

Air Pollution: Cause, Effect, and its Control Measures in India

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Abstract—The development of science and technology leads to environmental problems in both developed and developing countries. Air pollution is one of these problems which are basically can be manmade or occur naturally. Further emission reductions from automobiles, and transportation measures and programs will be more difficult to accomplish, but the challenge has been presented. Pollution is injurious to health and its prevention places an economic burden on the citizen. Air pollution has been a menace in recent years posing serious threats to environmental and social wellbeing. This paper therefore proposed preventive measures and sustainable solutions such as vehicle inspection, enforcement of legislations, effective refuse collection and evacuation and steady supply of electricity to stop use of gasoline generators among others to ensure safe environment for the population to live. Data for the study was generated through secondary sources. The impact of air pollutants on human health has become a major issue in India. Therefore it is important to investigate the effects and the controlling measures of air pollution.

1. INTRODUCTION

Air pollution is an undesirable change in the physical, chemical or biological characteristics of air, which will adversely affect plants, animals, human beings and inanimate objects. The development of science and technology leads to environmental problems in both developed and developing countries. Air pollution is one of these environmental problems. Air pollution, both indoors and outdoors, is a major environmental health problem affecting both developed and developing countries alike. It comes from sources of dust, gases, and smoke and is generated mainly by human activities but also naturally. Greenhouse effect, Ozone layer depletion, and Acid rain are global effects of Air pollution. The particulate matter and noxious gases floating in the atmosphere can trap solar heat in a process known as the greenhouse effect. Ideally, the sun's rays should penetrate the atmosphere and the Earth's surface should reflect excess radiation back out of the atmosphere. However, air pollution bounces some of that excess heat back down to Earth and contributes to climate change. The Environmental Protection Agency reports on its website that if the current trend of rising

temperatures continues, it could lead to the melting of the polar icebergs, rising sea levels and flooding in coastal areas.

Air pollution's destruction of the ozone layer exacerbates the problem of the greenhouse effect and leads to its own complications. The ozone layer serves as a filter limiting the sun's ultraviolet, or UV, radiation entering the atmosphere. Chlorofluorocarbons, or CFCs, carbon dioxide and other ozone depletes react with the sun's radiation and break down to their component atoms, which then rob the ozone of oxygen atoms. Currently, the ozone layer's concentration decreases by about 2 percent each year, allowing more and more UV radiation to reach the Earth's surface. The increase in radiation can cause skin cancer, damage to the human immune system and eye damage. It also kills small aquatic organisms like plankton, affecting marine food chains and releasing additional carbon dioxide into the atmosphere when the life forms decompose **In India the impact of air pollutants on human health has become a major issue. Therefore, it is important to investigate the effect and the control measures of air pollution. *****

2. OBJECTIVES OF THE STUDY

The main objectives of this study is

- i. To strengthen the control measures to abate the Air Pollution,
- ii. To find out the sources and causes of air pollution and pollutants,
- iii. To investigate the impact of air pollution on human health.
- iv. To take necessary steps to control air pollution.

3. CAUSES AND SOURCES OF MAJOR POLLUTANTS GENERATED BY HUMAN ACTIVITIES AND ITS EFFECTS.

The two main forms of outdoor air pollution include particulate matter, sometimes called black carbon pollution, and noxious gases. Burning fossil fuels to power vehicles, homes, and industrial plants releases tiny particles of matter into the air, according to information from the Lawrence Berkeley National Laboratory.

3.1. Nitrogen Dioxides (NO₂)

Especially nitrogen dioxide are emerges from high temperature combustion. Nitrogen dioxide is the chemical compound with the formula NO₂. A reddish-brown irritating gas causes photochemical smog. In the atmosphere, it gets converted into nitric acid (HNO₃). ** Sources: It is caused by burning fossil fuels in industries and power plants.

Health effects include lung irritation and damage. Environmental effects involve acid deposition leading to damage of trees, lakes, soil, and ancient monuments. NO₂ can damage fabrics.

3.2. Photochemical Smog

Photochemical Smog is a brownish smoke that frequently forms on clear, sunny days over large cities with significant amounts of automobile traffic. **Sources: It is mainly due to chemical reactions among nitrogen oxides and hydrocarbons in the presence of sunlight.

Health effects: Health effects include breathing problems, cough, eye, nose and throat irritation, heart diseases, reduced resistance to colds and pneumonia. **Environmental effects involve damage to plants and trees. Additionally, Smog reduces visibility.

