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REVIEW ARTICLE

A Pre and Post Covid -19 Appraisal on 'Saving Our Planet'

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ABSTRACT

A comprehensive data is available about climate change where toxins from various sources have played a vital role. The invention of polymer and plastics is imposing a huge threat and damage to the environment. Incineration of plastic waste in an open field is major source of air pollution. Burning of these plastics releases toxic gases like Dioxins, furans, mercury and polychlorinated biphenyls into the atmosphere. Industries in India are no less in producing toxic waste. The textile industry stands second in the position of releasing toxic pollutants in the environment. The major concern in textile industry is large amount of water usage for the production of goods and effluents discharged loaded with chemicals. The wastewater of the textile industry is extremely alkaline and not suitable for marine life. On the other hand, the hazard of global warming is continuously causing major damage to the Earth's environment. Fossil fuels are being continuously used to produce electricity. Deforestation is also leading to warmer temperatures. Fly ash, the major by-product is making the situation worst and along with this CO_2, NO_X, SO_X causes air pollution. COVID-19 turned the world up and down, however there was a silver lining on making environment cleaner.
Key words: Covid – 19, Climate change, air pollution, water pollution

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INTRODUCTION

Planet Earth provides humans with the natural resources on which we need to survive and thrive. Chemists invent and design many of the materials that is use to make items we use every day from electronics to medicine. Chemists and environmentalist have always cared about Earth. Unfortunately, some materials designed using chemistry have contributed to the most well-known challenges that our planet is now facing. Some of those mentioned below. Plastic plays an important role and is a futuristic product with globas impact on industries [2]. There is a negative impact of plastic also due to which its waste management becomes very important, the reason for this is that plastics are non biodegradable[3] and huge amount of plastic waste has been noted to cause a heavy amount of pollution and has had a negative impact on marine life.

Plastics are polymeric organic compounds which have wide applications in the manufacture of various products commonly in used from the cradle to the grave[9]. All plastics have high molecular weight. They are usually synthetic which are commonly derived from petrochemicals and many are partially natural.

Plastic contribute to an estimated 10% of household waste, most of which is disposed in landfill. However, 60-80% of the plastic waste found on beaches, floating on oceans, lakes and rivers. As per estimate by Central Pollution Control Board (CPCB) , in India plastic consumption is 8 million tons per annum and among which about 5.7 million tons of plastic is converted into waste annually [8]. Polybags, water bottles, disposable cutlery and many more except PET in particular have been a focus, as it has contributed to bunch of problems in India such as chocked sewers, animal death and clogged soils.

The properties of plastic makes it valuable as much as its disposal becomes problematic, such as its durability, light weight and low cost. Most of the times, Municipal Solid Waste(MSW) contains about 10-12% of plastic is burnt, releasing toxic gases into the environment which include substances like Dioxins, Furans, Mercury and Polychlorinated Biphenyls. Landfill contributes to nearly 20% of Green House Gases (GHS) followed by fossil fuels. Landfills are overloaded with waste dumps and these wastes are being burnt along with plastic bags are posing health risks. An immediate measure to address them is the need of the hour. Plastic waste attract contaminants, such as Persistent Organic Pollutants (POP). This happens in marine environment since many of these contaminants are hydrophobic, plastic cloud potentially act as a sink for contaminants, making them less available to wildlife, particularly if they are buried on the

seafloor. Conditions within landfill may cause the chemicals in the plastic to become more readily available to the environment a major concern in developing countries. Due to biofouling with micro-organisms, plants or algae onto plastic debris it becomes heavier and eventually sink. Effect of primary and secondary sources of micro plastics to the environment is to be addressed urgently.

In textile industry, number of chemicals and auxiliary chemicals are used to impart the required quality in the textile fabrics. The wastewater of the textile industry is extremely alkaline and contains high concentration or biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and alkalinity. If this effluent is not appropriately treated prior to its disposal, will leads to environmental complications. The spinning and weaving processes of a textile plants creates a large amount of lint which causes air pollution and is a precursor to various respiratory problems. Dust may lead to respiratory diseases among the workers. A chronic lungs disease, byssinosis, is frequently experienced by the workers expose to cotton, flax and hemp dust. Also there are a number of processes in textile industry that causes high decibel pollution.

The major environmental concern in the textile industry is the amount of water discharged and the chemical loads it carries. Other important issues are energy consumptions, air emission, solid wastes and odours which can be significant problem in certain treatments. Effluents creates toxicity as they largely comprise of formaldehyde- based dye fixing agents, hydrocarbon-based softners, and non-biodegradable dyeing chemicals along with sulphur, naphthol, vat dyes, nitrates, acetic acid, and certain auxiliary chemicals, also the following metals in toxic amounts such as lead , cadmium , mercury, nickel, and cobalt. Other harmful chemicals present in the water may be The mill effluent is often of a high temperature and pH, both of which are extremely damaging.

The trend of incoming and outgoing radiation that heats up the Earth is referred to as green house effect. There are many green house gases which are mainly emitted by human activity. The most important one is carbon dioxide. Burning of coal and oil is the major factor for producing this gas. Moreover deforestation i.e. removal of trees for acquiring lands also cause large amount of carbon dioxide in the atmosphere. The cement industry0 also contributes carbon dioxide to atmosphere when calcium carbonate is heated generating lime and carbon dioxide. The second culprit gas is methane, commonly known as natural gas. It is produced as result of agricultural activities such as livestock digestion, paddy rice farming and use of manure. Methane is also produced due to improper management of waste. Nitrous oxides are generated mainly by fertilizers. Moreover, fluorinated gases such as chlorofluorocarbons (CFCs) are chiefly a result of various industrial processes and refrigeration. These gases are responsible for global warming. They are continuously causing an increase in the Earth's temperature.

UN chief Antonio Guterres said in his message that "nature is sending us a clear message. We are causing great damage which may be fatal for us also due to mismanagement of waste material. This year world has faced global pandemic COVID19 health crisis. The pandemic has been caused by coronavirus and the outbreak was first identified in Wuhan, China, in December 2019. The World health Organisation declared a Public Health Emergency of International Concern on 30 January and a pandemic on 11 March. In the third weak of March the Government of India ordered a nationwide lockdown, due to which the movement of people in India was restricted. This was a preventive measure against the COVID-19 pandemic. As a result of this lockdown, there was an improvement in air quality due to massive reduction of air pollution. Hence, some pre-COVID and post-COVID scenarios have been discussed in this paper along with some alternatives measures to be taken.

