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IMPACT OF GLOBAL WARMING AND IT'S CHEMISTRY

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Abstract

Climate change, which is caused by human activity, is the primary cause of global warming, which is a significant environmental problem that has significant repercussions for the ecosystems and societies of our world. This research investigates the chemistry that underlies global warming, with a particular emphasis on the function that greenhouse gases play and the interactions that they have within the atmosphere of the Earth. Some of the most important greenhouse gases, such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), are responsible for the greenhouse effect, which is the process of retaining heat and causing an increase in the average temperature of the earth. In addition to the direct impacts of greenhouse gases, the chemistry of global warming encompasses a variety of processes, including the acidification of the oceans and the production of secondary pollutants. In addition, feedback mechanisms magnify the effects of global warming, which presents further obstacles for efforts to mitigate and adapt to the phenomenon. When it comes to establishing effective methods to solve this urgent problem and protect the future of our planet, having a solid understanding of the chemistry behind global warming is very necessary.

Keywords: *Global warming, Chemistry*

Introduction

It is now widely acknowledged that one of the most important problems of our day is global warming, which is an underlying effect of climate change that is caused by humans. Global warming may be broken down into its most fundamental component, which is the progressive rise in the average surface temperature of the Earth as a result of the accumulation of greenhouse gases (GHGs) in the atmosphere. The chemistry that underlies this phenomena is intricate and deeply impactful, and it plays a significant role in determining the delicate balance of the climate system on our planet.

The recognition of the function that greenhouse gases, such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated gases, play in the process of global

warming is essential to gaining an understanding of the chemistry behind the phenomenon. A warming effect that is known as the greenhouse effect is caused by these gases because they trap heat in the atmosphere, preventing it from escaping into space and causing the atmosphere to warm. Human activities, particularly the burning of fossil fuels, deforestation, and industrial processes, have amplified the concentration of these gases, thereby worsening global warming. This natural process is vital for sustaining a climate that is habitable on Earth; nevertheless, human activities have intensified the concentration of these gases.

The existence of greenhouse gases is only one component of the chemistry that contributes to greenhouse gas emissions. An example of this would be the dissolution of carbon dioxide in the ocean, which results in the acidity of the ocean and poses significant dangers to marine life and ecosystems. Furthermore, the interaction between greenhouse gases and other components of the atmosphere can lead to the creation of secondary pollutants, such as ground-level ozone and aerosols, which further influence climate patterns and the quality of the air we breathe.

In addition to this, the consequences of global warming are amplified by feedback processes that are triggered by it. Permafrost, for example, thaws as temperatures increase, which results in the release of methane, a powerful greenhouse gas, which further intensifies the warming process. Alterations in land use and patterns of vegetation can also have an effect on the entire carbon cycle by causing a shift in the equilibrium of carbon taken in and released out of the atmosphere.

In order to effectively design methods for mitigating the effects of global warming and adapting to its consequences, it is vital to have a solid understanding of the chemistry behind it. It is possible for us to create ways to cut emissions, promote sustainable habits, and protect the health of our planet for future generations if we are able to untangle the complex interaction of gases, particles, and feedback loops. As we continue to dive deeper into this intricate chemistry, we are gaining insights that are essential for minimising the effects of global warming and determining a route ahead that is sustainable.

Greenhouse Effect

Temperatures on the surface of the Earth are generally mild and consistent, in contrast to the temperatures of other planets in the solar system around the Earth, which are either extremely hot or extremely cold. The atmosphere of Earth, which is a thin layer of gases that covers and protects the globe, is responsible for the current temperatures that are experienced on Earth. On the other hand, 97% of climate scientists and researchers are in agreement that people have altering the atmosphere of the Earth in significant ways over the course of the past two centuries, which has led to the phenomenon of global warming. To have a better grasp on the phenomenon of global warming, it is essential to first acquire an understanding of the greenhouse effect. As shown in Figure 1, the natural greenhouse effect is responsible for retaining a certain amount of heat in such a way that prevents our planet from reaching temperatures below freezing. On the other hand, the greenhouse effect that is amplified by humans is responsible for the phenomenon of global warming. When fossil fuels are burned, the amount of greenhouse gases (such as carbon dioxide, methane, and oxides of nitrogen) that are released into the atmosphere is increased. This is the reason why this is happening.

