



Air Pollution – The Enemy of the Earth

¹PATEL HIRENKUMAR MOHANLAL

¹ASSISTANT TEACHER

¹SHRI N M MEHTA GIRLS PRIMARY SCHOOL NO.7, MAHUVA.

Abstract:-

There are many problems against human being in present. In this industrial age, some problems can't be eliminated completely. Air pollution is one of them. Air pollution is one of the most dangerous pollution than any other. No one can survive more than 2 minutes without air or breathing. There are many causes of air pollution. Nature and activities of humans are responsible for it. Air pollution has many worse effects on humans, animals, plants and other living beings. It creates major problems like smog, acid rain, global warming, reduce of ozone layer and many other diseases. We can't eliminate air pollution completely, but if we try by ourselves, society and government all together, we can reduce majority worse effect of air pollution on living beings on our planet.

Keywords:- Air Pollution, Air Pollutant

Introduction:-

The Supreme Court of India has declared, "Delhi has become worse than hell"^[1] on 25th Nov 2019. Supreme Court Justice Arun Mishra said that it is better to kill everyone with explosives.^[2] It is estimated that Air pollution kills about 25 million people every year through out in India which is the fifth largest killer in India. According to WHO report, India has the world's highest death rate from chronic respiratory diseases and asthma. In Delhi, the lungs of 2.2 million or 50 percent of all children damages irreversibly due to poor quality of air.^[3] This is not found only in Delhi or India, but it is the issue of all humans as well as all living organism on earth. Air pollution is the biggest enemy of the earth.

When air is perverted by unnecessary substances which have a harmful effect on both living and non living, it is considered as '**Air Pollution**'.^[4] Air pollution is referred to the atmosphere of chemical, particulates or biological waste which causes inconvenience, disease or death to humans, damages other living organisms like crops or ruins the natural environment or an obstacles to built environment. An adverse substance to humans and the environment is known as an '**Air Pollutant**'.^[5] An air pollutant is defined as the substance in the air that can have bad effects on humans and the whole ecosystem. Those substances may be solid particles, gases or liquid droplets. These pollutants are natural origin or manmade - classified as primary or secondary. Primary pollutants include processes such as ash from volcanic eruption. Carbon monoxide gas from motor vehicle exhausts or sulfur dioxide released from the factories are the other examples of primary pollutants. Secondary pollutants are not formed directly, in case the primary pollutants react or interact, they formed in the air. The prominent example of secondary pollutant is called the ground level ozone level. Some pollutants may be defined primary as well as secondary: they are both emitted directly and formed from other primary pollutants.^[6]

* Major Primary Pollutants

Major primary pollutants produced by human activity include:-

- 1. Carbon Dioxide (CO₂):**- Carbon dioxide has been considered as 'The Leading Pollutant'^[7] and 'The Worst Climate Pollutant'^[8] due to its contribution in greenhouse gas. CO₂ is the most necessary for plant's life which is exhaled by the human respiratory system.^[9] It has practical effects, for example as determining to regulate CO₂ emissions by the U.S. Clean Air Act is deemed.^[10] In compare to about 280 ppm(parts per million) in preindustrial times,^[11] CO₂ currently forms about 410 ppm of earth's atmosphere, by burning fossil fuels billions of metric tons of CO₂ are emitted annually.^[12] The level of CO₂ is excessively increasing day by day.^[13]
- 2. Sulfur Oxides (SO_x):**- Basically sulfur dioxides, a chemical compound with the formula SO₂. SO₂ is grown by volcanoes and through different industrial processes. Sulfur compounds often found in coal and petroleum, and their combustion creates sulfur dioxide. The reason for acid rain is the oxidation of SO₂, usually in the presence of catalyst such as NO₂ forms H₂SO₄.^[14] The use of these fuels as power sources causes the environmental impact.
- 3. Nitrogen Oxides (NO_x):**- From high temperature combustion, nitrogen dioxide expelled, thunderstorms by electric discharge also produced NO₂. They can be gazed as a brown haze dome above or a plume downwind of cities. Nitrogen is a chemical compound contains the formula NO₂ which is one of several nitrogen oxides. NO₂ is one of the for most air pollutants.^[5] This toxic gas has characteristics such as sharp biting odor and reddish brown color.^[6]
- 4. Carbon Monoxide (CO):**- CO is a product by incomplete combustion of fuel like wood, coal or natural gas. Characteristically - colorless, odorless non-irritating but toxic gas.^[15] The majority of carbon monoxide let into our atmosphere is contributed by vehicular exhaustion. It creates a smog type formation in the air which has been linked to many lung diseases and disturbance to the natural environment and animals.
- 5. Volatile Organic Compounds (VOCs):**- VOCs are an essential outdoor air pollutant. In this type they are often categorize of methane (CH₄) and non methane (NMVOCs). Methane forms a vital role to enhance global warming as it is an essential green house gas. Other hydrocarbon VOCs with their role in creating ozone and in prolonging the life of methane in the environment are also green house gases, although its various impact depends on local air quality. Within NMVOCs, the suspected carcinogens like benzene, toluene and xylene which are aromatic compounds may lead to leukemia through prolonged exposure. 1,3-Butadiene is often associated with industrial uses, which is another dangerous compound.
- 6. Particulate Matter / Particles (PM):**- Particulate Matter or Particles also known as atmospheric particulate matter, fine particles or PM, are micro particles of solid or liquid suspended in a gas. At the other hand, aerosol describes combined particles and gas. Originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray thus some particulate occur naturally. The burning of fossil fuels in vehicles, power plants and various industrial processes by humans also contributes significant amounts of aerosols. Recently 10 percent of our atmosphere is affected by averaged worldwide anthropogenic aerosols - those made by human activities. Health hazards such as heart disease,^[16] altered lung function and lung cancer are invited by the increased levels of solid particles in the air. Those who are already suffering from asthma or respiratory infections can have been harmful effects by particulates.^[17]
- 7. Persistent Free Radicals:**- related to airborne solid particles which are linked to cardiopulmonary disease.^{[18][19]}
- 8. Toxic Metals:**- like lead and mercury mainly their compounds.
- 9. Chlorofluorocarbons (CFCs):**- CFCs emitted products are recently banned to use as it is harmful to the ozone layer. It includes the gases from air conditioner, refrigerators, aerosol spray etc. When it