MECHANISM

TOXIC POLLUTANTS FROM PLASTIC WASTE

Plastic waste has several impacts on the health of ecosystem and humans. During pre-COVID-19 the pollution due to plastic all over the world was at peak. The effect of chemicals on humans and ecosystems is mainly due to plastic waste. Toxic substances may be transported through plastics causing tremendous harm. The threat posed by hazardous brominated compounds act as carcinogens and mutagens requiring immediate attention.

Dioxins are the lethal POPs and its worst component, 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) commonly known as agent orange is toxic compound which causes cancer and neurological damage disrupts reproductive, thyroid and respiratory systems. Burning of plastic waste increase the risk of heart disease, aggravates respiratory ailments such as asthma and emphysema and causes rashes, nausea or headaches and damages the nervous system. These vapours can damages eyes and mucous membranes. Additives used as heat stabilizers, heavy metals such as barium, lead and cadmium, sometimes in combinations. Lead and cadmium are the most serious environmental pollutants and effect on human health depending on their concentration. Polyvinyl chloride (PVC) contains chlorine which can be

released during burning as hydrochloric acid (HCl). High concentration of these effects human respiratory system. Burning plastic releases toxins as well as toxic chemicals causing air pollution.
Polystyrene is harmful to central nervous system. Burning of plastic leads to severe health risk such as heart disease, asthma, emphysema and damages kidney and liver. Dioxin settles on crops and in our waterways where they eventually enter into our food and get into our body.
The by-products of plastic combustion are air borne particulate emission (soot) and solid residue ash (black carbonaceous colour). Many studies have shown that health and environmental concerns are caused by soot and ash which possesses Volatile Organic Compounds (VOCs) semi- VOCs, smoke (particulate matter) and contains particulate matter which can travel thousands of kilometres, depending on prevailing atmospheric conditions and enter our food chain. Significant amount of pollutants of environmental and health concern including carcinogen such as PAHs, nitro-PAHs and dioxin have been identified in airborne particulate emission. These particulates are highly mutagenic. High concentration of persistent free radical (unstable and highly reactive) both in the soot and solid residual ash are considered to be very important in the creation of the adverse health effects especially to human lungs. Benzene amongst VOCs is a well known carcinogen and is released during plastic combustion.
Di(2-ethylhexyl) phthalate (DEHP) is one of the compounds among the plasticizers used in plastic manufacturing that has been described by USEPA (United States Environment Protection Agency) as probable human carcinogen, a potential endocrine disruptor and is believed to be harmful by inhalation, generating possible health risks and irreversible effects released during combustion of plastics. During extrusion process several substances such as additives, may be released from PVC , vinyl chloride, HCl. One way of dealing with waste is to incinerate it fully. On combustion plastic is reduced to carbonic acid which is a combination of CO_2 and water but PVC is an exception to this rule, since the chlorine it contains produces HCl when burned. Incomplete combustion of PE, PP, PS and PVC can cause further problem as CO and smoke may be produced. As a result of incomplete combustion of PVC, dioxins and other hazardous substances may be formed. These difficulties can be overcome by keeping the moulding period very short and by adding a heat stabilizers.
Bisphenol A – BPA is a widely used compound in daily life. It is wide used in the canning process to prevent the direct contact of food with the metal, to ensure the thermal stability and the mechanical strength of the can. It is also used as a plasticizer and an intermediate in the synthesis of epoxy resins and polycarbonated plastics, which can be ingested orally or through breathing causing immense damage. Food products are major source of BPA exposure. The most important dietary exposure to BPA is canned foods. BPA is used for the inside coatings of jar caps. Heating cans during sterilization or food preparation causes the BPA to leak into the content from the epoxy coating of the can wall.
Due to its phenolic structure BPA has been shown to interact with estrogen receptors and to act as agonist and antagonist via endocrine receptor (ER) dependent signalling pathways. Therefore, BPA has been shown to play a role in the pathogenesis of several endocrine disorders including female and male infertility, precocious puberty, hormone dependent tumours such as breast and prostrate cancer and several metabolic disorder including polycystic ovary syndrome.
Phthalates – They are mainly used as plasticizers and primary to soften polyvinyl chloride. The use of some phthalates has been restricted in the EU for use in children's toys. In 2008 the EU banned several types of Polybrominated diphenyl ethers or PBDEs when it was discovered that they were accumulating in breast milk. Polyethylene has the potential to degrade more readily than polypropylene, as it is more conducive to the oxidation process. There is a possibility that additives may provide preferential site for continued degradation, as indicated by small patches of heavily oxidised areas in otherwise intact plastic pellets. PE and PP are inert material. Under the influence of light and heat or mechanical pressure they can decompose and release hazardous substances. Styrene in polystyrene and vinyl chloride in PVC are poisoning. Pigments and colorants may contain heavy metals that are toxic to humans such as cadmium, copper, cobalt, selenium, lead and chromium are often used to produce brightly coloured plastics.

TOXIC POLLUTANTS FROM TEXTILE INDUSTRIES

The effluent from textile industry contains chemicals which are used during the various stages of processing. The toxic chemicals present in the textile effluent are listed below.
CHLORINATED SOLVENTS – Chlorinated solvents are used for a number of operations in the textile manufacturing industry such as scouring, resizing, dyeing and cleaning and contains the polluted chlorine. The commonly used chlorinated solvents in the textile industry are carbon tetrachloride (CCl_4), chloroform ($CHCl_3$), dicloromethane (CH_2Cl_2), tetrachloroethylene (C_2Cl_4), trichloroethane ($C_2H_3Cl_3$) and trichloroethylene (C_2HCl_3).

Chlorinated solvents can cause or are suspected of causing cancer and are toxic or harmful for aquatic organisms. Spill and leaks of chlorinated solvents have caused widespread subsurface contamination in the environment. Commonly, these contaminants are present in the subsurface in the form of non-aqueous phase liquids, as dissolved contaminants in ground water, associated with aquifer sediments and as vapours in the unsaturated zone. Because the density of these non-aqueous phase liquid is greater than water, they tend to sink in ground water systems, which result in a complex dispersal and plume patterns, long term sources in the subsurface and difficult cleanup.

