

ENVIRONMENTAL EFFECTS OF AIR POLLUTION AND APPLICATION OF ENGINEERED METHODS TO COMBAT THE PROBLEM

AHMAD ASHFAQ AND PRATIKSHA SHARMA**

* Assistant Professor, Faculty of Engineering & Technology, AMU, Aligarh, India

**Department of Chemistry, Faculty of Sciences, AMU, Aligarh, India

Key words : Particulate Matter, Ecosystem, Global Warming, Smog, Industrialization.

(Received 1 November, 2012; accepted 25 December, 2012)

ABSTRACT

Air pollution can have serious costs, penalties and consequences for the health of human beings and also ruthlessly distresses the natural bio-network and ecosystems. The main consequences of air pollution are global warming, acid rain, smog, ozone depletion etc. India ranks 13th most polluted country with an annual mean of 109 $\mu\text{g}/\text{m}^3$ of PM_{10} . China contributes 21.5% of the total CO_2 emission followed by U.S. (20.2%), Russia (5.5%) and India (5.3%). On a larger scale, government is taking measures to limit emissions of carbon dioxide and other greenhouse gases to protect the quality of environment. According to W.H.O. report air pollution cause about 2 million premature deaths worldwide per year. The Clean Air Act is a superb representation of the government's role in air pollution prevention. It aids to influence and enforce laws that attempt to eliminate or dilute the causes of air pollution. This paper deals with the causes, effects, present status and the remedial measures to counter the existing problem of air pollution, so as to create quality atmosphere in existence.

INTRODUCTION

Environmental litigation has increased over the last several decades. Vehicular emissions, rapid industrialization and urbanization are the main sources of air pollution. A compelling reason for controlling air pollutants, such as suspended particulate matter (SPM), respirable particulate matter (RPM) and sulphur dioxide (SO_2) is their damaging effect on human health. Of all air pollution constituents, the WHO has identified SPM as the most sinister in terms of its effect on health (Kjellstrom ; Singh *et al.* 2009). India stands third (after china and US) among the countries

with highest CO_2 emissions, with annual CO_2 emission estimate of 2,069,738 (in thousands of CO_2 metric tons). The percentage global total is 5.7 % (CEPA, USA.....). As the World Health Organization (WHO) points out, outdoor air pollution contributes as much as 0.6 to 1.4 percent of the burden of disease in developing regions, and other pollution, such as lead in water, air, and soil, may contribute 0.9 percent (WHO, 2002). Central Pollution Control Board is executing a nation-wide program of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP), covering one hundred and twenty one (121) cities/towns in twenty five (25) states

* **Corresponding Author:** 4/1287, AL-HAMD, SIR SYED NAGAR, ALIGARH, 202002, U.P.

Email : ahmad_ashfaq76@yahoo.com

and four (4) Union Territories of the country. Under this program, three criteria air pollutants (SPM, SO₂ and NO₂) have been identified for regular monitoring at 290 stations spread across the country. Values are different depending on the area whether industrial or

residential or areas with high traffic density like traffic intersection (CDIAC: Record High 2010). This paper deals with the causes, effects, present status and the remedial measures to counter the existing problem of air pollution, so as to create quality atmosphere

