

India's Leap Towards Ozone Layer Protection

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Abstract

This paper summarizes the world's collaborative efforts in combating the ozone layer depletion. This issue is an exemplary step towards solving environmental problems. Various treaties and agreements paved the way to minimize the use of potential ozone-depleting substances (ODS) in a planned manner. India as a developing nation firmly took steps to reduce the ODS and shift to green technology.

Key Words: -ODS, CFC, Ozone depletion

Introduction

The Earth's atmosphere is made up of several layers. The stratospheric layer extends 10 to 30 miles above the sea level and has a maximum concentration of ozone making a thick layer around the earth(1). This ozone layer shields the earth from harmful high-frequency UV radiation. The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. British meteorologist G. M. B. Dobson explored its properties in detail (2). Between 1928 and 1958, Dobson's work laid the foundation for our modern understanding of the ozone layer. He developed the Dobson spectrophotometer to measure ozone concentrations in the atmosphere by analyzing the ultraviolet radiation absorbed by ozone molecules. To honor his contributions, the unit that quantifies the total amount of ozone in a vertical column of the atmosphere overhead is named the Dobson unit (DU).

Formation of the Ozone layer and its depletion

Life came into existence around 3.7 billion years ago in an environment devoid of oxygen and high in methane. Cyanobacteria evolved around 2.4 billion years ago and set the stage for more complex photosynthesizers and other life forms (3). As photosynthetic organisms, particularly cyanobacteria, increased and began to produce oxygen through the process of photosynthesis, the levels of oxygen in the Earth's atmosphere gradually increased. This increase in oxygen facilitated the formation of ozone (O₃) from molecular oxygen (O₂) when ultraviolet (UV) light from the sun split O₂ molecules into individual oxygen atoms. These free oxygen atoms could then react with other O₂ molecules to form ozone.

With the Development of the ozone layer in the atmosphere, more advanced forms of life started coming into existence. The ozone blocks harmful solar radiation - all life on Earth has adapted to this filtered solar radiation. Stratospheric ozone depletion through the chemical reaction of ozone with man-made chlorofluorocarbons and halons is the major environmental issue of this century. In the 1970s, significant concern arose regarding the impact of human-made chemicals, particularly chlorofluorocarbons (CFCs), on the Antarctic ozone layer. This issue was notably highlighted by scientists Paul Crutzen, Mario Molina, and Sherwood Rowland (4). Their groundbreaking research demonstrated how CFCs could lead to the depletion of ozone in the stratosphere, which protects the Earth from harmful ultraviolet radiation. The importance of their work was widely recognized, culminating in the awarding of the Nobel Prize in Chemistry in 1995. The ozone layer depletion, particularly over regions like Antarctica, posed significant risks to human health, ecosystems, animals, and the climate. Without a protective ozone shield, harmful ultraviolet (UV) radiation from the sun would increase, leading to various negative impacts. These included higher rates of skin cancer,

cataracts, and weakened immune systems in humans, as well as damaging effects on marine life, agriculture, and terrestrial ecosystems. Furthermore, the increased UV radiation could exacerbate climate change by affecting global weather patterns and the carbon cycle.

World's efforts to address the ozone-depletion

Understanding the severe consequences of continued ozone layer depletion, the global community responded swiftly and decisively. The protection of the ozone layer has been addressed through a series of international treaties and protocols aimed at reducing and eventually eliminating substances that deplete it. These efforts have been crucial in preventing harmful ultraviolet (UV) radiation from reaching the Earth's surface, which can cause health and environmental problems. Vienna Convention for the Protection of the Ozone Layer (1985) was the first international agreement to protect the ozone layer. It established a framework for cooperation and research on ozone depletion. It recognized the need for global action to protect the ozone layer. It encouraged scientific research and international cooperation but did not impose binding commitments on countries to reduce ozone-depleting substances (ODS). The Montreal Protocol (1987) on Substances that Deplete the Ozone Layer is indeed a landmark international environmental agreement, widely regarded as one of the most successful treaties in history. The Montreal Protocol is one of the few treaties to achieve universal ratification. All 197 United Nations member states, along with regions and territories, have signed and ratified the treaty (1). The Protocol covers nearly 100 ODS including CFCs, halons, hydrochlorofluorocarbons (HCFCs), and more recently, hydrofluorocarbons (HFCs). HFCs, while not directly harming the ozone, were added due to their high global warming potential. The Protocol established a clear timetable for the phase-out of ODS, with developed countries committing to stop the production and use of many ODS by 1996, and developing countries following with a later deadline.

