed, pipe size, and heat transfer equipment are chosen based on economic factors, an ammonia plant always has much higher energy efficiency in practice. Tolerance to typical mineral oils, minimal sensitivity to tiny quantities of water in the system, easy leak detection, limitless availability, and cheap pricing are all significant benefits. All of these elements contribute to its long-term popularity and widespread use. The drawbacks of ammonia are mostly related to safety in big systems; however, there are now additional economic disadvantages in small systems. Ammonia's toxicity is generally not a significant issue; the odor is detectable at quantities as low as 5 ppm. At the same time, 50 ppm is the upper limit for daily exposure that should not be exceeded. At 500 ppm, ammonia is intolerable to humans, whereas acute toxicity begins at 2500 ppm and flammability begins at 15 vol. percent. Obviously, almost every danger is obvious in before, making ammonia a highly safe refrigerant in terms of direct risks.

1.2 Refrigerants based on hydrocarbons:

Propane, pentane, and butane are examples of hydrocarbons (HCs), a type of naturally occurring chemicals. Energy efficiency, critical point, solubility, transport, and heat transfer characteristics all make HCs ideal refrigerants. They are a safe and ecologically friendly replacement for CFCs, HCFCs, and HFCs. Hydrocarbons and their mixes have minimal ozone depletion potential and a very modest global warming potential, and they have no refrigeration-related issues. The most serious issue of using hydrocarbon as a refrigerant is that they are flammable. It's worth remembering that billions of tons of hydrocarbon are safely used every year for cooking, heating, powering cars, and as aerosol propellants all across the globe. Procedures and regulations have been established and implemented in these sectors to guarantee that the product is used safely. It is critical that the refrigeration sector takes the same strategy[7].

1.3 Refrigerant in the form of water vapour (R718):

Water has been considered as a refrigerant, and it is one of the best natural refrigerants due to its non-toxicity, non-flammability, zero-ODP, zero-GWP, and cheap cost. Desiccant vast applications cooling, absorbing chiller, adsorption chiller, and compression chiller are all examples of how water may be utilized as a refrigerant. Water's thermo-physical characteristics are compatible with a vapour compression chiller capable of achieving a high COP. According to Lorentzen, open cycle water vapour devices are sometimes employed for direct evaporation cooling in circumstances where the high power consumption is of little significance in comparison to the investment and labor expenses. The amount of vapors to be compressed is huge, comparable to that of an exposed cold air cycle of comparable capacity. Normally, steam ejectors are used. Water has also been suggested as a refrigerant in conventional systems that use turbo- or special rotary compressor. These devices' physical dimensions grow to be very enormous, and cost must be an issue. Water, on the other hand, is an excellent working medium for high-temperature heat pumps. For many years, it has been widely employed in open systems to concentrate liquids via evaporation. The COP rises to 20 or higher in certain situations since the temperature raise is restricted to what is needed for heat transmission. The low lift also allows for the use of simple, low-cost single-stage turbo compressors. Water is the natural option for open or closed cycle heat pumps in a range of manufacturing applications in the range of temperature of 80–100ºC[8].

1.4 Refrigerant made of carbon dioxide (R744):

Carbon dioxide (CO2 or R744) is among the few non-flammable and non-toxic natural refrigerants. It is low-cost, readily accessible, and does not have the same harmful effect on the environment as other refrigerants. CO2 has a GWP of 1, however since it is a waste material from industrial manufacturing; it has no net global warming effect when utilized as a technical gas. CO2 is a good natural refrigerant alternative, particularly in situations where ammonia and hydrocarbons' toxicity and flammability are a concern. CO2 has been favored in a wide range of refrigerators and air conditioners, including automotive, residential, commercial, and industrial. The most pressing concerns are improving energy efficiency and lowering system costs to an appropriate standard. R744 was employed as a refrigerant in ships' refrigerators and other fixed systems in the 1930s and 1940s. When ships traveled through tropical areas, however, refrigerant capacity fell quickly. Because of its decreased capacity at high temperatures and the advent of chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons (HCFCs), R744 was phased out as a refrigerant (HCFCs)[9].

2. Material and refrigerant compatibility:

2.1 Lubricants:

The use of oil in vapour compression operations is inherent and inevitable since oil is needed to maintain the internal working components of the compressor in order for it to operate properly. The lubricant, on the other hand, creates a seal between the moving components, allowing for effective vapour compression. According to Gibb et al., the advantages of using more efficient energy refrigeration lubricants may result in a 15% decrease in energy usage and indirect reductions in greenhouse gas CO_2 emissions. Despite its critical role in improving compressor energy efficiency, lubricant oil may migrate from the compressor and into other parts of the system, such as the evaporation, condenser, expansion device, and connecting piping, inevitably altering heat transfer and frictional characteristics.

2.2 Metals and sealing materials are listed in section:

Steel, brass, copper, and sealing materials are among the materials utilized in refrigeration circuits. With ester-based lubricants and HFC refrigerants, certain metals, particularly zinc alloys or solders, exhibit enhanced corrosion. There are no known issues with using hydrocarbons as a refrigerant. All materials typically used in refrigeration systems are completely compatible with natural refrigerants, with the exception of ammonia[10].