3.3. Carbon Monoxide (CO)

It is formed by incomplete combustion of fuel such as natural gas, coal or wood. A colorless, odorless gas is poisonous animals. Vehicular exhaust is a major source of carbon monoxide. Source of carbon monoxide is cigarette smoking and incomplete combustion of fossil fuels (more than 77% comes from motor vehicle exhaust). **Health effects: Health effects include reduced ability of red blood cells to carry oxygen to body cells and tissues. This leads to headache and anemia. At high levels, it causes coma, irreversible brain damage, and death.

3.4. Ozone

Ozone (O₃) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Chlorofluorocarbons (CFCs) harmful to the ozone layer emitted from products currently banned from use. **Human effects: Ozone is a highly reactive gas with an unpleasant odor occurring in the

stratosphere where it protects humankind from the harmful ultra-violet rays from the Sun. However on earth, it is a pollutant. Air pollution causes depletion of ozone layer due to which ultraviolet radiations can reach the earth and cause skin cancer, damage to eyes and immune system. **Source: It occurs on earth due to reaction between Volatile Organic Compounds (VOCs) and Nitrogen Oxides. Peroxy acetyl nitrate (PAN)–similarly formed from NO₂ and VOCs. **Environmental effects: It moderates the climate.

3.5. Radioactive Pollutants

Radioactive pollutants produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

3.6. Lead (Pb)

Lead is a solid and highly toxic metal. Its compounds are emitted into the atmosphere as particulate matter.

Sources: Paint, Smelters (metal refineries), lead manufacture, storage batteries, leaded petrol, etc

Health effects: Lead accumulates in the body and brain leading to nervous system damage and mental retardation (especially in children), digestive and other health problems. Lead containing chemicals are known to cause cancer in test animals. Lead pollution causes anemia, brain damage, convulsions and death. **Environmental Effects: It can harm wildlife.

3.7. Hydrocarbons

Lower hydrocarbons accumulate due to decay of vegetable matter.

Human effects: They are carcinogenic.

3.8. Chromium

It is a solid toxic metal emitted into the atmosphere as particulate matter.

Sources: Paint, Smelters, Chromium manufacture, Chromium plating.

Health Effects: Perforation of nasal septum, chrome holes, etc. 2. Air Pollution affects the central nervous system causing carbon monoxide poisoning.CO has more affinity for hemoglobin than oxygen and thus forms a stable compound carboxy hemoglobin (COHb), which is poisonous and causes suffocation and death.

3.9. Volatile Organic Compounds

VOCs are an important outdoor air pollutant. In this field, they are often divided into the separate categories of methane (CH₄) and non-methane (NMVOCs).

3.10. Particulates

Particulates, alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny

particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. **Human Effects: Persistent free radicals connected to airborne fine particles could cause cardiopulmonary disease.

3.11. Suspended Particulate Matter (SPM)

Includes a variety of particles and droplets (aerosols) that can be suspended in atmosphere for short to long periods.

Sources for SPM include burning coal in power and industrial units, burning diesel and other fuels in vehicles, agriculture, unpaved roads, construction, etc.

Health effects: It includes nose and throat irritation, lung damage, bronchitis, asthma, reproductive problems and cancer.

Environmental Effects include reduced visibility and acid deposition. Acid deposition may lead to damaged trees, soils and aquatic life in lakes.

4. HARMFUL EFFECTS OF AIR POLLUTION ON HEALTH

Numerous health problems are associated with air pollution. Number of people dying of asthma in India is more than elsewhere in the world. Indoor cooking fire is the third and outdoor air pollution is the fifth leading cause of death in India. **A study was conducted on non-smokers in India and Europe. It has been found out those lungs of a non-smoker Indian performs 30% less than a European because of pollution. Among hospitalized children in India, 13% deaths are caused by the acute respiratory infection. Because of high vehicular pollution, Delhi schoolchildren show poor lung function (reduced in 43.5% schoolchildren in Delhi) and attention-deficit hyper activity disorder (ADHD). Non-communicable diseases are increasing in India and accounts for 62% of the total disease. Apart from pollution, lifestyle and genetic also play their role. Cancer cases are increasing at an alarming rate in India. According to the estimates of the National Cancer Control Programme (NCCP) by 2026, there will be more than 1.4 million people suffering from cancer. One of the major reasons for this would be greater exposure to environmental carcinogens. i. Air pollution affects respiratory system causing breathing difficulties and diseases such as bronchitis asthma, lung cancer, tuberculosis, and pneumonia. ii. Air pollution causes depletion of ozone layer due to which ultraviolet radiations can reach the earth and cause skin cancer, damage to eyes and immune system. iii. It causes acid rain which damages crop plants, trees, buildings, monuments, statues and metal structures and also makes the soil acidic. iv. It causes greenhouse effect or global warming which leads to excessive heating of earth's atmosphere, further leading to weather variability and rise in sea level. The

