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CONSEQUENCES OF CEMENT INDUSTRIAL DUST ON GREEN PLANTS: A CASE STUDY IN KHREW INDUSTRIAL ZONE OF KASHMIR, INDIA

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ABSTRACT

Several emissions produced in cement manufacturing industries playing a major role in the deterioration and contamination of global environmental and brought several hazardous changes into it. Man has made several industries for their own profit. No doubt these industries have increased the economic profile of many industrialists on one hand, but on the other hand, these industries have degraded, damaged and contaminated to all the components of our environment. The cement emission, produced by cement manufacturing processing is considered one of the most hazardous pollutants which affect the all surrounding environmental components like water, air, and soil and green plant vegetation. Increased concentration of the cement manufacturing emission pollutants can cause continuous reduction in the photosynthetic process ability of all green leaves, resulting reduction of crop productivity and finally the death of green plant species. It is estimated that 23% of green plants are dying in every year around these cement industrial plants due to excessive continuous flow of huge amount of cement dust. Cement industry is one among the 17 most polluting industries listed by the Central Pollution Control Board (CPCB). Cement manufacturing is a high energetic intensive process, which involves intensive fuel consumption for clinker making and resulting in release of various harmful emissions such as SOx (sulphur oxides), NOx (nitrogen oxides) and CO2 (carbon dioxide), huge amount of cement dust, smoke, noise and also contains heavy metals like nickel, cobalt, lead, and chromium pollutants which harmfully affects human health, environmental components and finally our social life.

KEY WORDS: *cement industry, environmental impact assessment, environmental problem, cement emission, Chlorophyll, Photosynthetic pigments, human and animal health, social environment.*

INTRODUCTION

Environment plays an important role in the emergence of life on the planet of Earth. . All living things are directly and indirectly dependent on environment for day to day needs and approximately 95 % of the human needs which includes food, shelter, water, medicines etc are derived from the environment. The air which we breathe (oxygen) comes from all green plants and trees which is a very important component of our environment. Survival of life on the planet of earth is impossible without oxygen for a minute and in this way we can estimate the importance of environment (all green plants and trees) in our life. But multiple industrial activities are degrading various environmental components like water, air, soil and green plant vegetation in an unprecedented speed and if we have fail to control this speed, then

the day is not far to us when we have lost to our environment and if we have lost environment, we have lost everything. The environmental pollution as a result of cement industry could be defined as an undesirable process that is responsible to pollute water, air, land and all green plants through its various activities, right from the mining activity of the raw material to its crushing, grinding and other associated processes in cement plant. Air pollution has become a serious problem in recent times due to rapid growth of thermal power stations, cement factories, steel and coal industries in which, the presence of total solids in the form of salts of Ca, Na, K, Mg, Al as hydroxides sulphates and silicates leads to hardness of water which causes gastro intestinal disorders.

Cement industry is one among the 17 most polluting industries listed by the Central Pollution Control Board (CPCB). Cement industry is the major source of various harmful matters such as SOx (sulphur oxides) NOx (nitrogen oxides) and CO2 (carbon dioxide) emissions, huge quantities of dust and smoke, chlorides, fluorides, sulphur dioxide, carbon monoxide , and smaller quantities of organic compounds and heavy metals. These industries also emit 100,000 kilograms of toxic fumes, poisonous gases and life threatening elements in the air on daily basis. It is estimated that 5-6% of all greenhouse gases generated by human activities originates from cement production. These emissions are not only deteriorating air quality but also degrading human health, global environment impact resulting in global warming, ozone depletion, acid rain, biodiversity loss, reducing crop productivity of all green plants. Soil pollution is also caused due to constant fall of cement dust, resulted in the formation of colloidal gels of calcium silicate and calcium aluminates which affects and degrades fertility quality of soil and when the soil loses its fertility capacity it adversely affects plant growth.