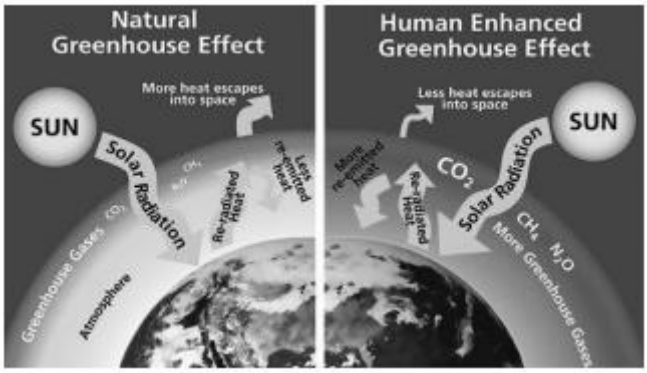

Fig.1 Types of greenhouse effects

It is common practice to refer to the phenomenon that causes the Earth to become warmer as the greenhouse effect. This is due to the fact that a greenhouse operates in a manner that is analogous to the greenhouse effect (Fig.2). When UV light enters a greenhouse, it is easily able to penetrate through the glass walls and is absorbed by the plants and the hard surfaces that are contained within the greenhouse. Low-energy infrared radiation, on the other hand, has a difficult time travelling through the glass walls and is consequently unable to escape, which causes the greenhouse to become warmer. Through the utilisation of this phenomenon, tropical plants are able to thrive inside of a greenhouse even throughout the winter months.

Fig. 2 Plants embodied in a greenhouse

There is a situation that is analogous to this that occurs in a car that is parked outside on a rainy and sunny day. The interior of the vehicle is heated by the solar radiation that is coming in, but the thermal radiation that is going out is stuck within the windows of the vehicles since they are closed. Because of this trapping, the automobile is essentially warmed up. This trapping takes place in such a way that the hot air does not rise and does not lose energy as a result of convention. Figure 3 illustrates this event in its entirety.

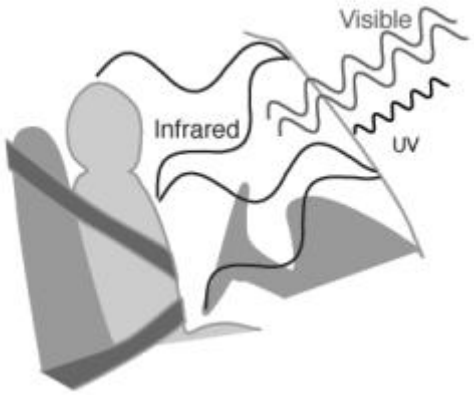

Fig. 3 Greenhouse effect example

According to Michael Daley, an Associate Professor of Environmental Science at Lasell College, "Gas molecules that absorb thermal infrared radiation and are present in sufficient quantities can exert a significant amount of influence on the climate system." The molecules that make up these sorts of gases are referred to as greenhouse gases. The greenhouse gases, which include carbon dioxide, perform the function of a mantle by collecting infrared radiation and preventing it from escaping into space because of their presence. The overall consequence is that the atmosphere and surface of the Earth are being heated on a consistent basis. It is anticipated that the consequences of the greenhouse effect, in conjunction with the rising quantities of greenhouse gases and the consequent warming of the planet, would have philosophical repercussions. There will be considerable climate change, an increase in sea levels, extreme weather occurrences, and other brutal natural, environmental, and societal repercussions occurring as a result of global warming if it goes unchecked and nothing constructive is done to stop this evil.