Table 1. Harmful effects of the pollutants in air

| S.No | Pollutant | Source/Cause | Effect |
|------|---|--|---|
| 1. | Carbon monoxide | Automobile exhaust, photochemical reactions in the atmosphere, biological oxidation by marine organisms, etc. | Affects the respiratory activity as haemoglobin has more affinity for Co than for oxygen. Thus, CO combines with HB and thus reduces the oxygen-carrying capacity of blood. This results in blurred vision, headache, unconsciousness & death due to asphyxiation (lack of oxygen). |
| 2. | Carbon dioxide | Carbon Burning of fossil fuels, depletion of forests (that remove excess carbon dioxide and help in maintaining the oxygen-carbon dioxide ratio). | Global warming as it is one of the greenhouse gases. |
| 3. | Sulphur dioxide | Industries, burning of fossil fuels, forest fires, electric generation plants, smelting plants, industrial boilers, petroleum refineries and volcanic eruptions. | Respiratory problems, severe headache, reduced productivity of plants, yellowing and reduced storage time for paper, yellowing and damage to limestone and marble, damage to leather, increased rate of corrosion of iron, steel, zinc and aluminium. |
| 4. | Hydrocarbons Polynuclear Aromatic Compounds (PAC) & Polynuclear Aromatic Hydrocarbons(PAH) | Automobile exhaust and industries, leaking fuel tanks, leaching from toxic waste dumping sites and coal tar lining of some water supply pipes. | Carcinogenic (may cause leukemia) |
| 5. | Chlorofluoro carbons (CFCs) | Refrigerators, air conditioners, foam shaving cream, spray cans and cleaning solvents. | Destroy ozone layer which then permits harmful UV rays to enter the atmosphere. |
| 6. | Nitrogen Oxides | Automobile exhausts, burning of fossil fuels, forest fires, electric generation plants, smelting plants, industrial boilers, petroleum refineries and volcanic eruptions | Forms photochemical smog, at higher concentrations causes leaf damage or affects the photosynthetic activities of plants and causes respiratory problems in mammals. |
| 7. | PAN - peroxyacetyl -nitrate | Photochemical reactions of hydrocarbons and nitrogen oxides. | Irritation of eye, throat and respiratory tract, damage to clothes, paint and rubber articles, damage to leaves and stomatal tissue in plants. |
| 8. | Particulate matter Lead halides (lead pollution) | Combustion of leaded gasoline products | Toxic effect in man. |
| 9. | Asbestos particles | Mining activities | Asbestosis - a cancerous disease of the lungs |
| 10. | Silicon dioxide | Stone cutting, pottery, glass manufacturing and cement industries. | Silicosis, a cancerous disease. |
| 11. | Biological matter like the pollen grains | Flowers | Allergy |
| 12. | Fungal spores, bacteria, virus, etc | Microbes | Infectious diseases |

Source: (www.tutorvista.com/environment-and-environmental-problems/air-pollution.php).

in existence. The various categories of air pollutants and their harmful effects are summarized in the given Table.

Environmental impacts

- **Global warming:** According to estimates, at the current rate of increase, the average global temperature will go up by 3°C to 8°C in the next 100 years. This will affect the climate of different regions, distribution of plants and animals, disturbance in agriculture and food production, melting of snow caps and resultant increase in sea levels. This will submerge parts of coastal cities of Calcutta, New York, London and other major cities.

- **Formation of photochemical smog:** When pollutants like hydrocarbons and nitrogen oxides combine in the presence of sunlight, smog is formed. This is a mixture of gases and since it is formed by photochemical reactions, it is called the photochemical smog. The word 'smog' is derived from the two words-smoke and fog. It forms a yellowish brown haze especially during winter and hampers visibility. It also causes many respiratory disorders and allergies as it contains polluting gases.

- **Formation of acid rain:** Sulphur dioxide and nitrogen oxides react with water in the atmosphere producing sulphuric acid and nitric acid. These acids come down along with the rain. This phenomenon is

called acid rain. The pH of acid rain varies from 3-6. The composition of acid rain is sulphuric acid, nitric acid and weak carbonic acid. Its adverse affects on the environment include: causes respiratory and skin disorders, affects productivity of plants by damaging the leaves, enters the soil and affects the soil, ph and causes leaching, enters the ground and river waters which causes harm to the aquatic life, causes damage to marble and thus damages buildings and monuments (like Taj Mahal).

- **Aerosol formation:** Aerosol is formed by the dispersion of solid or liquid matter in the atmosphere. If the aerosols form a thick layer in the troposphere, they affect the weather conditions by blocking the solar radiation. Aerosols are also deposited on the leaves and affect the photosynthesis. Aerosols disperse the organic metallic pollutants far and wide.