The extensive extraction of raw material not only adds various pollutants/contaminants to the environment but also disturb the total ecosystem of the nearby areas. The gases and dust from the cement plant are more hazardous if compared to other industries. The impact of the cement dust on soil properties and plant production has been investigated by some researchers (Saralabai and Vivekanadau 1995, Schuhmacher et al 2004., and Zerrouqi et al., 2008). Cement kiln dust is proven to have cytogenetic and mutagenetic properties (Shivkumar et al., 1995). Cement dust pollutants causes reduction in the photosynthetic ability of leaves, mechanism of open-closing leaf stomata and, mainly, a reduction in growth and productivity of plants (Larcher 1995). Cement dust contains different particulate pollutants which harmfully affecting our vegetation part of environment (Iqbal and Shafig 2001). The role of cement pollutants causing injury to plants either by direct toxic effect or modifying the host physiology rendering it more susceptible to infection (Gupta and Mishra 1994). . Air pollution has been described as an additional stress on plants since they often respond to atmospheric contamination in the same way as they respond to drought and other environment stressing severe case of pollution, the injury symptoms were expressed as foliar necrosis or completely disappearance of the plant (Mishra 1996). (Samal and Santra 2002) have also previously studied the impact of air pollution on plants with reference to foliar anatomical and biochemical changes by experimenting on various sensitive plants.

REVIEW OF EXISTED LITERATURE

Air pollution has a diverse effect on much metabolic process in plants such as photosynthetic activities, mitochondrial respiration and stomatal clogging of plants (Miller et al., 1973). Industries are emitting toxic substances which adversely affect man's food supply by polluting nearby growing plants. Rapid industrialization and addition of the toxic substances to the environment are responsible for altering the ecosystem (Sarala Thambavani and Saravanakumar, 2011; 2012). The Cement industry plays a vital role in the imbalances of the environment and produces air pollution hazards (Stern, 1976; Sarala Thambavani and Saravanakumar 2011). Physiological disorders such as reduced growth are ultimately due to the cumulative effects of the causal factors on the physiological processes necessary for plant growth and its development (Schutzki and Cregg, 2007). Due to immobility of higher plants, it need a greater protection against several stresses, including low and high temperature, water stress, salinity, metal toxicity, and others. Ambient level of air pollution has been shown to affect stomatal conductance, photosynthesis and root morphology of young beech (Taylor and Davies, 1990). One of the most recent studies of these stresses was a dust accumulation, which provokes severe damage in the photosynthetic apparatus (Santosh and Tripathi, 2008)

Lichtenthaler, H.K., F. Babani, G. Langsdorf and C. Bushcmann. 2000. Measurement of differences in red chlorophyll fluorescence and photosynthetic activity between sun and shade leaves by fluorescence imaging. Photosynthetica 38: (4) 521–529.

Wind erosion suspends large quantities of dust in the atmosphere that settle back to the earth's surface and are deposited on plant leaves when wind velocities decrease (Armbrust, 1986). Cement factories are major source of pollutants for the surrounding areas (Stratmann and Van Haut, 1966). Dusted plants with quantities of dust deposition ranging from 1 to 48 g/m2 per day; dust falling on the soil caused a shift in the pH level to the alkaline side. It was found that dust deposition affect photosynthesis, stomatal functioning and productivity (Santosh and Tripathi, 2008). A scant

numbers of literatures showed that there is a relation between cement dust deposition and physiological process in plant leaves. Since the studying area is suffering from heavy cement dust which deposits on the buildings and plants and producing a significant adverse effect. A periodical study was carried out to study the effect of cement dust pollution on the growth of selected plant species such as Azadirachta indica(L), Polyalthia longifolia(L), Ficus religiosa(L), Pongamia pinnata(L) and Delonix regia(L). Based on the results of these physiological parameters, insight into the mechanism responsible for dust tolerance in different plants will be elucidated.

Asada, K., T. Endo, J. Mano and C. Miyake. 1998. Molecular mechanism for relaxation of and protection from light stress In: K. Saton and N. Murata, Editors, Stress responses of photosynthetic organisms, Elsevier, Amsterdam. pp. 37–52.

The typical gaseous emissions to air from cement manufacturing plants include nitrogen oxide (NOx), sulphur dioxide (SO2), carbon oxides (CO & CO2) and dust (Pregger and Friedrich, 2009; Kampa and Castanas, 2008). The dust escaping from cement factories is often transported by wind and deposited in areas close and far away from the factory. These include agricultural lands, natural vegetation, towns and villages, such depositions of particulate matter and other pollutants interfere with normal metabolic activities of plants, causing direct injury and impairment of growth and quality and may ultimately lead to decrease in plant yield (Ediagbonya et al., 2013; Prajapati, 2012). The cement kiln dust, containing oxides of calcium, potassium and sodium is a common air pollutant affecting plants in various ways i.e. cement dust and cement crust on leaves plug stomata and interrupt absorption of light and diffusion of gases, lowering starch formation, reducing fruit setting (Lerman, 1972; Shrivastava, 1999), inducing premature leaf fall (Czaja, 1962; Tiwari et al., 2011) and leading to stunted growth (Darley, 1966). Besides causing suppression of plant growth, cement dust induces the change in the physico-chemical properties of soil, which are generally unfavorable to plant growth (Parthasarthy et al., 1975; Singh and Rao, 1978). In comparison to gaseous air pollutants, only limited studies have been carried out on the effect of particulates air pollutants on plant as reported with respect to fluoride dust (McCune et al., 1965), soot (Miller and Rich, 1967), lead particles, cement dust (Darley, 1966; Singh, 1979; Pandey and Simba, 1988, 1990) and coal dust (Rao, 1971).

