

Role of Chemistry in Combating Environmental Pollution

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ABSTRACT: Over the years, we have made significant developments in agriculture, energy and health that have contributed to human well-being. However, some of these improvements in our lives have resulted in changes to the environment around us.

Our environment is a hugely complex system that includes the air we breathe, the land we live on, the water we drink and the climate around us. We must work to ensure that our developments in some areas do not adversely affect our environment whilst also ensuring that we mitigate any damage that has occurred. Work by some researchers has shown that we are already at a tipping point that might lead to [“non-linear, abrupt environmental change within continental- to planetary-scale systems”](#).

The good news is that politicians globally are looking at how to solve this. The UN’s Sustainable Development Goals include universal calls to action to protect life on land and in water, producing clean water and tackling climate change. Meanwhile, the EU’s Environmental Action Plan includes nine priority objectives that aim to ensure “we live well, within the planet’s ecological limits”.

As we strive towards a better world, we work to ensure chemistry’s contributions are realised. Chemistry can help us to understand, monitor, protect and improve the environment around us. Chemists are developing tools and techniques to make sure that we can see and measure air and water pollution. They have helped to build the evidence that shows how our climate has changed over time. And they can be part of the effort to understand and address new problems that we face like microplastics and the potential effects of the different chemicals that we are exposed to.

KEYWORDS: chemistry, pollution, environment, sustainable, microplastics, researchers, action

I.INTRODUCTION

Chemical scientists have an important role to play in reducing air pollution (sometimes in unexpected ways), as well as in helping us to understand and monitor it.

The World Health Organisation reported that around 7 million people died as a result of air pollution in 2012. According to the Organisation for Economic Co-operation and Development, poor ambient air quality is set to be the world’s leading environmental cause of premature death by 2050 if we maintain current policies. By improving air quality, we can save millions of lives and improve our quality of living.[1,2]

Cleaner air will also help us to protect the environment and preserve cultural heritage sites. Pollutants such as sulfur dioxide and nitrogen oxides can form acid rain, which pollutes soil and water and damages buildings such as the Acropolis and the Taj Mahal.

Other pollutants, such as ground level ozone, affect vegetation and so reduce agricultural yields.

Air pollution is a concern for the whole world as pollutants can be carried long distances, even across countries. However, scientists and engineers worldwide are tackling this issue, and we aim to support chemistry’s vital role in understanding air pollution and developing solutions to reduce it. Air is a mixture of gases and particles, some of which are reactive and undergo complex chemical reactions in the atmosphere to form air pollutants such as ozone. Other air pollutants are emitted directly - for example, sulfur dioxide. Air pollutants can be solid, liquid or gas and come from

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natural and man-made sources; the biggest contributors to air pollution today are power stations, road transport, industry and residential burning of fuels.

A detailed understanding of pollutants and their chemistry is important for interpreting health effects, regulating emissions, and developing pollution-reducing technologies. For example, chemists have created a "[master chemical mechanism](#)" that describes the chemical reactions involved in degradation of [volatile organic compounds](#) in the lower atmosphere. This helps policy makers to "test" how effective a piece of proposed regulation or legislation would be. In another example, chemists identified trees as the source of high levels of organic pollutants during heatwaves. This unexpected result has improved the air quality forecasts provided to the public in the UK by taking into account natural emissions.[3,4]

Accurate measurements of pollutants are vital for checking that we comply with national and international air quality directives. In addition, measurements can help us to understand correlations between health problems and air pollution - for example, the relationship between different types of particulate matter and cardiovascular problems.

The UK has around 300 [air quality monitoring sites](#) measuring a variety of pollutants, including ozone, nitrogen oxides, sulfur dioxide, carbon monoxide and particulates. One such site is next to a busy road in central Cambridge and measures the concentration of nitrogen oxides from the traffic [in real time](#) using chemiluminescence.

The graph below shows the output from one such measurement. The UK and EU air quality target for nitrogen dioxide is an annual mean of 40 micrograms per cubic metre, and the hourly concentration should not exceed 200 micrograms per cubic metre more than 18 times in a year. Tackling air pollution takes a combination of approaches, including regulation, land use planning, technological solutions (such as vehicle engine design), and consumer behaviour. Chemistry plays a role in developing technological solutions.[5,6]

Chemists help to decrease emissions from transport in a variety of ways, ranging from developing cleaner fuels (such as low sulfur fuels) to increasing the efficiency of engines. Chemists are also working to enable new transport technologies – for example, batteries for electric vehicles and fuel cells for hydrogen vehicles, as well as systems to [produce fuels from renewable energy sources](#) rather than from fossil fuels.