Causes of Global warming

Greenhouse gases are the primary contributor to the phenomenon of global warming. In certain instances, chemicals containing chlorine and bromine are also included in this category. Carbon dioxide, methane, and nitrous oxides are also included. The imbalance of radiative energy in the atmosphere is altered as a result of the accumulation of certain gases in the atmosphere. The general impact of greenhouse gases is to warm the surface of the Earth as well as the lower atmosphere. This is due to the fact that greenhouse gases will absorb part of the radiation that is emitted by the Earth and then re-radiate it back towards the surface. During the period from 1850 to the end of the 20th century, the net warming was comparable to about 2.5 W/m2. Carbon dioxide was responsible for around sixty percent of this number, while methane contributed approximately twenty-five percent. Nitrous oxides and halocarbons were responsible for the remaining portion of the warming. Joe Farman, who worked for the British Antarctic Survey, wrote an essay that was published in 1985 that demonstrated the decline in ozone levels that occurred over Antarctica during the latter part of the 1980s. The reaction was remarkable: large-scale worldwide research projects were established with the purpose of demonstrating that chlorofluorocarbons (CFCs), which are utilised as aerosol propellants in industrial cleaning fluids and in refrigeration equipment,

were the root cause of the issue. More importantly, there was a sudden international movement to reduce the emissions of chlorofluorocarbons (CFCs).Another significant contributor to the phenomenon of global warming is the thinning of the ozone layer. The presence of chlorine-containing source gases is the primary cause of this phenomenon at the moment. The presence of UV light causes these gases to dissociate, which results in the release of chlorine atoms, which subsequently helps to catalyse the breakdown of ozone. Additionally, aerosols that are present in the atmosphere are contributing to the phenomenon of global warming by altering the climate in two distinct ways. They do two things: first, they scatter and absorb solar and infrared light; second, they have the potential to change the microphysical and chemical characteristics of clouds, which might potentially have an effect on the clouds' longevity and extent. The dispersion of solar radiation has the effect of cooling the globe, but the absorption of solar radiation by aerosols heats the air directly. This is because particles prevent sunlight from being absorbed by the surface of the Earth. There are several different ways in which humans contribute to the total amount of aerosols that are present in the atmosphere. Take dust as an example; it is a by-product of agricultural practices. The burning of biomass results in the production of a collection of organic droplets and soot particles. Aerosols are produced by a broad variety of industrial processes, and the types of aerosols produced vary according to the substances that are burnt or formed throughout the production process. Furthermore, exhaust emissions from a variety of modes of transportation create a diverse assortment of pollutants that are either aerosols from the beginning or are turned into aerosols as a result of chemical processes that take place in the atmosphere from the beginning.

Global Warming: The Effects

Among the most challenging jobs that climate experts must do, one of the most difficult tasks is to predict the implications of global warming. The reason for this is because the natural processes that are responsible for precipitation, snowfall, hailstorms, and the increase in sea levels are dependent on a wide variety of different elements. Moreover, it is extremely challenging to forecast the magnitude of emissions of greenhouse gases in the years to come since the scale of these emissions is mostly affected by the developments in technology as well as the decisions made by political leaders. The phenomenon of global warming has a multitude of adverse impacts, some of which are discussed in this article. The first factor that contributes to the occurrence of floods in different parts of the world is the presence of more water vapour in the sky, which then falls back down as rain. In response to an increase in temperature, the rate of evaporation from both the land and the sea increases. In locations where the enhanced evaporation process is not balanced by higher precipitation, this results in drought conditions. There will be a failure of crops and starvation in some regions of the world as a consequence of this, particularly in regions where the temperatures are already high. Flooding will occur as a result of the additional water vapour concentration in the sky, which will fall back down as further rain. It is possible for settlements and communities that are reliant on the water that melts from snow-covered mountains to experience drought and a lack of available water supplies. The reason for this is because glaciers all around the world are melting at a rate that looks to be quicker than what was previously expected, and all of these glaciers are receding at a very rapid rate. The Intergovernmental Panel on Climate

