

# Impacts of Air Pollution on Human Health, Plant and Vegetation

Achal Garg<sup>1</sup>, Harinder Yadav<sup>2</sup>

<sup>1</sup>Structural Engineer, Keppel Offshore and Marine Engineering, Mumbai, India

<sup>2</sup>Department of Civil Engineering, University of Petroleum of Energy Studies, Dehradun, India

**Abstract**— *The subject has long been a matter of concern since the industrialization of the country brought in its pollution hazards. The present exposure to the environmental chemicals is more likely to produce toxicity that adult exposure. Subtle functional deviations in the off-springs of exposed mothers may be one of the most sensitive indications of potential harm from environmental chemicals. The air pollutants contaminate air, water and soil, corrode materials, dirty buildings and clothing, harm plants and wild life and affect human health. To determine that an environmental change is going to be unfavorable requires a careful study of ecological system, known as the ecosystem. In an ecosystem the living organisms are inter-related and well-adjusted to their environment, comprising biotic components of plants, animals and microbes. The correlation between growth transitions of green plants, which grow outdoors and are continuously exposed to pollutants, and pollutant concentrations have helped decipher pollution zones. These zones extend in the direction of the prevailing wind, assuming an elliptical shape; the axis of the ellipse being oriented from south-west to north-east direction with the pollution source at the south-west end. In such instances the north-east extension of the ellipse penetrates deep into the natural and rural habitats.*

**Keywords**— *Air pollution, chemicals, environment, industrialization.*

## I. INTRODUCTION

Air pollution is a product of the activities of man. As man started manufacturing chemicals and metals, generating electrical power, developing faster means of transportation, crowding in overpopulated cities, problem of air pollution become inevitable. The air environment began to lose its earlier purity due to the concentration of smoke and other pollutants. The air near the ground is heated by solar radiation and rises up. While rising, it cools off until it reaches a point where its temperature is similar to that of the air directly above it. The air with its load of pollutants can go no higher than this may lead to temperature inversion. The air pollutants emitted from a

factory i.e. a point source of pollution or from a city complex i.e. an area source of pollution, get dispersed, distributed and pattern diluted in the air mass of adjoining areas. The fall out and ambient and ground level concentrations of pollutants are usually determined by direction and speed of the prevailing wind and vertical and horizontal thermal profiles of the area. Field studies reveal that pollutants generated at urban-industrial locations may traverse 50-100 km distances or more from the point of origin, and these may spread out in a much larger area, sometimes covering vast tracts and at times trespassing all geographical boundaries, be it local, national or international. So, the air pollutants do not remain confined or limited in the vicinity of industrial establishments or emission sources, but depending on the topography and meteorology of the area, these may spread into far off places of the natural landscape, affecting growth development and productivity of plants and animals present there.

## II. IMPACTS OF AIR POLLUTION ON HUMAN HEALTH

There is an association between sulphur oxide/particulate air pollution and deaths, in air pollution episodes. The photochemical oxidants are highly toxic and at low concentrations, a respiratory tract irritant. Deaths exclusively due to photochemical oxidants are not yet recorded. No single pollutant however could be considered responsible for the excess of deaths. Investigators in various countries have reported association between residence in heavily polluted areas and deaths from all causes combined and from bronchitis and other respiratory causes. The chronic obstructive lung diseases like chronic bronchitis, emphysema, etc. are reported to be caused by air pollution exposure. Many studies of chronic lung disease and air pollution conducted through the world have indicated a relationship between the prevalence of chronic respiratory systems and the sulphur oxides particulates complex. Chronic lung disease appears to develop in response to cumulative results that smoking intensity, recurrent lung diseases in childhood and exposure to dusts. Studies have shown that

most of the excess deaths and illnesses occurred in persons who had chronic lung illness before the air pollution episode. Frequently low temperatures exerts a greater effect than does air pollution and the similar temporal pattern of air pollution and cold temperature in the past may have accounted for some of the observed air pollution or disease aggravation relationships.