The deadlines have been consistently brought forward through subsequent amendments to the Protocol, notably the London Amendment (1990), Copenhagen Amendment (1992), and Beijing Amendment (1999). The most recent Kigali Amendment (2016) focuses on the phase-down of hydrofluorocarbons (HFCs), which, although not directly responsible for ozone depletion, are potent greenhouse gases contributing to climate change. The agreement aims to reduce HFC consumption by more than 80% by 2047.

India's efforts to adhere to the global agreements

India has made significant strides in protecting the ozone layer, particularly through its commitment to global agreements and domestic policies. The country has been actively participating in international efforts, such as the Montreal Protocol, which aims to phase out substances that deplete the ozone layer. India ratified this protocol in 1992 and has been adhering to its mandates, contributing to global efforts to protect the ozone layer. Its stand on the Montreal Protocol (1985) was one of cautious support, marked by a recognition of the need to protect the ozone layer but also an emphasis on the economic and developmental concerns of the country, especially concerning the phase-out of ozone-depleting substances (ODS). India recognized the importance of protecting the ozone layer and expressed its support for global efforts to prevent ozone depletion. India was aware of the potential negative effects of increased ultraviolet (UV) radiation on human health and the environment, such as skin cancer and crop damage. The primary concern with the Montreal Protocol was the potential economic impact on its developing economy. At that time, the country was still in the early stages of industrialization, and many industries relied on ozone-depleting chemicals like CFCs and halons in sectors such as refrigeration, air conditioning, and manufacturing. India was wary of the economic costs associated with the phasing out of ODS, particularly in terms of the availability of alternatives and the financial burden it would place on developing countries. As a developing country, India advocated for

differentiated responsibilities in terms of timelines for the phase-out. Developed countries, which had contributed more to ozone depletion, were expected to take the lead in phasing out ODS more quickly while developing countries like India would need more time to transition. India, along with other developing countries, emphasized the principle of "common but differentiated responsibilities". This principle suggests that while all countries share the responsibility to protect the ozone layer, the developed world, having contributed disproportionately to the problem, should bear a larger share of the cost and take the lead in reducing emissions of ODS. India played a role in establishing the Multilateral Fund (MLF) for the implementation of the Montreal Protocol. The MLF was designed to provide financial and technical assistance to developing countries to help them transition to ozone-friendly alternatives.

India was a strong advocate for this fund as it would help developing countries like itself mitigate the economic impact of the Protocol. India's position adapted to the changing circumstances. India progressively aligned with the global community on accelerating the phase-out of ODS, though always ensuring that its economic development was not unduly compromised. The phase-out of CFCs and halons in key sectors like refrigeration, air conditioning, and fire extinguishing systems. The Ozone Depleting Substances Regulation and Control Rules, in the year 2000 was a landmark step by the Indian government to regulate the use, production, and trade of ODS. The rules restrict the use of CFCs, halons, and other ozone-depleting substances in various industrial applications and enforce penalties for violations. The government of India also amended the Environment Protection Act (1986) to align with the Montreal Protocol's commitments, allowing stronger enforcement of ODS control. India has been active in international cooperative efforts related to ozone layer protection, advocating for technology transfer and financial support from developed countries to developing countries to make the transition feasible. India has made significant strides in eliminating the use of ODS. The National Ozone Unit was established to oversee compliance with international agreements and to provide technical and financial assistance for phasing out ODS.

It has phased out CFCs, halons, and HCFCs, and has embraced ozone-friendly alternatives like hydrofluorocarbons (HFCs), although HFCs are now being addressed due to their global warming potential (as per the Kigali Amendment of 2016). In 2013, India committed to phasing out HCFCs as part of the second phase of the Montreal Protocol's efforts. The country is moving toward reducing HCFC consumption by 35% by 2025 and aiming for a complete phase-out by 2030.

The Indian government has invested in raising awareness about the importance of ozone layer protection, particularly among industries, policymakers, and the general public. There are training programs and workshops to build capacity for the safe handling and disposal of ODS.

India has shown considerable progress in achieving the targets set by the Montreal Protocol. As a result, the country has contributed to the global recovery of the ozone layer. Satellite data has indicated that the ozone hole over Antarctica is slowly recovering, which is partly due to the collective action taken by countries like India.

India's role in global discussions on ozone layer protection is becoming increasingly influential. It advocates for the interests of developing countries in negotiations on ozone and climate protection and plays an active role in shaping international policy.

Conclusion- India's efforts in ozone layer protection reflect a combination of global cooperation, strong domestic policies, and technological innovation. By continuing to adhere to international agreements and

supporting green alternatives, India is contributing significantly to global ozone layer recovery, while balancing its development needs with environmental protection.

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