- **Depletion of Ozone:** The stratosphere of the atmosphere has ozone (O₃). Ozone is known to absorb the Ultraviolet (UV) rays present in the sun's radiation and protects us from the harmful effects of the UV rays. However, hydrocarbons such as the chlorofluorocarbons (CFCs) destroy the ozone molecules which deplete the ozone layer. Ozone holes have been detected in the atmosphere which permits the UV rays to reach the earth's surface. The harmful effects of the UV rays are visible in the countries such as Australia and New Zealand where the rate of skin cancer is

Table 2. Control Methods for Air Pollution

| Pollutant | Prevention and Control |
|--|---|
| 1. Ozone (O ₃) | Reduce motor vehicle, reactive organic gas (ROG) and nitrogen oxide emissions through emissions standards, reformulated fuels, inspection programs and reduced vehicle use, Limit ROG emissions from commercial operations and consumer products and from industrial sources such as power plants and refineries. |
| 2. Respirable Particulate Matter (PM ₁₀) | Control Dust Sources, Industrial Particulate Emissions, Wood Burning Stoves and Fireplaces, Reduce secondary pollutants which react to form PM10. |
| 3. Fine Particulate Matter (PM _{2.5}) | Reduces Combustion Emissions from Motor Vehicles, Industries, Agriculture and Residential Burning. Precursor controls, like those for ozone, reduce fine particle formation in the atmosphere. |
| 4. Carbon Monoxide (CO) | Control motor vehicle and industrial emissions. Use oxygenated gasoline during winter months. |
| 5. Nitrogen Dioxide (NO ₂) | Controls motor vehicle and industrial combustion emissions. |
| 6. Lead | Control metal smelters, unleaded gasoline. Replace leaded paint with non-lead substitutes. |
| 7. Sulfur Dioxide (SO ₂) | Reduces the use of high sulfur fuels (e.g., use low sulfur reformulated diesel or natural gas). |
| 8. Hydrogen Sulfide | Control emissions from geothermal power plants, petroleum production and refining, sewers, sewage treatment plants. |

Source: (Vehicular Pollution Control in Delhi, India)

higher than the other regions of the world (www.tutorvista.com).

CONCLUSIONS

Technologies to reduce air pollution at the source are well established and should be used in all new industrial development. Retrofitting of existing industries and power plants is also worthwhile. Various emission standards have been set for automobiles (Bharat stages-2, 3 and 4). On global scale, the UNCED, Earth Summit (1992) established principles for reducing GHG emission. The Kyoto Protocol (1997) aimed at achieving GHG emissions below 5% till 2012, followed by Copenhagen summit, 2009 & recent in 2011 at Durban to keep the process in run. The principles and practices of sustainable development, coupled with local research, will help contain or eliminate health risks resulting from air pollution. International collaboration involving both governmental and nongovernmental organizations or can guide this highly interdisciplinary and intersectional area of pollution control.

REFERENCES

- California Environmental Protection Agency, Air resources board, ARB factsheet: air pollution sources, effects and control.
- CDIAC: Record High 2010. Global Carbon Dioxide Emissions from Fossil-Fuel Combustion and Cement Manufacture Posted on CDIAC Site.
- Central Pollution Control Board, Ministry of Environment and Forests: New Delhi, India. <http://www.cpcb.nic.in/Air/Air.html>.
- Kjellstrom, T., Lodh, M., McMichael, T., Ranmuthugala, G., Shrestha, R. and Kingsland, S. Chapter 43, Air and Water Pollution: Burden and Strategies for Control.
- Singh, A., Gupta, V. and Sasm S. 2009. Air Pollution: Indian Scenario", The Pacific Journal of Science and Technology, <http://www.akamaiuniversity.us/PJST.htm> Volume 10. No 2. November.
- Vehicular Pollution Control in Delhi, India - Are The Efforts Enough?" <http://www.beijer.kva.se/publications/pdf-archive/Disc144.pdf>.
- www.tutorvista.com/environment-and-environmental-problems/air-pollution.php.