released to the aid, CFCs reaches to the Stratosphere where they confronted with other gases, result into the damage of ozone layer. This opens the door for harmful ultraviolet rays to reach on the surface of the earth. It can draw to skin cancer, eye disease and can damage to the plants also.

10. Ammonia:- Ammonia produced mainly by agricultural waste. It's a compound with the formula NH_3 . It is characterized with pungent odor. By serving as a precursor to food stuffs and fertilizers, Ammonia adds significantly to the nutritional needs of terrestrial organisms. Directly or indirectly for synthesis of many pharmaceuticals ammonia is a building block. Although in vast usage, ammonia is considered as caustic as well as hazardous. In the atmosphere, to form secondary particles, ammonia reacts with oxides of nitrogen and sulfur.^[20]

11. Odors:- Just like from sewage, garbage and industrial processes.

12. Radioactive Pollutants:- Mainly produced by nuclear explosions, nuclear events, war explosives and natural processes like the radioactive decay of radon.

* **Secondary Pollutant Include:-**

1. Particulates:- Particulates mainly created by gaseous basic pollutants and compounds in photochemical smog. Smog is one type of air pollution. Portmanteau of smoke and fog is called "Smog". From large amounts of coal combustion in an area caused by a mixture of smoke and sulfur dioxide results into classic smog. In modern time, smog doesn't usually come from coal instead it products from vehicular and industrial emissions which are effected on in the atmosphere by ultraviolet light from the sun to create secondary pollutants which also combine with the primary emissions to form photochemical smog.

2. Ground Level Ozone (O_3):- This formed from NO_x and VOCs. A key Constituent of the troposphere is Ozone. Ozone is also an essential Constituent of defined regions of the stratosphere generally know as the Ozone layer. Many of the chemical processes which occur in the atmosphere by day and by night are driven by photochemical and chemical reactions involving. Human activities (mainly the burning of fossil fuel) bought abnormally high concentrations; it is a pollutant and a constituent of smog.

3. Peroxyacetyl Nitrate ($\text{C}_2\text{H}_3\text{NO}_5$):- In a same way formed from NO_x and VOCs.

* **Minor Air Pollutant Include:-**

1. A very high number of minor harmful air pollutants. Few of these are regulated in USA under the clean air act and air frame work directive under Europe.

2. Organic compounds are a variety of persistent organic pollutants that can attach to particulates persistent organic pollutants (POPs) which are resistant to environment degradation by chemical, biological and photolytic processes. Due to this they have been noticed to persist in the environment, to be able of long-range transport, bio-accumulation in human and animal tissue, bio-magnify in food chains and to have potentially noticeable effects on human health and the environment.

* **Sources**

There are two types of sources responsible for the air pollution. One is human activity another one is natural activity.