HYDROCARBON SOLVENTS – ALIPHATIC HYDROCARBONS – The aliphatic hydrocarbons present in the effluent of the textile industry are cyclohexene (C_6H_{10}), cyclohexane (C_6H_{12}), n-hexane (C_6H_{14}), n-heptane (C_7H_{16}), pentane (C_5H_{12}) and petroleum ether.

These compounds are inflammable, allowing the use of hydrocarbons as fuel. Aliphatic hydrocarbons are asphyxiants and central nervous system (CNS) depressants. Among the adverse causes of inflammable hydrocarbon are asphyxia and chemical pneumonitis for many paraffins, axonal neuropathy for n-hexane and cancer for 1,3-butadiene.

HYDROCARBON SOLVENTS – AROMATIC HYDROCARBONS – Effluents of textile-dyeing plants are extremely difficult to treat due to their high content pollutants such as polycyclic aromatic hydrocarbons (PAHs). Some of the aromatic hydrocarbons found in the textile effluent are benzene (C_6H_6), naphthalene ($C_{10}H_8$), toluene (C_7H_8) and xylenes or dimethylbenzene (C_8H_{10}).

Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes and rivers. PAHs are carcinogenic compounds and it sticks tightly to particles. It may also move through soil to contaminate under-ground water. Some people who have breathed or touched mixtures of PAHs and other chemical for long periods of time have developed cancer.

OXYGENATED SOLVENTS – An oxygenated solvent contains oxygen molecule, with high solvency and low toxicity. These solvents are widely used in textile processing and found in the effluent of textile industry. Such oxygenated solvents are methanol (CH_3OH), ethanol (C_2H_5OH), propanol (C_3H_7OH), butanol (C_4H_9OH), ethylene glycol ($C_2H_6O_2$), diethyl ether ($(C_2H_5)_2O$), ethyl acetate ($C_4H_8O_2$), acetone (C_3H_6O), butanone (C_4H_8O), methyl isobutyl ketone ($C_6H_{12}O$) and methyl n-butyl ketone or 2-hexanone ($C_6H_{12}O$).

These oxygenated solvents are volatile and reactive to sunlight; they can yield the so called "ground-level ozone", which can be harmful for human health as well as for all flora and fauna. Prolonged exposure to solvents can cause blindness, irregular heartbeat and damage to kidney, liver, lungs and CNS. Benzene and trichloroethylene are human carcinogens. Solvents anticipated to be human carcinogen include carbon tetrachloride, chloroform, 1,4-dioxane, perchloroethylene and styrene. Exposure to glycol ether may cause damage to developing fetus and low fertility in men.

GREASE AND OIL IMPRIGANATED WASTES – Grease is a thick and oily lubricant consisting of inedible fat rendered from waste animal parts, or a petroleum derived or synthetic oil containing a thickening agent. White grease is made from inedible fat and has low content of free fatty acids. Grease is harmful to aquatic life with long lasting effects. The product contains a substance which is toxic to aquatic organisms and may cause long term adverse effects in the aquatic environment. The waste clothes soaked with grease and oil when burnt emit the toxic gases such as carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons, nitrous gases (NO_X) and sulphurous gases (SO_X). The hazards caused by grease and oils to the living beings are eye damage eye irritation and toxic and harmful to aquatic life with long lasting effects.

DYESTUFFS AND PIGMENTS CONTINING DANGEROUS SUBSTANCES – Presence of colour in the waste water is one of the main problems in textile industry. Most of the dyes are stable and there is effect of light and oxidising agents on them. Removal of dyes by known methods is not simple as they very stable.

Organo halogens – A pigment containing a covalent fluoro-carbon, chloro-carbon, bromo-carbon or iodo-carbon bond; and toxic elements - A pigment containing lead, cadmium, mercury, vanadium, chromium (VI), cobalt, nickel, arsenic, antimony or selenium involve toxic and hazardous risks.

CAUSES AND EFFECTS OF GLOBAL WARMING

The major cause of global warming is the green house gases. They include carbon dioxide, methane, nitrous oxides and in some cases chlorine and bromine containing compounds. Their overall effect of the increasing concentration of these gases is to warm the Earth's surface and the lower atmosphere because green house gases absorb some of the outgoing radiation of earth and re-radiate it back towards the earth surface. Another major cause is the depletion of ozone layer. This happens mainly due to the presence of chlorine-containing source gases. When ultraviolet light is present, these gases dissociate releasing chlorine atoms which then catalyses ozone destruction. Global warming is also causes the production of aerosols which change the climate into two different ways. Firstly, by absorption of solar and infrared

radiation and secondly, they may bring about a change in various physical and chemical properties of clouds and this may affect their lifetime and extent. The scattering of solar radiation results in cooling the earth, while absorption by aerosols heats the air, thereby, preventing the absorption of heat of the sun rays by the earth surface.

We mortals have also contributed in many ways to increase the concentration of aerosols:

- Dust is a by-product of agriculture.
- Biomass burning aggregates a mixture of organic droplets and soot particles.
- Many industrial processes produce a wide diversity of aerosols depending on what is being burned or generated in the manufacturing process.
- The exhaust emissions from various sorts of transport produce a rich mixture of pollutants

There are many adverse effects of Global warming:

- Excessive water vapour which is present in the atmosphere falls again as rain which leads to floods in various regions of the world.
- When weather turns warmer, evaporation process from both land and sea rises. This leads to drought in the regions where increase evaporation process is not compensated by increased precipitation.
- In some areas of the world, this will result in crop failure and famine particularly in the areas where the temperatures are already high.
- The extra water vapour content in the atmosphere will fall again as extra rain hence causing flood. Towns and villages which are dependent on the melting water from snowy mountains may suffer drought and scarcity of water supply. It is because glaciers all over the world are shrinking at a very rapid rate and melting of ice appears to be faster than previously projected.
- The warmer climate will likely cause more heat waves, more violent rainfall and also amplification in severity of hailstorms and thunderstorms.
- The rise in temperature is causing the ice and glaciers to melt rapidly. This will lead to rise of water levels in oceans, rivers and lakes that can cause devastation in the form of floods.
- Excess heat can cause stress which may lead to hypertensive and cardiac conditions compromising health.
- Crop failures and famines, which are direct consequences of heating up of earth, can cause a decline in human body resistance to viruses and infections.
- Warmer oceans and other surface waters may lead to severe cholera outbreaks and harmful infections in some type of sea food.
- Warmer temperatures lead to dehydration which is a major cause of kidney stones.