increased temperature may cause melting of ice caps and glaciers, resulting in floods. v. Air pollution from certain metals, pesticides, and fungicides causes serious ailments. vi. Certain metals cause problem in kidney, liver, circulatory system, and nervous system. vii. Fungicides cause nerve damage and death. viii. Pesticides like DDT (Dichloro biphenyl tri chloromethane) which are toxic enter into our food chain and gets accumulated in the body causing kidney disorders and problems of brain and circulatory system.

5. PREVENTION AND CONTROL OF AIR POLLUTION

Different techniques are used for controlling air pollution caused by 'gaseous pollutants' and that caused by 'particulate pollutants'.

5.1. Methods of Controlling Gaseous Pollutants

The air pollution caused by gaseous pollutants like hydrocarbons, sulphur dioxide, ammonia, carbon monoxide, etc. can be controlled by using three different methods- Combustion, Absorption and Adsorption.

5.1.1. Combustion

This technique is applied when the pollutants are organic gases or vapors. The organic air pollutants are subjected to 'flame combustion or catalytic combustion' when they are converted to less harmful product carbon dioxide and a harmless product water.

5.1.2. Absorption

In this method, the polluted air containing gaseous pollutants is passed through a scrubber containing a suitable liquid absorbent. The liquid absorbs the harmful gaseous pollutants present in air.

5.1.3. Adsorption

In this method, the polluted air is passed through porous solid adsorbents kept in suitable containers. The gaseous pollutants are adsorbed at the surface of the porous solid and clean air passes through.

5.2. Methods of Controlling Particulate Emissions

The air pollution caused by particulate matter like dust, soot, ash, etc., can be controlled by using fabric filters, wet scrubbers, electrostatic precipitators and certain mechanical devices.

5.2.1. Mechanical Devices

It works on the basis of following:

Gravity: In this process, the particulate settle down by the action of gravitational force and get removed. Sudden change in the direction of air flow: It brings about separation of particles due to greater momentum. i. Fabric Filters: The particulate matter is passed through a porous medium made of

woven or filled fabrics. The particulate present in the polluted air are filtered and gets collected in the fabric filters, while the gases are discharged. The process of controlling air pollution by using fabric filters is called 'bag filtration'. ii. Wet Scrubbers: They are used to trap SO₂, NH₃ and metal fumes by passing the fumes through water. iii. Electrostatic Precipitators: When the polluted air containing particulate pollutants is passed through an electrostatic precipitator, it induces electric charge on the particles and then the aerosol particles get precipitated on the electrodes.

6. FINDINGS

The major findings of the study are:

- i. Proverb 'Prevention is better than cure' appropriately suits to this condition. Pollution must be prevented rather than letting it go and then dealing with it. India has been working hard to improve the air quality for the last 15 years. This has resulted in the drop of the major air pollutants during 1995-2008.
- ii. For regulating air pollution the Air (Prevention and Control Pollution) Act was passed in 1981.
- iii. The Supreme Court in India can work wonder in combating the problem of air pollution. It has taken many decisions in this regard and one of the most beneficial was the mandatory use of compressed natural gas in public service vehicles in Delhi in 1985. This had effectively changed the percentage of air pollution.
- iv. Many residential areas of Delhi, Lucknow, Mumbai, and Bhopal have shown the declining trends in the level of sulphur dioxide. Local measures like reduction of sulphur in diesel, introduction of clean fuel standard, and increasing use of LPGs instead of biomass as domestic fuel are some of the likely reasons for this decline.
- v. Introduction of metro in Delhi as public transport was one of the way to reduce pollution.
- vi. But India needs to put more efforts to control this frightening condition. Public awareness should be raised and stringent measures should be taken to regulate the vehicular emission. We must use public transport wherever possible, use energy-efficient appliances do not burn wood or coal, kitchen, and bathrooms should have exhaust fan to reduce indoor pollution.