* **Man made sources: -**

They are mostly done by burning various types of fuel.

- Smoke stacks of fossil fuel power stations, manufacturing facilities and waste incinerators as well as furnaces and other types of fuel burning devices are included in stationary sources. Traditional

biomass burning is the major source of air pollutants in developing and poor countries. Wood, crop waste and dung are included in traditional biomass.^{[21][22]}

- Motor vehicles, marine vessels and aircraft are included in mobile sources.
- In agriculture and forest management controlled burn practices. Prescribed or controlled burning is a kind of method sometimes used in forest management, farming, prairie restoration or abatement of green house gas. Both forest and grassland ecology, fire is a natural part and foresters use controlled fire as a tool. The germination of some desirable forest trees is stimulated by controlled burning, thus renewing the forest.
- Fumes from varnish, paint, aerosol sprays, hair spray and other solvents are considered to be substantial emissions. Los Angeles basin in the 2010s has estimated these sources to account for almost half of pollution from volatile organic compounds.
- Disposition of waste in landfills, generates methane. Methane is highly flammable and its mixtures with air may form explosive. Methane is also an asphyxiant and oxygen may have been displacing in an enclosed space. If the oxygen concentration is reduced to below 19.5% by displacement it may result into asphyxia or suffocation.
- Military weapons like nuclear bomb, toxic gases germ warfare and rocketry.
- A major source of nitrogen oxides may be fertilized farmland.

* Natural Sources:-

- Dust from natural sources, usually found in an area of low vegetation or no vegetation.
- The digestion of food by animals like cattle emits methane.
- Radon is formed from the decay of radium, which is colorless, odorless, naturally occurring radioactive gas. Radon gas from radioactive decay within the earth's crust. It is considered to be a health hazard. From natural sources radon gas can accumulate in buildings, especially in defined areas like the basement and after cigarette smoking it is the second most frequent cause of lung cancer.
- Wildlife causes smoke and carbon dioxide. Smoke from uncontrolled biomass combustion may cause almost 75% of all air pollution by concentration during the periods of active wildfires.^[25]
- In some regions, environmentally significant amounts of volatile organic compounds (VOCs) have been emitted by vegetation on warmer days. To produce a seasonal haze or secondary pollutants, these VOCs react with primary anthropogenic pollutants like NO_x, SO₂ and anthropogenic organic carbon compounds.^[26] There are some examples of vegetation from which a very huge amount of VOCs has been produced i.e. black gum, poplar, oak and willow. These species produce VOCs that is eight time higher than the low impact tree species.^[27]
- Volcanic activity produces sulfur, chlorine and ash particulates.

* Effects of Air Pollution

* Health Effects

According to WHO, air pollution is a significant risk factor for multiple health conditions which includes respiratory infections, heart disease and lung cancer. Every year, premature death of around 7 million people worldwide is caused by air pollution - estimated by WHO in 2014^[28]. Difficulty in breathing, wheezing coughing, asthma and aggravation of existing respiratory and cardiac conditions are the health effects caused by air pollution. These may become reason of increased medication use, increased doctor or emergency room visits more hospital admissions and premature death. The poor air quality is far reaching to the human health, but principally affects the body's respiratory system and the cardiovascular system.^[29] Particulates, ozone, nitrogen dioxide and sulfur dioxide are the most common sources of air pollution. Approximately 3.3 million deaths have been caused by indoor and outdoor air pollution. In terms of total deaths attributable to indoor and outdoor air pollution, Children aged less than five years that live in developing countries are the most vulnerable population.^[30] Due to air pollution, India has highest death rate.^[31]

* Environmental effects

Acid rain can be formed by poisonous air pollutants. Dangerous ground level ozone can also be formed by it. These destroy trees, crops, farms, animals and makes water bodies harmful to animals and humans that live and depend on water.^[5]

* Economic effects

According to the joint study by the world Bank and Institute for Health Metric and Evaluation (IHME) at the university of Washington, air pollution costs the world economy \$5 trillion per year as a result of productivity losses and degraded quality of life.^{[32][33][34]} Due to diseases caused by air pollution, these productivity losses are caused by death in 2013, it has been noticed that one out of ten deaths was caused by diseases related to air pollution and the problem is getting worse. The problem is even more panic in the developing countries. In lower income countries, children under age 5 are likely to die more than 60 times from the exposure to air pollution in compare with the children in high income countries.^{[32][33]} The report says that additional financial losses caused by air pollution including health costs^[35] more than this the adverse effect on agriculture and other productivity were not calculated in the report, and so the real costs to the world economy are far higher than \$5 trillion.

