



The Effect of Cement Dust on Vegetation

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ABSTRACT

This study was undertaken to study the effects of cement dust in vegetation in *Azadirachta indica* and *Mangifera indica*. The different amounts of cement dust mixed with soil on the seed germination, plant growth, leaf area. The reason for this was that cement dust generated as a by-product from the cement factories is rich in potassium. Cement dust is a potentially phyto-toxic pollutant. Large amounts of toxic substances are emitted during its production viz. carbon dioxide, particulate matter (dust), oxides of nitrogen and sulfur dioxide. Cement dust also contains heavy metals like nickel, cobalt, lead, chromium and mercury. Its alkaline constituents such as oxides of calcium, potassium and sodium are responsible for the alkalization of ecosystem and soil. It is a common air pollutant affecting tree leaf in various ways i.e. cement dust deposition on leaves plugs stomatal activity and interrupts light absorption and gaseous diffusion. The cover formed by deposition of dust particles decrease the pigmentation of plant leaves. The physical and chemical properties of plant tissues can change by such large dust pollution. The behavior of plant body cells depends upon the chemical properties of dust particles. The cement dust artificially sprayed on the plant surface with different levels. All the morphological and biochemical were analyzed. Morphological parameters Root length, Shoot Length, and dry weight were inhibited in high dose of cement deposition when compare control plant.

Keywords: cement dust deposition, vegetation, seed, photosynthesis

INTRODUCTION

Research on the effects of cement dust pollution on plant communities has never received the same level of attention as that given to phytotoxic pollutants such as SO₂, NO₂ and O₃. Results from research that has been undertaken, together with repeated observations of dust deposits on vegetation, suggest that the effects of dust may be important and are worthy of greater research attention. Cement industry is one of the most boomed up industry in India which is now the second largest cement producer in the world. It plays a crucial role in the infrastructural development of the country as there is an interlinking relation between cement consumption and the economic growth. As India is on a high growth track and at present the focus is on the development of the infrastructure facilities such as highways, ports, canals, bridges etc. Infrastructural development obviously gives rise to increased demand for cement production. It is listed as one of the 17th most polluting industries by the Central Pollution Control Board (CPCB). The gases and dust from the cement plant are in no way less hazardous compared to other industries. Cement kiln dust is proven to have cytogenetic and mutagenesis properties (Shivkumar et al., 1995). Dispersion pattern of suspended particulate matter is ambient air of electrostatic precipitator (ESP) of cement plants.

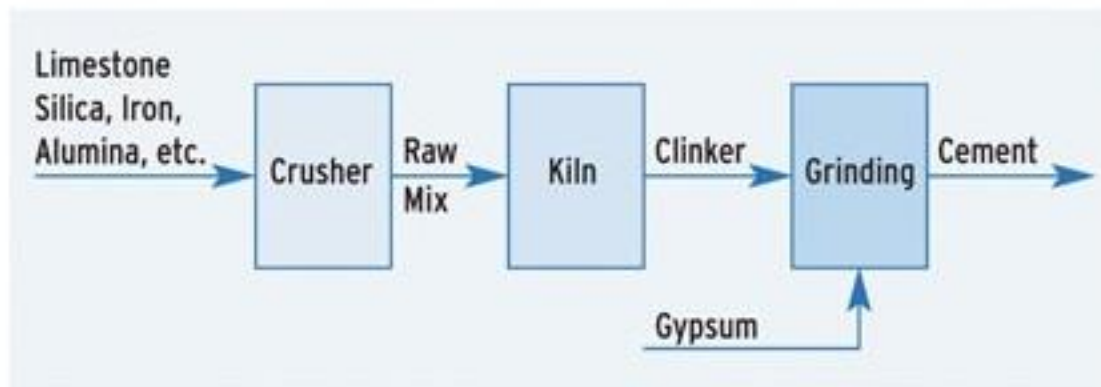
STUDY AREA

Shree Cement, Aurangabad, Bihar was selected for the present study. It is one of the biggest cement factories of India. Shree cement 2.5 km from Aurangabad Town. Villages Jasoia (~0.8 km in South

direction) for present study, located in different directions and distances from the plant.

COMPOSITION OF CEMENT

The main raw material used for cement industry includes limestone (CaCO_3), clay, sandstone (SiO_2), bauxite (N_2O_3) and gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and involves the release of various particulates, dust, gases and heavy metals.



CHARACTERISTICS OF CEMENT DUSTS

A number of characteristics of cement dust are important in considering its impacts. Cement Dust can have both a physical and a chemical impact. Cement Dust falling onto plants may physically smother the leaves. The absolute level of deposition is important. This is affected by dust emission rates, meteorology and conditions on the leaf surface. Cement Dust can also physically block stomata. Particle size is important if dust is to act in this way on stomatal functions. Dusts of diverse origin have very different chemistries. The chemical effect of cement dust, either on soil or directly on the plant surface, may be more important than any physical effects. Thus before describing effects of cement dusts themselves it is necessary to consider how these characters vary.

DEPOSITION OF CEMENT DUST ON SOIL

Cement dust deposition on soil surface changes the physico-chemical properties of soil as it causes a shift of pH towards alkaline range, which generally reduces the absorption of mineral substances from the soils. Interference of alkaline cement dust with soil may mediate both the synthesis and decomposition of soil organic matter and therefore influences ion exchange capacity, the soil N, S, and P and soil water-holding capacity. It also affects the microbial activity of the affected soil.