Change (IPCC) estimates that around one-sixth of the total population of the globe resides in locations that are expected to be impacted by a reduction in the amount of water that is melting. Because of the warmer environment, there will most likely be an increase in the number of heat waves, an increase in the intensity of rainfall, and an increase in the severity of hailstorms and thunderstorms. The rise in temperature is forcing the ice and glaciers to melt at a rapid rate, which is the most dangerous effect of global warming. Rising sea levels are the most devastating effect of global warming. The result of this will be an increase in the water levels of lakes, rivers, and seas, which can lead to the destruction of the environment in the form of floods [6]. As can be seen in Figure 5, it is anticipated that temperature anomalies will become more prevalent in the years to come. A significant amount of control was exercised over the situation before to the 20th century; but, around the beginning of the present century, the situation began to significantly deteriorate.This was all owing to an increase in global warming, which was mostly caused by the fact that new businesses and power houses began operating, which resulted in the emission of dangerous gases that brought about a rise in the temperature of the world. These findings are derived from the study that was conducted by a variety of organisations that specialise in climate and environmental studies.

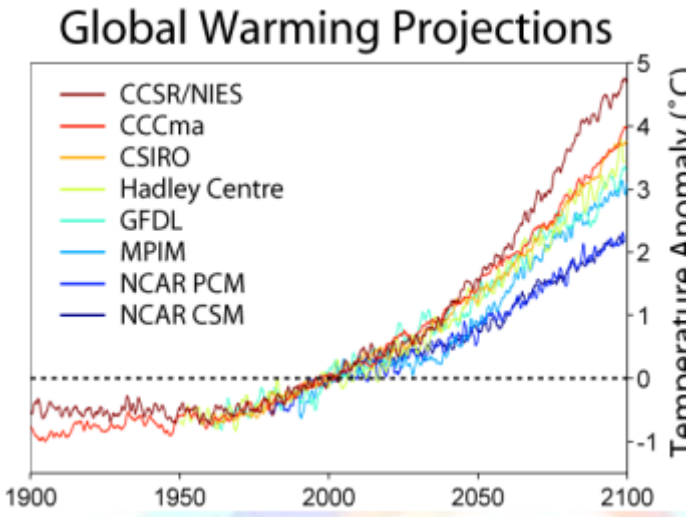

Fig. 5 forecasts of global warming made by a variety of research organisations in the fields of science and engineering

THE CHEMISTRY OF GLOBAL WARMING

Emphasizing Essentials

1. a. Indeed. According to the distance from the sun and the amount of radiation that reaches the globe, the temperature of the earth is higher than what was projected. We would not be able to sustain life as we know it on our planet if it were not for the greenhouse effect, which causes temperatures to rise.

b. Yes. At this point, the majority of scientists have arrived at the conclusion that the observed rises in the average temperature of the Earth are proof that the greenhouse effect, sometimes known as global warming, is occurring.

2. The oceans are where a significant portion of this carbon dioxide is dissolved, where it may combine with the calcium in the water to produce calcium carbonate, also known as CaCO3. This environmental "sink" for carbon dioxide is still present, but the pace at which the process occurs is extremely sluggish. The evolution of plants that were capable of photosynthesis was yet another mechanism that occurred throughout the elimination process.

3. In the greenhouse, the "windows" are constructed of molecules that are transparent to visible light but absorb infrared radiation. These molecules are composed of molecules that are transparent to visible light.

4. 6 CO2(g) + 6 H2O(l) C6H12O6(aq) + 6 O2(g)

a. The number of atoms of each element on either side is the same. C = 6, O = 18, H = 12

b. There is a difference in the total number of molecules between the two sides of the equation. On the left, there are twelve, while on the right, there are only seven. Due to the fact that each glucose molecule has 24 atoms, the big molecule glucose has been generated on the product side of the equation.