Another way to reduce pollutant emissions is by fitting pollution control devices to the vehicle exhaust. For example, most petrol engines have three-way catalytic converters to reduce carbon monoxide, unburnt hydrocarbons and nitrogen oxides from the exhaust.

Platinum or palladium catalysts oxidise carbon monoxide and hydrocarbons to produce carbon dioxide and water, while rhodium catalysts reduce nitrogen oxides to produce nitrogen and oxygen. Chemists, materials scientists, and engineers develop and improve the catalysts, absorbers, and particulate filters that reduce pollutant emissions.[7,8]

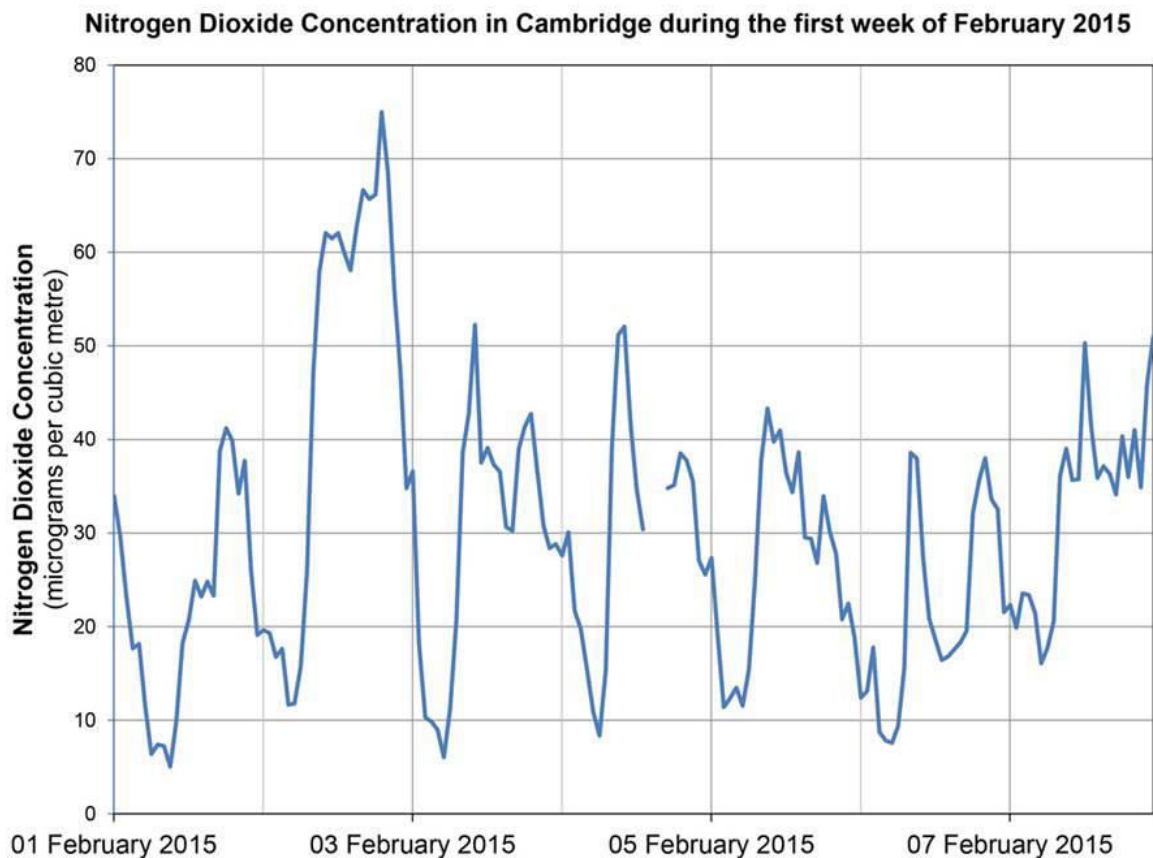
In the future, even the [clothes you wear](#) and our buildings could purify the air. [Photocatalytic clothing](#) can break down nitrogen oxides and volatile organic compounds using just oxygen and light. The same technology has been used in paint and cement, allowing buildings to clean the air around them.

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II.DISCUSSION

The overwhelming weight of scientific evidence indicates that human activity is the predominant cause of recent climate change. It is clear that the increase in carbon dioxide and other greenhouse gas emissions since the industrial revolution is the chief cause of observed global warming. Regional and year-on-year variations are expected within climate systems, but the evidence shows warming over the last half-century that cannot be explained by natural causes.