* Agricultural effects

In India, crop yields in the most affected areas by almost half in 2011 when compared to 1980 levels due to air pollution like black carbon and ground level ozone as per the report in 2014.^[36]

* Special effects (case study)

• Bhopal Disaster

Bhopal disaster in India in 1984 was the world's worst short term civilian pollution crisis.^[37] At least 3787 people killed and injured from 1,50,000 to 6,00,000 due to leaked industrial vapors from Union Carbide factory, belonging to Union Carbide, Inc., U.S.A. (later bought by Dow Chemical Company).

• Taj Mahal Shining

Taj Mahal, India's most famous tourist attraction which is located in Agra has become a matter of concern from the last 2 decades. Experts have discovered that due to pollutants in air the whiteness of its marble is discoloring. It is the result of the pollution of the industries located in and around Agra, mainly the Mathura oil refinery.^[4]

* Solution to Reduce Air Pollution

There is always a big problem to make effort in this field. That's why to control air pollution prevention interventions are always a better way. Either individually or by government, these prevention methods can apply. In many metropolitan cities, monitoring equipments have been established at many points. They are regularly monitories by authorities.

* Government or Community Level Prevention

1. By introducing green energy, governments throughout the world have already taken action against air pollution. To minimize burning of fossil fuels, which cause heavy air pollution, some governments are investing wind energy and solar energy, as well as other renewable energy.^[5]
2. Governments are preventing companies to be irresponsible for their manufacturing waste. So that even though they still responsible for the pollution, they have been controlled a lot.^[5]
3. Car companies are busy in producing more energy efficient cars with less pollution than before.^[5]

* Individual Level Prevention

1. Encourage your family to use public transport like bus, train etc when commuting. If we follow this, there will be fewer individual vehicles like cars and bike thus there will be less fumes.
2. Use various energy i.e. light, water, boiler, kettle and fire woods advisably. To generate electricity, lots of fossil fuels have been burnt and thus if we can cut down the use, the amount of pollution we create will automatically cut down.^[5]
3. Recycle and re-use things. We should always remember that manufacturing industries create a lot of pollution, so if we can re-use things like shopping bags, clothing, paper and bottles, it can help to minimize the dependence of producing new things.^[5]

* Control Devices

In industry and transportation, few items are commonly used as pollution control devices, they are as below. Before it is emitted into the atmosphere, they can either destroy contaminants or remove them from an exhaust stream.

1. **Mechanical Collectors** dust cyclones, multi cyclones.^[6]
2. **Electrostatic Precipitators** an electrostatic precipitator (EPs) or electrostatic air cleaner is a particulate collection device using the force of an induced electrostatic charge to remove particles from a flowing gas like air. Electrostatic precipitators are highly efficient filtration devices which can easily remove solid particulates like dust and smoke from the air stream, and minimally impede the flow of gases through the device.^[6]
3. **Bag Houses** To handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system and a dust receptacle or dust remove system (distinguished from air cleaners which utilize disposable filters to remove the dust), bag houses has been designed.^[6]
4. **Particulate Scrubbers** Wet scrubber has been considered a pollution control technology. A variety of devices to use pollutants from a furnace flue gas or from other gas streams is called web scrubbers. In web scrubber techniques, to remove the pollutants, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method.^[6]

* The Air Quality Health Index (AQHI)^[38]

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population	General Population
Low	'-1-3'	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.
Moderate	'-4-6'	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	'-7-10'	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion and should stay indoors.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