Materials and Methods of research

Present investigation deals with comparative study of under heavy pollution with those growing in less or unpolluted areas. For this purpose leaf samples of *Azadirachta indica* (Neem) and *Mangifera indica* (Mango) were collected from highly polluted and less or unpolluted area.



1. Mango leaf cover by cement dust



2. Research scholar and mango leaf



Research scholar with mango tree

RESULTS

Photosynthetic pigment Changes

Variations in physiological characteristics of selected plant species exposed to cement dust pollutants. The results obtained with polluted and non-polluted *Azadirachta indica* and *Mangifera indica* were compared. In general, plants showed a decrease in photosynthetic pigments due to air pollution. *Azadirachta indica* and *Mangifera indica* showed a significant reduction in total chlorophyll content, chlorophyll 'a' and chlorophyll 'b' in the study period. But there is no significant change in total carotenoids of the selected plant species.

Azadirachta indica

The concentration of Chl 'a' in the leaves of *Azadirachta indica* at polluted sites was recorded as 0.50 ± 0.09 mg/g which was 1.62 ± 0.27 mg/g at the control site. Thus a reduction of 75.3% in Chlorophyll 'a' was recorded in the samples from the polluted sites in comparison to control. The concentration of Chl 'b' was 0.29 ± 0.10 mg/g in the leaf samples collected from polluted sites while it was 0.65 ± 0.09 mg/g in the samples from control site. The polluted sites sample thus had 53.78% less Chl 'b' content. Total chlorophyll content was 1.06 ± 0.05 mg/g and 2.22 ± 0.05 in the leaf samples collected from polluted and control site respectively. Thus, there was a reduction of 55.4% in the total chlorophyll content in the samples from polluted site. The concentration of total carotenoids in the leaf samples from polluted and control site was recorded as 0.39 ± 0.06 mg/g and 0.55 ± 0.16 mg/g respectively with a reduction of 32.71% in leaf samples from polluted sites.

Determination of Chlorophyll Content

50 mg of fresh leaf tissue was weighed accurately. Chlorophyll was extracted by crushing leaf and suspended in test tubes containing 10 ml of Dimethyl Sulfoxide (DMSO). Test tubes were incubated at 60°C – 65°C for 4 hours in a hot air oven. The supernatant was decanted and the chlorophyll extract was transferred to a cuvette and the absorbance was read in a spectrophotometer at 645 and 663 nm against DMSO blank. Chlorophyll a, b, total chlorophyll and chlorophyll a/b ratio were calculated by using formula.

Mangifera indica

The concentration of Chl 'a' in the leaves of *Mangifera indica* at polluted sites was recorded as 1.85 ± 0.35 mg/g which was 2.35 ± 0.42 mg/g at the control site. Thus a reduction of 23.14% in Chlorophyll 'a' was recorded in the samples from the polluted sites in comparison to control. The concentration of Chl 'b' was 0.23 ± 0.04 mg/g in the leaf samples collected from polluted sites while it was 0.65 ± 0.14 mg/g in the samples from control site. The polluted sites sample thus had 67.48% less Chl 'b' content. Total chlorophyll content was 2.12 ± 0.46 mg/g and 2.76 ± 0.65 in the leaf samples collected from polluted and control site respectively. Thus, there was a reduction of 26.59% in the total chlorophyll content in the samples from polluted site. The concentration of total carotenoids in the leaf samples from polluted and control site was recorded as 0.18 ± 0.09 mg/g and 0.35 ± 0.12 mg/g respectively with a reduction of 45.63% in leaf samples from polluted sites.

Air pollutants, fly ash and dust emissions have a profound impact on the concentration of different photosynthetic pigments. Polluted and dusted leaf surface is responsible for reduced photosynthetic and thereby causing reduction in chlorophyll content. The similar impact of air pollutants in the concentration of chlorophyll contents have been reported by a number of other works. In the present study the highest decrease in total chlorophyll was in *Azadirachta indica* (55.48%) and *Mangifera indica* (28.52%).

PHOTOSYNTHETIC PIGMENTS

The photosynthetic pigments are the most likely to be damaged by air pollution. Chlorophyll pigments exist in highly organized state, and under stress they may undergo several photochemical reactions such as oxidation, reduction and reversible bleaching. Hence any alteration in chlorophyll concentration may change the morphological, physiological and biochemical behaviour of the plant. Air pollution-induced degradation in photosynthetic pigments was also observed by a number of workers. In both the plants chlorophyll a and chlorophyll b content were reduced significantly at polluted site.

CONCLUSION

The research presented in this work revealed that the cement industry is one of the highly pollution industry, the major impact being confined to air environment. Control SPM and other emissions should be given top priority to maintain the ecosystem around the unit in its natural or near to natural form. The results of this study indicated a decline in chlorophyll content in trees growing in industrial area. The reduction in chlorophyll content is due to degradation of chlorophyll into phaeophytin by the loss of magnesium ions. Chlorophyll content may differ in different period of time under different conditions of pollution stress and different meteorological conditions. It is concluded that in the study area there is need to develop green belt for the betterment of environment and human being. On the basis of this study, it could be concluded that growth of plants was found to be affected by cement dust, which might be due to the presence of different toxic pollutants in cement dust. The phonological behaviour of *Azadirachta indica* was found to be highly affected than *Mangifera indica*. It is clear that the air pollution caused by industries and automobile smoke are operative ecological factor causing deterioration in the quality of our environment.

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