Carbon dioxide is already at levels much higher than at any time in the last 800,000 years, and continued emissions are expected to lead to significant further warming. Moreover, the speed of warming will be faster than during past natural climate change events, making adaptation more difficult. This change in climate is expected to bring changes in regional temperature and precipitation and to increase the frequency of heat waves, heavy rainfall, and some other types of extreme weather events. These will have a serious adverse effect on human wellbeing and the natural world.[9,10]

The choices we make now will have far-reaching consequences. We need to develop mitigation and adaptation strategies to address the challenges that climate change poses. These strategies include developing and deploying low carbon technologies, improving energy efficiency, and changing behaviours to enable sustainable development.

The Royal Society of Chemistry and the Institution of Chemical Engineers are committed to supporting the chemical sciences community in their contributions to tackling climate change. The chemical sciences help us to understand, mitigate, and adapt to climate change. The best evidence based on the best science is essential to inform the right policy decisions on all three fronts. Already, chemists and chemical engineers contribute in a variety of ways, such as

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improving our understanding of atmospheric and ocean chemistry, investigating the consequences of climate change, developing new energy and carbon mitigation solutions, and helping crops to tolerate the changing conditions.[11,12]

Environmental issues such as water pollution, climatic changes, air pollution and renewable energy have become important issues in our daily life. Many people think that chemistry as well as chemical industries are harmful to the environment. However, nowadays many new advances and scientific researches in the field of chemistry are developed to invent more environment friendly applications and objects, while they held keep up with the lifestyle we expect. An example of environment friendly chemistry is “**Green chemistry**”. Green chemistry is the utilization of some principles that reduce or eliminate the use of hazardous substances in design, manufacture and application of chemical products.

III.RESULTS

Principles of green chemistry:

1. i) **Minimum toxicity** : Way of production should be well designed to minimize the incorporation of all the reactants used in the process to carry out the final product.
2. ii) **Renewable materials**: Auto regenerating

iii) **No solvents**: For washing, cleaning and binding the materials a huge amount of several solvents are used which are toxic to environment. Thus use of solvents should be reduced.

1. IV) **Catalytic -energy efficient**: Energy requirement should be minimized.
2. v) **Avoid waste**: Raw materials or residue should be renewable instated of depleting into the open place.
3. vi) **Safe ingredients**: Prevention of accidental risk by proper analytical methods.

Advantages of green chemistry:

1. i) **Environmental benefit**:
 2. a) Fewer raw materials and natural resources are used.
 3. b) It reduces the emission and product impacts.
 4. c) Lower levels of chemicals are released to the environment.[13,14]
1. ii) **Business benefits**:
 2. a) It improves the resource efficiency and lowers the material and utility bills.
 3. b) It reduces waste treatment and disposal costs.
 4. c) Improve health and safety for staff members.

Chemists are now researching new methods that are more environmental friendly and sustainable. Such examples are given below:

i) **Biofuels**:

It can be obtained from biomass which is coming from Sugar cane, Rapeseed, Corn, Straw, Wood, Animal and Agriculture residues. **Example: Bio-diesel**:**Bio-diesel** is produced from oil or fat through a process called “ **transesterification** “.The yield which is burnt in diesel engine with hydrocarbons and reduces the petroleum fuel consumption as well as toxic gaseous substances.

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ii) Lighter vehicles preparation, reduced costs and carbon dioxide emission.

The modern “ Polyesters “ reduce the quantity of foam used in the seats of the car, decreasing its weight sufficiently. It reduces the fuel consumption and carbon dioxide emission into atmosphere.[15,16]

iii) Bio plastics:

Bio plastics are derived from renewable biomass sources such as corn starch, vegetable oils and fats. It is used for disposable items such as packaging, pots, crockery, bowls, etc.

iv) **New Lighting technologies:** OLEDs (organic light emitting diodes) which produce more light with lower energy consumption.

v) Unleaded petrol:

Octane number (higher the octane number better is the quality of petrol) to petrol can be increased without addition of lead components e.g. TEL (tetra ethyl lead) .Unleaded petrol is obtained by adding methyl tertiary butyl ether (MTBE) which supplies oxygen of petrol and hence reducing the formation of per-oxy compounds.

vi) Nonpetroleum fuels:

Power Alcohol: When ethyl alcohol is used in an internal combustion engines, it is called “ power alcohol “. It is mixed with Gasoline in the ratio of 4:1 to increase its octane number. In India ethyl alcohol is manufactured from molasses. It is the dark brown mother liquor residue left after the crystallization of sugar, glucose and fructose. As a result a huge amount of residue is consumed and reduces the pollution.[17,18]

Benzol: It is an important side- product of coal carbonization. It is also derived from the fractional distillation of light oil. It is a mixture of benzene (70%), Toluene (18%) and Xylenes (6%) with other hydrocarbons. It can be used as a component of motor fuels due to its high anti knocking value and hence it reduced the fuels consumption as well as toxic pollutants.