Ecology, 16: 178-179

Pandey DD, Simba AK. 1990. Effect of cement kiln dust on chlorophyll in wheat leaf. Environment and Ecology, 8: 461-463 Pandey DD, Nirala AK, Gaulam RR. 1999. Impact of stone crusher dust pollution on maize crop. Indian Journal of Environment and Ecoplanning, 2: 43-46

STATEMENT OF THE PROBLEM

The investigator while scanning the literature found that no study have been conducted on the current topic. The investigator found that the entire field is unexplored and after making in-depth study of different surveys, journals and other research inputs, it is found that no systematic study have been conducted which could objectively study the impact of cement industrial emissions on all green plants in the selected area of study. So, therefore taking these things in our mind, we have chosen this problem in my current research paper. We hope this research will be useful for the planners and policy makers for framing several policies and schemes for protecting the green plants of the harmful cement industrial emissions. We also hopes that this research will provide us complete structure of the total impact of cement pollution on all green plants of the study area.

THE OBJECTIVES OF THE STUDY

1. To determine the relationship between the symptoms of various harmful cement emissions on all green plant life.
2. To find out the various hazardous of cement emissions and its adverse effects on green plant leaves in the study area.
3. To examine various plant disorders associated with the final products of cement emissions.

STUDY AREA

All cement industries of Khrew area of district Pulwama of Jammu and Kashmir, India which are collectively known as JK Cements were taken into consideration for present study. In March 2009 four more industries started in this area. Khrew is located at 34.02^0N 74.98^0E, and contributing 840 crores per annum to the state economy which is second contributor to the state economy after Jammu and Kashmir Bank Ltd. It is one of the biggest cement industrial plants of India. The whole area is facing multifarious environmental problems caused by various kinds of pollutions produced by Cement industries having a total productions capacity more than 100 million tons per annum. The area is located at southern part of Kashmir valley which is about 25 km away from summer capital Srinagar. Eight villages were chosen for present study, located in different directions and distances from the plant, as given in Table 1(Shukla et al., 2003).

Khrew village is nearest to JK Cements (JKC). The total area of the village is 945.22 hectares and the population is 1134 on the basis of the 2011 survey.

Noginder village is on the south of JKC about one km distance, with 649.67 hectare area. Population of this village is 5552. The mining of limestone is carried out in this village.

Bathen village is located about 2 km on north JKC. It has 513.12 hectare area and 5130 population. The lime stone mining is the major activity.

Shar village is situated in the north east direction of JKC located at a distance of 3 km. Total land of this village is 397.18 hectare and population is 4842.

Wuyan village is located at a distance of 3 km on the south east direction. It has 473.83 hectare land and 5320 individuals.

Lodhu village is nearer to **Wuyan** village at a distance of 3 km in the south-east direction, it has 529.15 hectare land and population 3990 individuals.

Balhama village is located at a distance of 5 km on the south west direction, with 329.55 hectare total area and 3225 population.

Shampora village is located at a distance of 5 km on the west direction of JKC. The total area of this village is 623.52 hectare and total 6558 individuals live in this village.

MATERIAL AND METHOD

Impact assessment on plant vegetation:-

An attempt has been made to record the impact of emissions from cement industrial plant on green plant vegetation. Five plant species were selected i.e. Saffron, Almonds, Walnuts, Apricots and Peach in an area of five kilometres surroundings the cement plant and experiments were conducted in order to measure harmful consequences of cement dust on green plants as is described below (Carlson et al., 1996; Chang et al., 1999).