FLY ASH FROM THERMAL POWER PLANTS

In India, 75% of the total power is obtained from Coal- based thermal power plants which have been a major source of power generation in India. The coal reserves in India are about 200 billion tones and its annual production reaches to 250 million tones approximately. A large amount of it is used in the power generation. The major concern which India is facing unlike other developed countries, the ash content in the coal used for power generation is 30-40%. This causes damage to power plant and machinery, low thermal efficiency of the boiler , slogging, choking and scaling of the furnace and the most serious problem is the generation if a large amount of fly ash. India, at 210 GW has the 5th largest electricity generation sector in the world and rank 4th in the world in the production of coal fly ash as the by-product waste. Fly ash is fine glass powder, the particle are spherical and range in size from 0.5 to 100μm. On the basis of type of coal used, fly ash is classified into two types- first, Class F fly ash – produced from anthracite and bituminous coal. Second, Class C fly ash- produced by burning lignite or sub-bituminous coal. Class C fly ash has self-cementing properties.

The major problem in coal-fired thermal power plant is the disposal and management of fly ash. Emissions of fly ash from a variety of coal combustion units show a wide range of composition. Coal ash contains all elements below atomic number 92. A functional thermal power plant releases a large amount of SO_2 , NO_2 and fly ash approximately every day. The particulates matter (PM) considered as the source of air pollution constitutes fly ash. The fine particles of fly ash reach the pulmonary region of the lungs and behave like cumulative poisons. The residual particles being silica (40-73%) causes silicosis. The heavy metals (Ni, Cd, Sb, As, Cr, Pb, etc.) usually found in fly ash are toxic in nature. The main diseases cause by these heavy metals are respiratory problem and lung cancer cause by the presence of nickel in the fly ash, anaemia, hepatic disorder cause by cadmium, Gastroenteritis by antimony , skin cancer and dermatitis by arsenic, cancer by chromium and anaemia cause by the presence of lead.

Extensive studies over the last three decades has shown that fly ash is not harmful and can be put to constructive use[6].Fly ash can be disposed off in a dry or wet state but the wet disposal of this waste does not protect the environment from migration of metal into the soil. Heavy metals unlike other organic waste cannot be degraded biologically into harmless products. In viewing the disposal problem, many countries come up with plans to utilize the fly ash in various sectors [1].

Fly ash as bricks- The Central Fuel Research Institute, Dhanbad has developed the technology for the utilization of fly ash for the manufacture of building bricks. These fly ash bricks have many advantages over the conventional burnt clay bricks. It is also being utilized in unglazed tiles for use on footpaths. To advance the use of fly ash awareness among the public is required and the Government has to provide special incentives for this purpose.

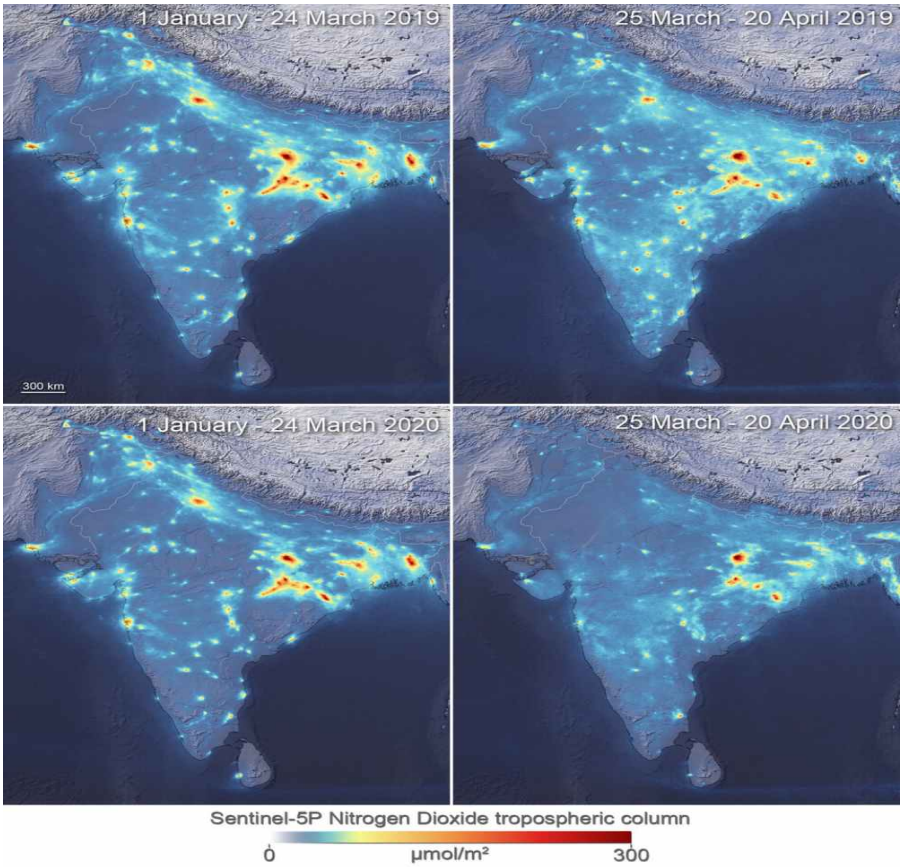
Fly ash in manufacture of cement- Fly ash can be utilize as pozzolana. In the presence of moisture, it reacts chemically with calcium hydroxide at room temperature to form compounds possessing cement like properties. Fly ash contain high amount of silica and alumina in reactive form which compliment the hydration chemistry of cement. On hydration, a gel comprising of C-S-H is obtained which binds the concrete giving strength. Water, sulphates and CO_2 present in the environment attack the free lime causing deterioration of the concrete but reactive elements present in the fly ash convert the problematic free lime into durable concrete. Fly ash particles are actually totally spherical in shape, allowing it to flow and blend freely in mixtures. This property makes fly ash a good admixture for concrete.

Fly ash as fertilizer- Fly ash provides the uptake of vital minerals (Ca, Mg, Fe, Zn, Mo, S and Se) by crops and vegetation, and can be considered as potential growth improver. It serves as a good fertilizer.