Asthmatic patients are particularly susceptible to short term peak concentrations of air pollutants. Increased rates of asthma attacks were noted during episodes of sulphur oxide or particulate and photochemical oxidant air pollution. It was found that although asthma frequency was directly related to the lower temperature gradient, air pollution concentrations still exerted a significant effect. The asthmatic person appears to represent an extreme on the scale of respiratory sensitivity to external stimuli. Increased concentrations of air pollution are one of many factors that may represent attacks in some persons with asthma. Of the known environmental risk factors that contribute to heart diseases, smoking, diet, lack of exercise, high blood pressure, and increased lipid concentrations have received the most attention. Higher rates of case fatality among patients admitted to hospitals for myocardial infarction have been observed during periods of relatively increased carbon monoxide pollution. There are other reports which suggest relationships between exposure to ozone and damage to myocardial fibers, between exposure to sulphur dioxide and cardiovascular deaths. Cadmium in large concentration in the air is also suspected to increase death rates from heart disease. Some of the air pollutants cause irritation of the mucous membrane of the eyes. These effects are temporary, acute and short term in nature. The person recovers as soon as he comes out of the polluted zone. The odour of some air borne substances and the irritation to the eyes, nose and throat caused by other pollutants are the most common and annoying aspects of air pollution for many persons. Perception of these effects is very real, but it is difficult to quantify their perception in populations. At concentrations more than 30 PPM, H<sub>2</sub>S may impair the sense of smell and produce unconsciousness and death. Ammonia is a strong respiratory irritant. Ozone causes a burning, can alter human performance as well as cardiac function. Inhalation of significant amounts of air borne lead can cause neurologic disturbance and even adverse effects on the nervous system.

### III. POLLUTION INDUCED HABITAT CHANGES

The changes in physical and chemical properties of soil and plant can be attributed mainly to the acidity caused by

SO<sub>2</sub>. It can be argued that SO<sub>2</sub> fallout and acid precipitation may affect the plant system, directly through the leaf surface and indirectly through acidity and mineral imbalance of the soil. Under acidic conditions, the activity of soil microbes and processes of litter decomposition and mineral recycling can get awfully disturbed. The acidity causes chemical weathering of rocks in the area. It has been seen that H<sub>2</sub>SO<sub>4</sub> reacts with rock material to form sulphates which in turn are gradually washed away, leaving the uneven surfaces exposed to further erosion. The habitat transformation consequent to SO<sub>2</sub> pollution includes a series of changes. To start with, the trees are injured followed by shrubs and herbs. Gradually some of the plant species, especially the sensitive one, are unable to regenerate in the area and get eliminated from the landscape. Once the SO<sub>2</sub> sink provided by the vegetation cover is substantially reduced, there is rapid increase in soil acidity which leads to cation-anion imbalance and microbial population reduction. These changes accelerate the processes of erosion making the soil infertile and hopelessly unsuitable for regeneration and growth plants. While considering the pathways of fluoride in the environment and its long-term biological implication, one must realize that the ambient fluoride gradually settles on and accumulates in water, soil and living systems. The fluoride accumulated into the plant body enters into the food-chain through the herbivorous animals and its subsequent transfer from one animal to another continues along the prevailing food-web pattern. Fluoride is a cumulative pollutant whose concentration in the ecosystem increases with time and once introduced into the system its cycle continues in an un-ending manner. These simple but far reaching changes clearly show how the fallout of pollutants from urban-industrial areas can transform and despoil distant natural habitats.

### IV. POLLUTANT UPTAKE AND PLANT RESPONSE

In terrestrial of plants, the enormous surface area of expanded levels acts as a natural sink for pollutants especially the gaseous ones. A gaseous pollutant upon entering the leaves through the open stomata comes in contact with the large surface area of moist, spongy cells, which are oxygen rich during the day time. In such a condition, the pollutant may injure the cell and eventually get changed to a less toxic state. For detection, quantification and interpretation of plant responses, symptoms of injury, such as chlorosis and necrosis, changes in growth-habitat, reductions in quality and yield, biomass accumulation and energy content of plants, changes in transpiration, photosynthesis and respiration