Total dust load estimation:-

In order to estimate the dust load on each selected plant, 25 leaves from different branches of selected tree species have been collected and kept these leaves in separate polythene bags. The leaves from each polythene bags were washed completely. The water containing dust had been filtered through pre-weighed filter papers. The filter papers were dried in the oven over night and weighed again. Different amount of quantities of cement dust have been found. The difference in the weight of filter papers yields the amount of dust on the sampled leaves. The surface of these leaves were also measured and calculated. From this data, dust load per cm2 of leaves were calculated (Carlson et al., 1996; Chang et al,. 1999).

Two disorders Chlorosis and Necrosis:-

Both these two disorders are caused due to continuous over load of cement dust. Chlorosis is the disorder which is characterised by turning of green colour of leaves into yellow colour due to the loss of chlorophyll pigment which is present in all green plant leaves. Necrosis is another disorder characterised by wilting (drooping) of leaves due to the lack of chlorophyll pigment. Chlorosis and necrosis occur due to exposure to pollutants like SOx, NOx etc. For measuring the extent of chlorotic effects, 200 leaves were collected at different heights and the percentages of leaves exhibiting chlorosis and necrosis were also calculated (Carlson et al., 1996; Chang et al., 1999).

RESULT AND DISCUSSION

Table 2 and Fig. 1 reveals that the dust load was maximum on all types of plants sampled Bathen village, located at 2 km on the north side, followed by Khrew (East) and Shar situated 3 km away on North-East side. The maximum deposition per cm2 was on Walnuts, followed by Apricots. The smallest amount of deposition was found on Almonds. The dust load study revealed that a small amount of dust was deposited in Balhama and Shampora located 5 km away on south-west and west direction respectively. Prevalent wind flow direction was also north and north-east direction. Walnuts and Apricots showed a high dust holding capacity followed by Saffron, while Peach and Almonds showed a small dust holding capacity.

Table 3 shows the data on leaves suffered from Chlorosis/ Necrosis of all five tested plants. It was found that the highest values resulted in Shar village, situated 3 km in north-east direction and Khrew, in north direction. This was followed by Lodhu (South East) and Bathen (North). The smallest number of leaves suffering of Chlorosis/ Necrosis was found in Shampora (West) and Balhama (South West) (Fig. 2). Peach and Walnuts were affected the most, while Saffron and Apricots were affected least plant species from chlorosis and necrosis disorders.

Table 1. Details of village studies

No. Of site	Village name	Direction with respect to industry	Distance with respect to industry (km)	Area in hectares	Total population
1.	Khrew	East	0	945.22	1134
2.	Noginder	South	1	649.67	5552
3.	Bathen	North	2	513.12	5130
4.	Shar	North- East	3	397.18	4842
5.	Wuyan	South- East	3	473.83	5320
6.	Lodhu	South- East	3	529.15	3990
7.	Balhama	South- West	5	329.55	3225
8.	Shampora	West	5	623.52	6558

Table 2. Dust load on plant species

Site number	Plants in villages	Distance and direction	Dust load of 25 leaves (mg)	Dust load per leaf (mg)	Dust load mg/cm^2
1.	**Khrew**	0 km			
	Peach		600	24	0.4
	Almonds		165	6.6	0.62
	Apricots		900	36	1.9
	Walnuts		1350	54	0.87
	Saffron		1880	75.2	0.87
2.	**Shar**	3 km (NE)			
	Peach		556	22.6	0.42
	Almonds		119	7.6	0.15
	Apricots		780	31.2	1.32
	Walnuts		1225	49	1.48
	Saffron		625	25	0.28
3.	**Wuyan**	3 km (SE)			
	Peach		600	24	0.43
	Almonds		500	10	0.33
	Apricots		400	16	0.66
	Walnuts		600	24	0.81
	Saffron		500	20	0.91
4.	**Lodhu**	3 km (SE)			
	Peach		525	21	0.45
	Almonds		400	16	0.30
	Apricots		175	7	0.19
	Walnuts		475	19	0.63
	Saffron		165	14.9	0.130
5.	**Balhama**	5 km (SW)			
	Peach		255	10.2	0.24
	Almonds		225	9	0.15
	Apricots		2510	100.4	0.21
	Walnuts		125	5	0.18
	Saffron		575	23	0.23
6.	**Shampora**	5 km (West)			
	Peach		330	13.2	0.30
	Almonds		210	8.4	0.14
	Apricots		215	8.6	0.17
	Walnuts		90	3.6	0.13
	Saffron		457	19	0.18
7.	**Bathen**	2 km (North)			
	Peach		125	21	0.05
	Almonds		150	6	0.09
	Apricots		860	34.4	1.25
	Walnuts		1295	51.8	2.46
	Saffron		800	32	0.48
8.	**Noginder**	1 km (South)			
	Peach		550	22	0.42
	Almonds		110	4.4	0.52
	Apricots		100	4	0.136
	Walnuts		850	34	0.22
	Saffron		4100	164	1.63