7. MEASURES TO CONTROL AIR POLLUTION

Activated carbon is one of the most popular forms of air pollution control. This type of control involves the use of a pollution filter, carbon, to reduce the amount of pollutants that are allowed to escape into the air. When in use, these filters absorb pollutants helping to cleanse the air of any possible

toxins. **Bio filtration is another effective type of air pollution control. It uses microorganisms, often bacteria, and fungi, to dissolve pollutants. Industries that employ bio filtration systems include food and waste plants, pharmaceutical companies, and wastewater management facilities. While this method of air pollution control works rather well, a large space is required in order to operate a bio filtration system. Many industries do not have this amount of available space, so this method is often disregarded. **Change in Fuel: This technique involves the use of less polluting fuel to reduce air pollution. Use of low sulfur fuel instead of high sulfur fuel by electric utilities is an example of this method. Remember that low sulfur fuel is much more expensive than high sulfur fuel.

The other choice for an electric utility can be the use of natural gas as a fuel. Fuel switching based on meteorological conditions or air pollution forecasts have been used to prevent air pollution problem in many areas. **Use of oil with low ash content or natural gas for a dryer at an asphalt plant to reduce particulate matter is another example of this method. Introduction of compressed natural gas, propane, ethanol and oxygenated fuels for automobiles have helped in the reduction of air pollutants

Nuclear power plants are relatively pollution free when compared to the coal fired power plants. However, they have been subjects of controversy in their overall environmental impact.

Improve Dispersion: This approach is based on the concept that dilution of air contaminants before they reach ground will lower the concentrations to which the population is exposed. The US EPA discourages the use of this approach for industry.

The emissions from the plant are passed through a control device before releasing to atmosphere. The pollutants are removed, destroyed or transformed in the control device before discharging into ambient air. **This is one of the most commonly used methods, especially for controlling emissions from small sources. It can be physical adsorption or chemisorption. The later is rarely used for the VOC emission control because, it involves a less-reversible chemical bonding of the adsorbate (pollutant) and the adsorbing solid (packing) and is relatively expensive. Physical adsorption uses the Van der Waals force, giving the advantage of reversibility and regeneration due to the weaker bonding of the gas and adsorbent material. The adsorbed material can be either recovered or incinerated. Regeneration is usually accomplished by heating or extraction/displacement. Activated carbon is a commonly used adsorbent.

8. SUGGESTION FOR PREVENTION

In this industrial age, air pollution cannot be eliminated, but steps can be taken to reduce it. The government has developed, and continues to develop, guidelines for air quality and ordinances to restrict emissions in an effort to control air

pollution. On an individual level, you can reduce your contribution to the pollution problem by carpooling or using public transportation. **The atmosphere has several built-in self-cleaning processes such as dispersion, gravitational settling, flocculation, absorption, rain-washout, etc. to cleanse the atmosphere. However, control of contaminants at their source level is a desirable and effective method through preventive or control technologies. Some measures that can be adopted in this direction are:

1. Emission rates should be restricted to permissible levels by each and every industry
2. Incorporation of air pollution control equipment in design of plant layout must be made mandatory
3. Continuous monitoring of the atmosphere for pollutants should be carried out to know the emission levels.
4. Using unleaded petrol.
5. Using fuels with low sulphur and ash content.
6. Encouraging people to use public transport walk or use a cycle as opposed to private vehicles.
7. Ensure that houses, schools, restaurants, and playgrounds are not located on busy streets
8. Plant trees along busy streets as they remove particulates, carbon dioxide and absorb noise
9. Industries and waste disposal sites should be situated outside the city preferably on the downwind of the city.
10. Catalytic converters should be used to help control emissions of carbon monoxide and hydrocarbons
11. Tall chimneys should be installed in factories.
12. Better-designed equipment and smokeless fuels should be used in homes and industries.
13. Renewable and non-polluting sources of energy like solar energy, wind energy, etc., should be used.
14. Automobiles should be properly maintained and adhere to emission control standards.
15. More trees should be planted along roadsides and houses.

9. CONCLUSION

From this, it is clear that we have numerous ways of controlling air pollution. The only thing requires is to use it in appropriate form. This paper represents the different technologies that are employed in various industries and the use of different fuels that are immanent for the solution of air pollution. Air pollution involves spate of pollutants, which creates a lot of chronic and acute diseases in human being so we have to put the foreign particles within the constraint of standard limit. Therefore, we have come under a conclusion that the best technologies given for controlling air pollutants are given in the above article.

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