References:-

1. "“Delhi worse than hell”: Supreme Court rebukes Centre, states on air pollution". *Hindustan Times*. 25 November 2019. Retrieved 26 November 2019.
2. "“Better To Get Explosives, Kill Everyone”: Supreme Court On Delhi Pollution". *NDTV.com*. Retrieved 26 November 2019.
3. *Air pollution in Delhi – Wikipedia* https://en.wikipedia.org/wiki/Air_pollution_in_Delhi
4. *Science Textbook of std-8, chapter-18, (NCERT Textbook)*.
5. (PDF) Causes, Consequences and Control of Air Pollution https://www.researchgate.net/publication/279202084_Causes_Consequences_and_Control_of_Air_Pollution
6. *Air pollution – Wikipedia* https://en.wikipedia.org/wiki/Air_pollution
7. "Air Pollution Causes, Effects, and Solutions". *National Geographic*. 9 October 2016.
8. Vaidyanathan, *ClimateWire*, Gayathri. "The Worst Climate Pollution Is Carbon Dioxide". *Scientific American*.
9. Johnson, Keith (18 April 2009). "How Carbon Dioxide Became a 'Pollutant' ". *Wall Street Journal*.
10. Barbalace, Roberta C. (November 7, 2006). "CO₂ Pollution and Global Warming: When does carbon dioxide become a pollutant?". *Environmentalchemistry.com*
11. "Graphic: The relentless rise of carbon dioxide" . *Climate Change: Vital Signs of the Planet*. NASA.
12. "How much of U.S. carbon dioxide emissions are associated with electricity generation?". Retrieved 2016-12-16.
13. "Full Mauna Loa CO₂ record" . *Earth System Research Laboratory*. Retrieved 10 January 2017.
14. Daniel A. Vallero. "Fundamentals of Air Pollution". Elsevier Academic Press.
15. "Carbon Monoxide Poisoning – NHS". 17-10-2017.
16. "Evidence growing of air pollution's link to heart disease, death". Archived from the original on 2010-06-03. Retrieved 18-05-2010. // American Heart Association. May 10, 2010.
17. J.R. Balmes, J.M. Fine, D. Sheppard Symptomatic bronchoconstriction after short-term inhalation of sulfur dioxide *Am. Rev. Respir. Dis.*, 136 (1987), p. 1117
18. "Newly detected air pollutant mimics damaging effects of cigarette smoke" (PDF). *Physorg.com*. Retrieved 29-08-2010.
19. "Infant Inhalation Of Ultra-fine Air Pollution Linked To Adult Lung Disease". *Sciencedaily.com*. 23-07-2009. Retrieved 29-08-2010.
20. "The Effect of Changing Background Emissions on External Cost Estimates for Secondary Particulates". *Open environmental sciences*. 2008.
21. David Pennise; Kirk Smith. "Biomass Pollution Basics" (PDF). WHO.
22. "Indoor air pollution and household energy". WHO and UNEP. 2011.
23. "Wall Paint, Perfumes and Cleaning Agents Are Polluting Our Air". *Npr.org*. Retrieved 12 March 2019.
24. Diep, Francie (31 January 2018). "California's Farms Are an Even Larger Source of Air Pollution Than We Thought". *Pacific Standard*, Retrieved 2 February 2018.
25. "Education Data, Visualizations & Graphics on particulate pollution". www.cleanairresources.com. Retrieved 20-03-2019.
26. Goldstein, Allen H.; Charles D. Koven; Colette L. Heald; Inez Y. Fung (2009-05-05). "Biogenic carbon and anthropogenic pollutants combine to form a cooling haze over the southeastern United States". *Proceedings of the National Academy of Sciences*. 106(22): 8835–40. Bibcode:2009 PNAS..106.8835G. doi:10.1073/pnas.0904128106. PMC 2690056 . PMID 19451635.
27. Fischetti, Mark (2014). "Trees That Pollute". *Scientific American*. 310 (6): 14. Bibcode:2014SciAm.310f..14F. doi:10.1038/scientificamerican0614-14. PMID 25004561.
28. "7 million premature deaths annually linked to air pollution". WHO. 25 March 2014. Retrieved 25 March 2014.
29. Daniel A. Vallero. "Fundamentals of Air Pollution". Elsevier Academic Press.
30. "Air quality and health" . *Who.int*. Retrieved 26-11-2011.
31. *The New York Times International Weekly* 2nd February 2014 'Beijing's Air Would Be Called Good In Delhi' by Gardiner Harris.

32. World Bank; Institute for Health Metrics and Evaluation at University of Washington – Seattle (2016). *The Cost of Air Pollution: Strengthening the Economic Case for Action*(PDF). Washington, D.C.: The World Bank. xii.
33. McCauley, Lauren (8 September 2016). "Making Case for Clean Air, World Bank Says Pollution Cost Global Economy \$5 Trillion". *Common Dreams*. Retrieved 3 February 2018.
34. "The Rising Cost of Smog". *Fortune*: 15. 1 February 2018. ISSN 0015-8259.
35. Environment, U.N.(2018-10-11). "Air pollution linked to "huge" reduction in intelligence". *UN Environment*. Retrieved 01-07-2019.
36. India air pollution 'cutting crop yields by almost half' *The Guardian*, 3 November 2014.
37. Simi Chakrabarti. "20th anniversary of world's worst industrial disaster". Australian Broadcasting Corporation.
38. "Environment Canada – AQHI categories and explanations". *Ec.gc.ca*. 16-04-2008. Retrieved 11-11-2011.