5. The term "weather" refers to the conditions that are present in the environment at a specific location and time. Climate is a term that is used to define the aggregate of all weather that occurs over a period of years in a certain location.

6. a. $\frac{343\ \text{W}}{1\ \text{m}^2} \times \frac{30\ \text{parts}}{100\ \text{parts}} = \frac{103\ \text{W}}{\text{m}^2}$

b. Under circumstances of steady state, 103 W/m2 radiates forth from our atmosphere..

7. a. The concentration of carbon dioxide in the atmosphere is around 376 parts per million at the current moment, but it was only approximately 190 parts per million 20,000 years ago. On the other hand, this concentration was around 370 parts per million 120,000 years ago, which is comparable to the levels that exist now.

b. The current mean temperature of the atmosphere is somewhat higher than the mean temperature of the atmosphere between the years 1950 and 1980. By around 9 degrees Celsius, the average temperature of the atmosphere was lower 20,000 years ago. To put that into perspective, the average temperature of the atmosphere was just approximately one degree Celsius cooler than it is right now 120,000 years ago.

c. Despite the fact that there appears to be a link between the average temperature of the atmosphere and the quantity of carbon dioxide, this figure does not imply that one thing causes the other.

8. In spite of the fact that the quantity of energy that is emitted is more than twice as much as the amount that is absorbed, the Earth does not cool down very quickly because the atmosphere keeps a significant percentage of the heat energy that is emitted.

9. a. Visible light is able to pass through the glass, but infrared radiation is unable to pass through the glass. In addition, there is no circulation of air, which means that the heat cannot

be removed, which results in a rise in temperature within the vehicle. On nights when the sky is clear, the heat from the Earth may be released into space in a more complete manner. On the other hand, the heat is retained by the water vapour in the clouds because it absorbs the heat. Among the gases that contribute to the greenhouse effect, water vapour is one of them. c. There is a very low concentration of water vapour in the desert, which makes it difficult to block infrared radiation. Among the gases that contribute to the greenhouse effect, water vapour is one of them.

10. These are the two Lewis structures.

H—H and 

A straight line is the only possible configuration for the atoms that make up H2 when there are just two of them. Furthermore, despite the fact that the Lewis structure of water has been shown as a straight line, this does not necessarily imply that the molecule is linear. In point of fact, the Lewis structure is frequently expressed in this manner since the bending structure of water is of such widespread recognition.

11. Depending on the model kit that is utilised, the exact distances that are measured will. The distance between the hydrogen atoms in a square configuration, on the other hand, will always be considerably less than the distance between the hydrogen atoms in a tetrahedral arrangement. This is true regardless of the circumstances. This is due to the fact that the angle that represents the distance between the hydrogen atoms in the tetrahedral configuration is larger.

Conclusion:

In conclusion, the chemistry of global warming highlights the urgent need for collaborative effort to limit the repercussions of global warming and create solutions that are sustainable. A increase in global temperatures has been brought about by the accumulation of greenhouse gases in the atmosphere, which is mostly the result of human activity. This rise in temperature has had far-reaching effects for ecosystems, economies, and the well-being of humans. It is possible to establish targeted measures to cut emissions, boost renewable energy sources, and increase efforts to sequester carbon if we have a thorough knowledge of the complex chemical processes that are driving global warming because of this understanding. In addition, in order to address the feedback mechanisms and secondary pollutants that are connected with global warming, it is necessary to collaborate across disciplines and to take novel methods. In order to effectively mitigate the effects of global warming, worldwide collaboration and a commitment to setting lofty climate objectives are essential. The transition to a low-carbon economy, the protection of vulnerable populations, and the preservation of biodiversity all need collaborative efforts from governments, corporations, and individuals. We have the chance to not only alleviate the negative consequences of global

warming but also to build a more sustainable and resilient future for future generations if we are able to successfully navigate the complicated chemistry of global warming. Our ability to address the underlying causes of global warming and plot a course towards a world that is healthier and more wealthy may be achieved via the use of our combined knowledge and inventiveness.

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