rates, reduction in chlorophyll, amino acids, ascorbic acid, etc., are determined and correlated with pollutant to concentration and dose. Plant responses usually increase with the increase in ambient concentration of pollutant. In case of SO<sub>2</sub>, it has been observed that at higher concentrations the rate of pollutant uptake is much more than the rate of pollutant detoxification by the plant. At lower concentrations, less pollutant is absorbed per unit time which helps oxidation of the pollutant to innocuous levels with no apparent injury to the plant. In case of the HF, the most severe injury and the highest fluoride accumulation occurs at the highest pollutant levels. The fluoride concentration in plant body may be gradually decreased during pollution free or recovery periods due to dilution of the pollutant. The rate of pollutant varies from species to species, stage of plant development and ecological conditions, such as solar radiation, temperature and humidity. For low levels of ground temperature, wind velocity and precipitation, high level of humidity and basin topography the pollution potential is greater than those for high levels of ground temperature, wind velocity and precipitation and low levels of relative humidity and flat topography. Besides ecological conditions, plant responses to pollutants may also depend upon its internal conditions. Plants on the basis of their responses to pollutants under field and laboratory conditions have been classified into sensitive and tolerant species. The degree of sensitivity of a plant depends on its developmental stage, nutritional status and other ecological factors.

The living organisms can serve as excellent quantitative as well as qualitative indices of the pollution of the environment. Plants and animals are continually exposed and can act as long-term monitors. They can show the pathway and points of accumulation of pollutants in ecological systems. Their use can remove the extremely difficult task of relating physical and chemical measurements to biological effects. In connection with bio-monitoring, one should remember that plants are more sensitive to air pollutants than animals, including man. Many plants can act as early warning sentinels for particular pollutants. The exposure of plants to pollutants may continue for a short or long duration, depending on the air and objectives of the experiment. The exposed plants are then analysed with respect to changes in some of the reliable morphological, physiological and biochemical parameters.

## V. CONCLUSION

It is obvious that there are short-term and long-term ecological implications of fallout and drift of pollutants from urban-industrial complexes to natural habitats. The pollutants may gradually affect and alter the structure and

function of an ecosystem by altering its biotic and abiotic components. Such changes in course of time affect transformation of a healthy and fully productive habitat into an unhealthy and less productive one. Therefore, there is need for a constant monitoring of pollution load in an ecosystem. Since plants constitute a living system, it is imperative to have a proper understanding of all the ecological factors influencing the ambient pollution potential and pollution absorption pattern of plants. As a note of caution it may be added that for understanding the total impact of pollution on ecological systems, the effect of not only one specific pollutant but the action and interaction of all different pollutants should be considered. Furthermore, the total effect of a large number of minor pollutants may be as great as that of one major pollutant. Thus, the total pollution burden may be impossible to estimate except by direct observation of its overall effect on ecosystem.

## REFERENCES

- [1] Amitai Y, Zlotogorski Z, Golan-Katzav V, Wexler A, Gross D. Neuropsychological impairment from acute low-level exposure to carbon monoxide. *Arch Neurol*, 55, 845-848, 1998.
- [2] Badami MG. Transport and urban air pollution in India. *Environ Manage*, 36, 195-204, 2005.
- [3] Banik S, Lahiri T. Decrease in brain serotonin level and short term memory loss in mice: a preliminary study. *Environ Toxicol Pharmacol*, 19, 367-370, 2005.
- [4] Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry*, 4, 561-571, 1961.
- [5] Behera D, Sood P, Singh S. Passive smoking, domestic fuels and lung function in north Indian children. *Indian J Chest Dis. Allied Science*, 40, 89-98, 1998.
- [6] Bendahmane DB. Air pollution and child health: Priorities for action. Environmental Health Project, Activity Report no. 38. Washington DC: US AID. 1997.
- [7] Churg A, Brauer M, Avila-Casado MC, Fortoul TI, Wright JL. Chronic Exposure to High Levels of Particulate Air Pollution and Small Airway Remodelling. *Environmental Health Perspective*. 111, 714-718. 2003.