Table 3. Chlorosis/ Necrosis on plants

Site number	Village	Distance and Direction	% of leaves suffered from Necrosis/Chlorosis				
			Saffron	Peach	Walnuts	Almonds	Apricots
1.	Khrew	(o) East	6	60	42	37	5
2.	Noginder	(1)South	3	14	24	13	3
3.	Bathen	(2)North	5	42	43	39	5
4.	Shar	(3)North- East	20	60	60	46	19
5.	Wuyan	(3)South- East	2	14	38	6	2
6.	Lodhu	(3)South- East	9	58	55	37	9
7.	Balhama	(5)South- west	4	6	8	3	3
8.	Shampora	(5)West	NA	NA	NA	NA	NA

FINDINGS AND CONCLUSION

After the final results that we get in this research paper revealed that the cement industry is one of the highly degrading source of all environmental components especially air component. Due to air pollution, all species of biodiversity facing several types of problems, especially all green plant species who have lost their normal functioning routines which results several types of disorders such as Chlorosis and Necrosis that are caused due to the affecting chlorophyll pigment. When the chlorophyll pigment get damaged, the effect goes to the whole mechanism process of photosynthesis because chlorophyll pigment is raw material for photosynthesis process, resulting no preparation of food in the plant and finally the death of the plant occurs. The comparison of five plant species of different dust susceptibility permitted determining that the tolerance or sensitivity to dust pollution was clearly manifested throughout the photosynthetic activity. The study showed that all types of plants sampled of different distanced villages show different deposition of dust load particles. All types of plant sampled of most near villages show higher quantity of dust load than others which depends on their distance to the cement plant. The exposure to dust pollution stress provoked important reductions in photosynthesis in most studied plants. This study indicates that exposure to particulate deposition may alter plant growth life. Moreover, accumulation of dust particulates on studied plant leaves could be a major problem in their production.

REFERENCES

1. *M. S. V. Prasad,. and , J. A. Inandar (1991). Effect of cement kiln dust pollution on growth and yield of Vigna spp. Indian Journal of Ecology, 18: 91-94.*
2. *J. Misra; V. Pandey; S. N. Singh; Singh, N.; M. Yunus,. and K. J. Ahmad (1993). Growth responses of Lycopersicum esculentum to cement dust treatment. Environmental Scientific Health, 28: 1771-1780.*
3. *Banerjee D., Pandey G.S., (1986), Dispersion pattern of suspended particulate matter in ambient air of ESP equipped cement plant, Indian J. Environmental Protection, 6, 244-248.*
4. *Banerjee D., Pandey G.S., (1987), Calcification of surface soils in the vicinity of a cement plant, Indian J. Environmental Protection, 7, 37-38.*
5. *Carlson R.E., Simpson J., (1996), A Coordinator's Guide to Volunteer Lake Monitoring Methods, North American Lake Management Society.*
6. *Chang Y.M, Chang T.C., Chen W.K., (1999), An estimation on overall emission rate of fugitive dust emitted from road construction, Environmental Engineering Science, 16, 253–267.*
7. *USEPA, (2002), Third external review draft of air quality criteria for particulate matter, Vol. 1-2, United State Environmental Protection Agency, Washington DC.*
8. *Shivkumar S., John D.B.A., (1995), Effect of cement pollution on soil fertility, J. Ecotoxic Environ. Monitoring, 5, 147-149.*
9. *Kumar S.S., Ajay S., Sunisha B., Preeti S. Deepali S., (2003), Impact Assessment of a Cement Industry on some Environmental Descriptors, M. Sc. Dissertation, School of Environmental Biology, APS University Rewa, India.*
10. *W. E. Winner (1994). Mechanistic analysis of plant responses to air pollution. Ecological Applied, 4: 651-661.*
11. *L. Marlin. and E. Nilsa, on the distribution of epiphytic lichens. Proc. Eston. Acad. Sci. Ecol., 2: 181-185.*
12. *M. Ayyad. and A. Fakhry (1996). Plant biodiversity in the western Mediterranean desert of Egypt. Verhandlungen der Gesellschaft fur Okologie, 25: 56-76.*