IMPACT OF COVID-19 ON ENVIRONMENT OF INDIA

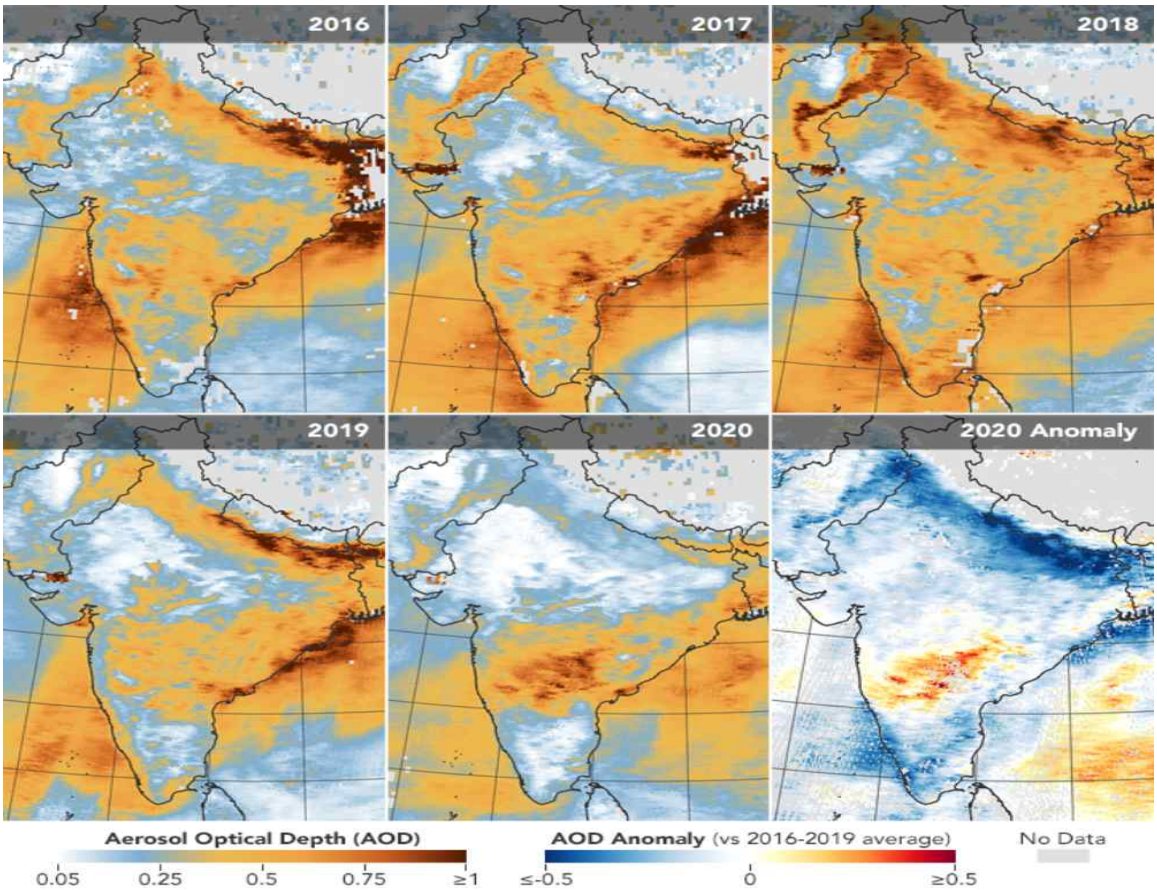
The lockdown imposed by the government to restrict the spread of novel corona virus has shown a positive effect on air quality across the country. It is observed that during the COVID-19 lockdown that started on 25 March, there has been a remarkable reduction in pollution levels across major Indian cities .

AIR POLLUTION – As per the report of European Space Agency (ESA), Mumbai and Delhi have witnessed a significant reduction of around 40 to 50 per cent of nitrogen dioxide (NO2) compared to the same period last year.



These images above show a pre and post covid lockndown of nitrogen dioxide

According to the agency, the new satellite maps, shows a reduction in average NO2 concentrations over India from 1 January to 24 March 2020 and 25 March to 20 April 2020- compared to the same period last year.
NO_X is usually emitted into the atmosphere from thermal power plants, industrial facilities and vehicles. High levels of NO2 increase the possibility of developing respiratory problems and lung diseases.
US space agency NASA has also said in its report that its satellite sensors have observed aerosol levels at a 20-year low in northern India since the government imposed the COVID-19 lockdown.



The first five maps above show aerosol optical depth measurements over India in the period March 31 to April 5 period for each year from 2016 through 2020. The sixth map (anomaly compares AOD in 2020 to the average for 2016-2019.

Aerosols are tiny airborne particles which reduce visibility and can cause lung and heart damage in humans.
As due to the coronavirus pandemic lockdown enforced over much of the world by early April, daily global carbon dioxide emissions fell by 17% compared with 2019 levels. This reduction is mainly due to the result of disarray to ground transportation, power generation and industry. The largest drop in carbon emissions is due to the reduced traffic from cars, buses and trucks, accounted for roughly 43% of the total estimated emission reduction. Reductions from the power and industrial sectors accounted for another 43% of the total. The peak decline in emission by 17% daily occurred during April, when China, U.S., India and most other major carbon emitting countries were all under a high-level of lockdown.
WATER POLLUTION - During the lockdown periods, major polluting industries that affect the aquatic ecosystems such as industrial wastewater disposal, crude oil, heavy metals and plastics have shrunk or completely stopped. This is greatly witnessed in some Indian rivers and lakes namely; Ganga river, Vembanad lake and many more. Vembanad lake, located in the state of Kerala, is the longest freshwater lake in India. The lake is one the famous tourist destination in the state and served as a livelihood for the local population in the form of tourism as well as aquaculture as the main source of income. Despite of these features, it is one of the most polluted lake – abundant amount of microplastics, high concentrations of toxic elements such as mercury are reported from surface and subsurface sediment samples as well as from fish samples. The spatial variation of the pollutants shows that industrial effluents are the major

source of pollution in the Vembanad lake. Since the industries and tourism activities (houseboats which run diesel engine) have closed down completely after lockdown, the pollutants from these sources have been reduced to large extend. Many studies clearly shows that comparing the average suspended particulate matter (SPM) concentrations during the lockdown period with those of the pre-lockdown period, a significant decrease in SPM concentrations was observed.