3. Natural refrigerant selection guidance:

Refrigerants are chosen for their ability to contribute to system efficiency. Alternative refrigerants are tested for compliance with system and equipment design before being used. A comprehensive study both with refrigerant providers and equipment manufacturers is also required to verify that refrigerants are completely compatible with and appropriate for the application software design [11].

CONCLUSION

Accelerated technological economic growth around the world over the last century have resulted in serious environmental issues, forcing us to acknowledge that while technological advancements may improve human comfort, they also pose a risk to the planet through atmospheric depletion and global warming. For the last several decades, halocarbon refrigerants used in refrigeration and air have been a source of considerable worry.The issue is not with the refrigerants themselves, but rather with their discharge into the environment. Because Earth seems to be the only planet in the universe with a habitable atmosphere, maintaining the ozone layer and decreasing greenhouse gas emissions are two of the many critical measures that must be taken to ensure the survival of life on earth for future generations. The earth's protective ozone layer has been shown to be harmed by CFCs and HCFCs. As a result, the Montreal Protocol and other international accords ban their manufacture. In refrigerator and air-conditioning systems, HFC refrigerants are presently the most common alternative for CFC and HCFC refrigerants. However, they are just as alien to nature as CFCs and HCFCs, so using natural chemicals, which are already circulating in large quantities in the biosphere and are proven to be safe, is apparent and much preferable.

As a result, the issues and causes of ozone emissions and global warming are discussed in this article. It lays a solid foundation for the need to accept natural refrigerants as a viable alternative to halocarbon refrigerants. It also examines the possibilities of different natural refrigerants, as well as their uses in refrigeration and air-conditioning systems. Natural refrigerants, particularly hydrocarbons, and their combinations are flammable with the both mineral oil and poly-ol-ester oils, which are used in CFC and HFC systems, respectively. They are also fully compatible with in all materials typically used in refrigeration systems, with the exception of ammonia. Finally, the results of this study show that natural refrigerants are the best long-term options in refrigeration and air-conditioning systems.

REFERENCES

1. B. O. Bolaji and Z. Huan, "Ozone depletion and global warming: Case for the use of natural refrigerant - A review," *Renewable and Sustainable Energy Reviews*. 2013, doi: 10.1016/j.rser.2012.10.008.
2. Linde Group, "Refrigerants Environmental Data: Ozone Depletion and Global Warming Potential," *Refrig. Environ. Data*, 2015.
3. W. T. Tsai, "Fate of chloromethanes in the atmospheric environment: Implications for human health, ozone formation and depletion, and global warming impacts," *Toxics*. 2017, doi: 10.3390/toxics5040023.
4. P. L. Ward, "Ozone Depletion Explains Global Warming," *Curr. Phys. Chem.*, 2017, doi: 10.2174/1877946806999160629080145.
5. D. L. Hartmann, J. M. Wallace, V. Limpasuvan, D. W. J. Thompson, and J. R. Holton, "Can ozone depletion and global warming interact to produce rapid climate change?," *Proc. Natl. Acad. Sci. U. S. A.*, 2000, doi: 10.1073/pnas.97.4.1412.
6. S. Solomon, J. B. Burkholder, A. R. Ravishankara, and R. R. Garcia, "Ozone depletion and global warming potentials of CF3I," *J. Geophys. Res.*, 1994, doi: 10.1029/94jd01833.
7. M. E. Davis, F. Bernard, M. R. McGillen, E. L. Fleming, and J. B. Burkholder, "UV and infrared absorption spectra, atmospheric lifetimes, and ozone depletion and global warming potentials for CCl2FCCl2F (CFC-112), CCl3CClF2 (CFC-112a), CCl3CF3 (CFC-113a), and CCl2FCF3 (CFC-114a)," *Atmos. Chem. Phys.*, 2016, doi: 10.5194/acp-16-8043-2016.
8. P. Hallock, "Global change and modern coral reefs: New opportunities to understand shallow-water carbonate depositional processes," *Sediment. Geol.*, 2005, doi: 10.1016/j.sedgeo.2004.12.027.
9. A. Hobson, "Global Warming: Lessons from Ozone Depletion," *Phys. Teach.*, 2010, doi: 10.1119/1.3502504.
10. D. K. Papanastasiou, N. R. Carlon, J. A. Neuman, E. L. Fleming, C. H. Jackman, and J. B. Burkholder, "Revised UV absorption spectra, ozone depletion potentials, and global warming potentials for the ozone-depleting substances CF2Br 2, CF2ClBr, and CF2BrCF2Br," *Geophys. Res. Lett.*, 2013, doi: 10.1002/grl.50121.

11. D. Coulomb, “Refrigeration and cold chain serving the global food industry and creating a better future: two key IIR challenges for improved health and environment,” *Trends Food Sci. Technol.*, 2008, doi: 10.1016/j.tifs.2008.03.006.