IV. CONCLUSIONS

The Earth is made up of many tiny substances and particles that participate in reactions that lead to the formation of new particles. Therefore, the earth is thought to be a closed system and the energy to and from the planet, most of its mass remains here. This means that all the elements on this planet are continuously recycled in the environment. The field of chemistry concerned with the study of the reactions, origin, transport, influence, and fate of all chemical species present in the soil, water, and air environments, as well as their effects of technology for these things. The environmental chemistry is a scientific research on biochemical and chemical phenomena that occurs in natural locations. [19,20] The environment chemistry of the environment is a more research than air, water, soil and chemicals. This field uses biological, math, genetic, technical, hydrology, toxicology will help find an answer to all environmental issues. Environmental chemistry also contains aspects of chemistry analysis, physical chemistry, organic chemistry and inorganic chemistry as well as more diverse areas, such as epidemiology, public health, biochemistry, biology and toxicity. Environmental chemists are tasked with discovering how unpolluted environments work and finding sustainable development methods that don't harm the environment. Air is a mixture of gases and particles, some of which react and undergo complex chemical reactions in the atmosphere to form air pollutants such as ozone. Other air pollutants are emitted directly, such as sulfur dioxide. Air pollutants can be solid, liquid or gaseous and come from natural and man-made sources; the main contributors to air pollution today are power plants, road traffic, industry and

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civil fuel burning. The danger of chemical substances is decided via way of means of protection of surroundings. Therefore, A device for the evaluation of substance in surroundings consists of [21,22]

- Exposure modelling
- Risk evaluation base on substance associated homes
- Comparative effect evaluation
- QSAR (exceptional device evaluation reorganization) device for the estimation of substance, homes and effect
- Expert opinion/ recommendation/ trying out for environmentally pleasant product design

Environmental chemistry thoroughly studies the risk factors of all chemicals to get solutions for the sake of environmental safety. It is applied to study new products and their effects on the environment. Environmental chemistry is used in the method of protecting groundwater from contamination by soil, dust, and waste particles. It is useful for the protection of surface water against sedimentation, microbial and radioactive contaminants. [23] Soil quality is protected by environmental chemical methods such as the use of chemical indicators and Eco toxicants. Impermeable surfaces inside cities such as parking lots, roofs and roads are susceptible to the accumulation of undesirable pollutants such as engine oil, gasoline, nutrients and sediments (soil), carbon compounds, hydrocarbons, metals. Environmental chemistry is applied in waste management and cleaner production. Sustainability is becoming increasingly important in almost every industry, and chemistry is no exception. Green chemistry aims to reduce the environmental impact of the chemical industry. This includes switching from petroleum to renewable sources whenever possible. Green chemistry also prioritizes safety, improves energy efficiency, and most importantly, reduces (and ideally) eliminates hazardous waste in the first place. Important examples of green chemistry include: phasing out the use of chlorofluorocarbons (CFCs) in refrigerants, which play a role in creating the ozone hole; develop more efficient ways to manufacture drugs, including ibuprofen, a wellknown painkiller, and the chemotherapy drug Taxol; and develop cheaper and more efficient solar cells. This is different from pollution clean-up (also called remediation), which involves treating waste streams (end of pipeline treatment) or cleaning up environmental spills and other wastes. Contamination disposal may include separating hazardous chemicals from other materials and then disposing of them so that they are no longer hazardous, or concentrating them for safe disposal. Most of the treatment operations do not use green chemicals. Sanitation removes hazardous materials from the environment; on the other hand, green chemistry prevents harmful materials from leaving the environment in the first place. If a technology that reduces or eliminates hazardous chemicals is used to clean up the environmental contaminants, that technology will be considered as green chemistry. An example replaces a dangerous absorbent [chemistry] used to capture airmanship to removes safely with an effective absorber, but without attractive substances. The use of non-smoking absorbers means dangerous absorbers that are never produced and remedy technology meet green chemistry definitions. [24]

Addressing air pollution requires a combination of approaches, including regulation, land-use planning, technological solutions (such as vehicle engine design), and consumer behaviour use. Chemistry plays a role in the development of technological solutions. Chemists help reduce transportation emissions in a variety of ways, from developing cleaner fuels (such as low-sulfur fuels) to increasing engine efficiency. Chemists are also working to enable new transport technologies – for example, batteries for electric vehicles and fuel cells for cars that run on hydrogen, as well as systems for producing fuel from renewable energy sources generated rather than from fossil fuels. [25]

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