It is observed as per report that the DO levels of river Ganga has gone above 8 ppm and BOD levels down below 3 ppm at Kanpur and Varanasi which ranged around 6.5 ppm and 4 ppm in 2019 respectively. The primary cause of river getting less turbid is lack of industrial effluents entering the rivers due to enforced lockdown under this pandemic situation. Other factors which contributed in enhancing the quality of of the rivers are like high snowfall now melting with summer, reduction of irrigation water demand, above average rainfall and human activities like reduction of religious and cultural activities as puja, bathing and cremation on the banks of the rivers. It is reported that on daily basis the total effluent dumped in Ganga is around 6500-6700 MLD and out of which 700 MLD (approximately 10%) come from industries . 30% of total BOD is due to the industries situated along the holy river which is 130-150 tons per day. The organic load can be diluted in the river but the industrial pollution destroys the self-cleansing property of water. Researchers believe that the self-cleansing property of river Ganga has improved which has enhanced the water quality by 40-50% during this lockdown.

MARINE LIFE – The impacts of COVID-19 on the oceans have been largely positive due to reduction in various types of pressures that lead to pollution, overfishing, habitat loss invasive species introductions and the impacts of climate change on ocean. It is already evident that significant slowdowns are occurring in fisheries, shipping, coastal tourism, coastal development, and oil and gas extraction. There is significant drop in demand for shrimps, octopus, crabs, snappers, groupers, squids and mahi-mahi. This is mainly due to lower demand from export markets , the challenge of practicing sanitization on fishing boats, difficulties in accessing supplies and shortage of labours. The decrease in demand of seafoods is mainly due to shutdown of restaurants, complete collapse of tourism and elimination of seafood markets in some effected countries like China.

COVID-19 also dramatically affects the international shipping as many ships are being used for offshore storage of excess supplies of oil as demand has slumped. The reduction in shipping traffic will decrease the sector's Greenhouse Gas emissions as international shipping contributes about 2.5% of greenhouse gas emissions. The reduction in the greenhouse gas will benefit the ocean by slowing the rate of acidification, warming and deoxygenation. Tremendous reduction in fossil fuel consumption is already resulting in measurable reduction in greenhouse gas emissions which slows the pace of melting glaciers.

The COVID-19 not only affects the planet positively but also negatively. To protect from nova corona virus a lot of personal protective equipment, the masks, gloves and other medical equipment are being used. All these are made up of plastics which are thrown away or dumped carelessly. Though these single-use plastic has been a lifesaver in the fight against COVID-19 especially for frontline health workers and facilitated to social-distancing rules, by enabling home delivery of basic goods but it has been witness that plastic sacks of medical waste pilling up outside hospitals and used personal protective equipment floating in coastal waters and washing up on the world's beaches. Hundreds of tons of discarded masks were being collected daily from public bins alone during the outbreak peaks; there is no record how many more were being discarded in household waste systems. Many waste-management services have not been operating at full capacity to solve the problem due to social-distancing rules and stay-at-home orders. Extent of plastic coming through waste is decreasing as has been reported by some companies involved in the recycling of waste. This situation has reversed the government polices of banning single-use plastics and adding even more problem to the already existing one.

The positive impacts of COVID-19 on environment are all temporary which is going to be vanished in air in the blink as soon as the lockdown over the world will release. Tourism, transportation, manufacturing and other human activities will bring back the black clouds all over the world again. So, the world could not rely on the lockdown which is enforced as the protective measure against the COVID-19 pandemic. Scientist and researchers have to come up with better option to save the planet Earth. One of the solution is to stick with green chemistry and renewable sources of energy [5].

DISCUSSION

Green chemistry has laid an important role in sustainable development and waste management which has gone a long way in saving our planet for our descendents. In the Polymer Industry, issues with the extensive use of fossil-based raw materials and large amount of reagents that are environmental concern, in addition to the accumulation of polymeric materials in the environment, gives scientist and engineers to re-examine the polymerization process in light of the principles of green chemistry.

- Prevent waste: Residual monomers are especially problematic because of their typically hazardous nature. Since most monomers demonstrate significant toxicity to human health, reducing the residual monomer content is desired to prevent workplace exposure as well se exposure to the consumer. Residual monomer removal techniques are generally classified into two categories: Chemical methods and Physical methods. Chemical methods include the reaction of the residual monomer to generate additional polymer or to produce non-toxic or at least, easily removable compounds. Physical methods include the removal of residual monomer from the polymer by evaporation, by solvent extraction or with the aid of the ion-exchange resin. Extraction of the residual monomer using supercritical CO_2 was reported to give better performance than steam stripping techniques.

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  Commonly used chemical methods include ramping the reaction temperature and/or using finishing catalyst often referred to as "chaser". Post-polymerization methods or chemical monomer removal are often employed to reduce the monomer content before the use of devolatilization processes. Other techniques of this type include post-catalysis procedures followed by spray-drying and hydrolytic slitting of the monomers followed either by distillation or by the use of an oxidising agent.

  In addition to the above mentioned methods, there are ways to ensure that the monomer consumption in the polymerization is as high as possible. An example is the formation of polystyrene latex via ultrasonic initiation. The presence of ultrasonic irradiation results in the increase of the polymerization rate. The molecular weight of polymer latex obtained from this method is higher than conventionally manufactured one, yielding a higher monomer conversion and lower residual monomer content in the final polymer product.

  One major principle that governs the choice of residual monomer techniques is that the method used should not affect the final properties of the polymer product.
- Design safer chemicals and products: Functional fillers represent a significant component of polymer products. They are primarily used to modify mechanical and thermal properties. Interesting subclasses of fillers, nanofillers are material having at least one dimension in the nanometer range. Due to their high aspect ratio and high surface area, even low loading of these nanomaterials impart usually strong modifications to polymer properties. Whether synthetic or natural, when these materials are modified to the nanoscale, it is not known how these might impact the environment and human health. At least one of these, cellulose nanocrystals has been approved in some sectors as environmentally benign.

  Plasticizers are incorporated into a material to increase its flexibility and processability. These are generally non-volatile, low molecular weight materials, which consequently, can leach out of the polymer product. Some of the plasticizers are phthalates, bisphenol A, and polybrominated diethyl ethers (PBDEs). Studies have shown that exposure to bisphenol A and PBDEs causes altered endocrine function and reproductive effects and might also result in cancer in the case of high percentage accumulation.

  Bisphenol A has been utilized in four main classes of polymers: epoxides, polycarbonates, polyesters and polyimide. In order to minimize this endocrine disruptive additive, several pathways and replacements have been investigated. For example aliphatic-aromatic components derived from 2,2,4,4-tetramethy-1,3-cyclobutanediol(TMCBD) and isosorbide have been studied as promising candidates for bisphenol A replacement.

  Another class of highly toxic chemicals have been used for cross-linking and network formation is highly reactive isocyanate containing compounds. Isocyanates are used extensively in polyurethrane production resulting in outstanding mechanical and thermal properties. Replacement of isocyanate component with other, less harmful di- and tri-functional molecules such as bis-propargyl-succinate has been reported. Additionally, less toxic route to synthesis of isocyanate free polymers or non-isocyanate polyurethanes (NIPUs) have been explored using different monomers. For example, monomers such as cyclic carbonates, for the synthesis of poly(urethane-carbonate) and carbonated soybean oil for catalytic synthesis of NIPUs have been studied.

  A logical approach has been made to replace these compounds with higher molecular weight materials to achieve lower solubility and migration rates. Research on a number of natural-based plasticizers is underway. Notable examples include soybean oil, epoxidized triglycerides from vegetable oils, water, polyols (e.g. glycerol, sorbitol and xylitol), monosaccharides (e.g. mannose, glucose, fructose and sucrose), amino acids, saturated fatty acids. The use of triethyl citrate in the

development of cellulose acetate biopolymer is a good example of combining renewable, non-toxic plasticizers with a renewable polymer.

- Design less hazardous chemical synthesis: The transformation of one or more monomer into final polymer product often includes a number of additional components to aid in synthesis or to modify the final product properties. As noted in previous section, large volume of solvents, often petroleum-based, as well as plasticizers, fire retardants, pigment, stabilizers, catalysts and the like, are used throughout synthesis stage and these often pose serious toxicity concerns.

  Cellulose derivatives are attractive bio-based materials, among which nitro-cellulose (NC) and cellulose acetates (CA) are the most common. Many recent studies have focused on CA, mostly because it is produce in large quantities. Polylactic acid (PLA) is another class of bio-based polymers which is highly bio-compatible; not surprising giving its monomer, lactic acid, is a natural product found in the body. Early application of PLA was in the biomedical field and greater improvements in its synthesis have been achieved over the past decade, particularly from fermentation pathways to convert corn starch into lactic acid. PLA is used in wide range of applications such as packaging materials, plastic bags and thermoforms.

  Biodegradable polycarbonated synthesized by ring opening polymerization of six-membered cyclic carbonates is another interesting class of polymers that can be used for the production of thermoplastics. These polymers are widely used in medical field, e.g., in the production of sutures, drug delivery systems, implants and tissue engineering.

  Several other benign exit either as naturally occurring compounds or through certain chemical modifications based on natural substances. Conversion of starch into environmentally benign monomers via catalytic reduction has been studied and compounds such as polyols, organic acids (lactic and glycolic acid), 5-hydoxymethyl-furfural and levulinic acid have been formed as a result of the catalytic breakdown of starch.

  Flame retardants are also common additives used especially in the plastic industry. Two significant classes of flame retardants are organohalogen and organophosphorous compounds which are highly toxic and hazardous. Recent research has been conducted on a non-toxic flame retardant derived from tartaric acid, a by-product of the wine industry and can be used in the synthesis of bio-based environmentally friendly flame retardants for polymers. One can also look to bio-based nanofillers for improved flame retardant properties.

- Use of safer solvent and reaction conditions: Some important environmentally-friendly alternative solvents are – Monoterpenes (MTs) are a class of terpenes and have the molecular formula $C_{10}H_{16}$. MTs have several similarities with petroleum solvents based on available data for dielectric constants and densities and they resemble aromatic solvents such as toluene and xylene. Therefore, they have the potential to act as solvents for broad range of monomers and catalysts and have the ability to replace non-renewable solvents in some polymerization processes. MTs have been utilized for the production of hyperbranched polymers in a one-pot process that provides an economic alternative to multi-step dendrimer synthesis. The polymers produced using MTs show good physical properties compared to the network produced in the presence of toluene. However, in the presence of MTs, chain transfer reactions were observed which limit the formation of growing insoluble networks; which can be important in some processes.

  Ionic liquids (ILS) are organic salts composed ions in liquid form, close to room temperature. In the last decade, ILS have been considered the "green" media of the future and as shown potential as non-volatile organic solvents for polymerizations because of their near-zero vapour pressure, non-flammability and ease of production. ILS are relatively non-volatile therefore they do not produce VOCs. They show good thermal stability over a wide temperature range and can thus be utilized at higher temperatures (e.g.,800). Being both polar and non-coordinating solvents, ILS exhibit good solvent properties for a wide range of monomers in different chemical processes. In addition, they have the ability to interact through hydrogen bonding and dipolar and electrostatic interactions. Their highly ionic character improves the reaction rates in various reactions such as microwave-assisted organic synthesis and polymerizations.

  Supercritical fluids like supercritical CO_2 are a small class of solvents which have been employed in polymerization reactions. In general, using supercritical CO_2 can be beneficial because of the fact that it is in-expensive and non-toxic. However there are certain constrains for its use as a solvent in polymer synthesis. Contrary to its outstanding solvent properties for small molecules, it is a poor solvent for most high molecular weight polymers under mild conditions (i.e., <100°C and/or <350 bar).

Biodiesel is more commonly used as an alternative to petroleum diesel for use in combustion engines. It is a fatty acid alkyl ester (FAAE) produced via catalytic transesterification of vegetable oils, animal fats or grease with an alcohol. Biodiesel fulfills the requirements of a good polymerization solvents; it is environmentally benign and has low volatility, low viscosity and good solubility.

The effluent from the Textile Industry contains chemicals which are used during the various stages of processing. These effluents can be treated by UASB technology for energy generation. Also, the heat and energy generation can be achieved by treating waste water effluent using microbial fuel cells (MFCs).

- MFCs, use domestic sewage, industrial effluent, sediments and rhizodeposits as biodegradable substrates, offer a technology for electricity generation in addition to benefits to the environment. Organic matter can be used as renewable resources to generate electrons and protons via electrochemically by active bacteria in MFCs. The MFC has gained much attention because of its ability to generate power from organic and inorganic compounds via microorganisms. A century ago, the technology of generating electricity through bacteria was found but it did not gain much attention. They can convert chemical energy to electrical energy; MFCs can be used for electricity generation, bio-hydrogen production, wastewater treatment and biosensor.

  Microorganisms oxidise substrates to produce electrons and protons, in the anodic chamber, while producing carbon dioxide as an oxidation product. Electrons attached to anode (negative terminal) flow to the cathode (positive terminal) through an external circuit. The Proton migrates across the exchange membrane to combine with electrons producing water In MFCs, oxidation of organic carbon source does not increase the net amount of CO_2 in the atmosphere. There is a major advantage of MFCs over hydrogen fuel cells; however, the power production by MFCs is currently limited.

  The hazards cause by Global Warming is tremendous. Excessive use of fossil fuels such as coal, natural gas and oil play a part in it too. We must switch to alternative sources which include wind, solar, biomass, geothermal and hydro. As they do not produce any kind of pollution or toxic gases that can lead to global warming.
- It is essential to turn to renewable energy as it will help to avert medical hazards. This will ensure a stable climate for our future generations.
- Governments should advice and pass policies which encourage the energy companies and people, in general, to use renewable energy instead poof conventional energy. Non-government organisations (NGOs) should distribute pamphlets to people motivating them to use alternative sources of energy and discourage them from using fossil fuels.
- Many developed countries are already generating huge amounts of power using renewable energy as it is the most effective way to curtail the emission of gases which play a major role in global warming.
- It is well known that toxic emissions are a major cause of global warming. A likely solution to reduce harmful emissions is to limit the usage of vehicles such as the odd even formula which was in practice in Delhi and contributed significantly in harnessing air pollution.
- At present, India is relying over thermal power plants mainly coal-based for the generation of electricity which is hazardous to human being in many ways. Thus in near future it should be replace by Nuclear power plants which is more reliable source of power generation. Here are some outlines why Nuclear power plant is better energy source than coal thermal power plants –
- In nuclear power plant nuclear energy comes from the energy stored in the nucleus of an atom. This energy released through fission or fusion. The energy which is release can be used to generate electricity. On other hand fossil fuels mainly include coal, oil and natural gas. The predominant rule of fossil fuels is the generation of electricity but this source is limited.
- By splitting uranium atom nuclear energy can be generated. The nucleus of an atom comprises of protons and neutrons. When the nucleus splits, it releases energy in the form of heat. In the course, some neutrons are also released in the split. There may also occur a chain reaction when neutrons might split other nuclei, releasing more heat and neutrons. This chain reaction is called nuclear fission; whereas fossil fuels were formed from the organic remains of million years of old plants and animals. These remains were converted by heat and pressure in the earth's crust into carbon containing fuels.

Both nuclear and coal thermal power plants produce electricity in the same way. The heat generated in these plants used to generate steam. This steam drives a turbine which powers the generator that converts mechanical energy to electrical energy.

- Nuclear energy is more eco-friendly while generating electricity. Nuclear fission provides energy without releasing greenhouse gases such as CO_2. However, nuclear power plants generate radioactive waste but in comparison between the two combustion of coal releases CO_2 into the atmosphere which responsible for global warming and also emit pollutants such as SO_X , NO_X , toxic metals arsenic cadmium and mercury.
- The efficiency of nuclear power plant is much higher- a pellet of nuclear fuel weighs approximately 6 grams which yields the amount of energy equivalent to that generated by a ton of coal, 12 gallons of oil or 17,000 cubic feet of natural gas, making nuclear fuel much more efficient than fossil fuels.
- The most abundant source of nuclear energy on Earth is Uranium. The largest source of uranium is monazite sand and in India large concentration of monazite sand is found on the Kerala coast. One of the advantages of nuclear fuel over fossil fuel is that uranium can be reprocessed and used again. Fossil fuels, on the other hand are non-renewable.
- In modern times health issues occupy a large segment of societal framework in which the following activities are focused upon immunization of human or animal research activities, diagnosis and treatment[7]. This also results in production of wastes which has to be addressed.
  In Andhra Pradesh a large amount of such wastes as well as plastic wastes was mixed with coaltar and used in road surfacing due to which the waste was conveniently disposed off.

CONCLUSION

The ill effects of climate change have already begun to be felt. Toxic substances are released via burning from plastics, open combustion, incineration, posing a threat to the surrounding areas including vegetation and health of individuals. Proper development of policy with respect to chemical exposure caused by plastic must be set in place with encouraging research in this direction. A sustainable step like "Green Chemistry" should be included towards tomorrows cleaner and healthier environment is the need of the hour. This would help the masses to be aware of the severity of the problem and go for technologies which can pose less risk hazards on human health with reference to developing nations. Instead of combustion and incineration, pyrolysis can be another alternative method which is known to produce less toxic substances if conditions are appropriate with variable amounts of potentially useful by-products.

The emerging industries in the developing countries cause a threat to human and animal life. The role of Textile industry has become very significant. From knitting the clothes and fabrics used for human consumption to the extent of synthetic arteries and livers in medical textiles, the need of textile industry is highly unavoidable. Textile industry is also a highly influential industrial sector and contributes highly toward the growth and development of a country. In order to reduce the harmful impact of textile wastewater on the environment, the same must be treated by other sustainable techniques. One of such environmental-friendly possibility is to utilize the textile wastewater as a source of renewable energy and producing energy out of the effluents. MFCs use industrial effluent as biodegradable substrates to convert chemical energy to electrical energy.

Global warming is a very serious issue and suitable steps must be taken to tackle it. This problem is not only causing the trouble to the human beings but also to animals and plants. The melting of glaciers leads to floods which can wreck havoc everywhere. Rise of sea levels will devastate agricultural and fishing activities. To embark upon these problems, some remedial steps must be timely taken which include the replacement of Thermal power plants with more reliable and efficient energy generator, Nuclear power plants.

Chemistry has a big role to play improving our overall sustainability. Through scientific research and green chemistry, chemists can not only help to clean up the planet but also keep pollution from happening in the first place. Green chemistry technology must succeed in three areas: cost (must be cost-effective and affordable), safety (must be safe for the environment) and performance (must work well) in order to save our planet.

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